**AN ALTERNATIVE APPROACH TO EVOLUTIONARY ECONOMICS?**

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Abstract: Shiozawa, Morioka, and Taniguchi (2019) provide an alternative approach to evolutionary economics. Drawing on ideas developed within the Japanese language literature of economics and also inspired by the structure and development of the Japanese economy itself, they develop a rigorous microfoundation for a model of both firm behavior and the general evolution of an economy. This follows a critique of both standard equilibrium economics as well as various schools of evolutionary economics, even though they draw substantially on some of those schools, especially the neo-Schumpeterian and bounded rationality approaches. Influences on their model range from ideas of Keynes, Sraffa, Kornai, Scarf, and Hayek, among others in an innovative synthesis that lays out conditions for a gradualistic absorption of shocks and developments with agents maintaining a loose framework and relying on moving averages of data to drive inventory and other adjustments.

Keywords: evolutionary economics, micro-macro loops, looseness, inventory adjustments

1. **Introduction**

The interaction between biology and economics goes back to initial formulation of the law of natural selection in the theory of evolution (Rosser, 1992). Both of the independent developers of that law, Charles Darwin and Alfred Russel Wallace, were separately inspired to initiate their advocacy of it by reading Malthus (1798) and his discussion of humans competing with each other for food as population presses against the means of subsistence in the face of limited land (Darwin and Wallace, 1858).

This would be followed in turn by economists acknowledging the importance of the development of evolutionary theory, especially by Darwin. Karl Marx may have been the first to do so in a letter to Engels (Marx and Engels, 1942) in which he praised the achievement of Darwin in explaining evolution in the plant and animal kingdoms, while holding out that humans can overcome the Malthusian limits through management of nature and planning.

Even more enthusiastic than Marx was Alfred Marshall, who in the Prefaces of all eight volumes of his *Principles of Economics* from 1890 to 1920 that “the Mecca of the economist lies in economic biology” (Marshall, 1920, p. xiv), even as most of his formal analysis drew more on physics models of mechanics. Nevertheless Marshall declared that changes in market structures over time reflect evolutionary forces, and he also quoted Darwin on the title page of all editions of his most famous book, “Natura non facit saltum,” (“Nature does not take a leap”), which Darwin had in turn borrowed from Leibniz.

Nevertheless, a self-conscious *evolutionary economics* had to wait for Thorstein Veblen to form it in his “Why is economics not an evolutionary science?” (Veblen, 1898). His emphasis was on the evolution of institutions and organizations, and indeed his formulation inspired the formation of the US-based Association for Evolutionary Economics, the main group that supported Old Institutional Economics in the US that also derived from the German Historical School (Commons, 1934).

Following Veblen, other approaches to evolutionary economics appeared. Among the most important has been one emphasizing the role and nature of technological change initiated by Joseph Schumpeter (1911). Arguably this approach would be combined with that considering the evolution of organizations by Richard Nelson and Sidney Winter (1974, 1982). The nature of competition between firms in markets as being an evolutionary process would be introduced by Armen Alchian (1950). Among Austrian economists, Friedrich Hayek (1988) would come to argue that evolutionary processes are involved in the competition among economic systems. Beyond these approaches, evolutionary ideas would also be introduced into game theory by biologists (Maynard-Smith, 1982). All of these schools and approaches have seen substantial and considerable development.

Now a completely new alternative has appeared in the 2019 book by Yoshinori Shiozawa, Masahi Morioka, and Kazuhisa Taniguchi, *Microfoundations of Evolutionary Economics* (henceforth “SMT”). It comes out of literature much of which appeared over recent decades in the Japanese language, and especially drawing on initial work by Shiozawa (1990, 2004). This work draws on various strands of thought from outside Japan, critiquing some of the approaches mentioned above while adopting or varying others. It also draws on some outside influences not explicitly evolutionary, such as Sraffian/neo-Ricardian economics (Sraffa, 1960; Kurz and Salvadori, 1995) and elements of behavioral economics and bounded rationality (Simon, 1947), as well as the work of Keynes (1936). It at times combines elements of socialist planning theory, Post-Keynesian economics, and Austrian economics. But an important theme is to develop a rigorous microfoundation for evolutionary economics. This paper will examine this effort they have made.

1. **Schools of Evolutionary Economics**
2. **Preliminary Considerations**

The first chapter of SMT, written apparently by Shinozawa, has the same title as the whole book and discusses the relationship between the model presented later in the book with various schools of evolutionary economics. The authors profess this model to provide a microfoundation for evolutionary economics, but they also critique some of these schools, finding none of those they discuss to be fully satisfactory as they stand, and often not just because they supposedly lack microfoundations. So we shall consider the larger state of evolutionary economics, including schools of thought not mentioned in SMT, thus hopefully laying out a full perspective here on what is involved in all this.

There is no discussion in SMT of the pre-origins of evolutionary economics in Malthus, Darwin and Wallace, or Marx and Marshall. The latter two do get mentions in the book, but only in their more standard roles within economics, per se. Marx appears in his role as a founder of the socialist approach to economics, with quite a bit of discussion in connection with the model in the book about socialist central planning, both its advantages as well as its flaws and failures. Marshall is discussed largely for his role in developing essentially the neoclassical view of competition in contrast with monopoly, but as with Marx there is no discussion of their roles in the pre-history of evolutionary economics.

1. **The Founding of Evolutionary Economics by Veblen**

There is also no discussion of the explicit founder of evolutionary economics, Thorstein Veblen (1898), but we need to consider his view of his own creation, which has certain distinctive aspects to it. Indeed, it is part and parcel of his critique of both Marx and Marshall, with his critique of the latter involving his coining the term “neoclassical economics,” a coinage that was not a favorable one as David Colander (2000) has noted. But his turn to rely on Darwin as he did was perhaps more driven by his decision not to fully follow Marx, who was arguably more of an influence on him than was Marshall, and with him arguably seeing more of the Darwinian approach in Marx with his dynamic theory of systemic economic change than he saw in what he considered to be the overly static nature of Marshallian neoclassical economics.

Indeed, Geoffrey Hodgson (1988) argues that he came to his invention of “evolutionary economics” out of trying to reconcile the respective roles of the individual and the state in the economy, with emphasizing the more general role of institutions and their change over time as a result of Darwinian natural selection as the way out of this dilemma. In doing so, Veblen reflected a version of Darwinism that was emerging then in Britain, the so-called *emergentist* view most strongly developed by C. Lloyd Morgan (1923) but initiated by George Henry Lewes (1875), who in turn drew on the idea of “heteropathic laws” as introduced by john Stuart Mill (1843).

The emergentist view of evolution took a holistic approach, positing natural selection as operating at the level of entire organism and also operating at higher levels as well as in the theory of multi-level selection (Crow, 1955; Henrich, 2004). In Mill’s depiction of heteropathic laws, as taken up and relabeled by Lewes (1875), these involve the phenomenon of the “whole being greater than the sum of the parts,” with Mill’s original examples coming from chemistry, as when one gets salt, which is quite different from its constituent components, sodium and chlorine. Such emergence was important for Veblen in his analysis of the evolutionary emergence of institutions within economies. This approach, while eschewing a specifically Marxist approach, sharply contrasted with the reductionist individualism Veblen saw in Marshallian neoclassical economics. This struggle between a more holistic and a reductionist approach also went on in biological evolutionary theory, with the emergentist approach falling out of favor in the 1930s as the neo-Darwinian synthesis that emphasized stochastic processes at the reductionist genetic level was developed by Ronald A. Fisher (1930), J.B.S. Haldane (1932), and Sewall Wright (1931), although emergentism would arguably re-emerge with the later study of multi-level evolution, where cooperation at higher levels plays an important role, something that would show up as a central issue in evolutionary game theory.

In any case, in Veblen’s evolutionary economics, even as he drew on an emergentist view of evolution, including noting its emphasis on the importance of cooperation, he posited the crucially evolving objects of evolutionary economics as being these intermediate forms, institutions, that operate at a higher level than mere individuals do, but also are generally at lower levels that entire states as such figures as Hegel would emphasize or total socio-economic classes as Marx would emphasize. Also influenced by Hegel and the German Historical School, Veblen found his own dialectical synthesis between these competing forces of individualism and a totalistic holism in the concept of the evolving institution.

1. **Schumpeter and the Neo-Schumpeterians**

Veblen was a deep student of technological change, but focusing more on this as the central element of economic evolution came out of another school of evolutionary economics, that drawing on the work of Joseph Schumpeter (1911) and would achieve a focus on this operating on firms with the work of Richard Nelson and Sidney Winter (1974, 1982) and their followers, the neo-Schumpeterian school. SMT did comment on this school and find it lacking, even as it arguably is the school of evolutionary economics most influential on their approach, with their discussion of Nelson and Winter initially appearing on the first page of the first chapter in SMT. SMT very much emphasize the importance of routines, which for Nelson and Winter (1982) is the central *meme* of evolutionary economics, drawing from the biological evolutionist, Richard Dawkins who saw the gene as the central meme in his generalized Darwinism approach (Dawkins, 1976).

An issue that arises with Schumpeter and his followers that is a central debate in evolutionary theory involves continuity versus discontinuity or *saltationalism* (Rosser, 1992). Schumpeter famously argued for the central importance in technological change of sudden breakthroughs that can discontinuously change the economic system, revolutionary changes. As he put it, no number of improved horse carriages could bring about the railroad train and all that it entailed in economic history. As it is, evolutionary economists, especially those following Schumpeter, have been more open to this saltationalist perspective than the biological evolutionists, who have tended to be more the followers of Darwin and his title page quotation: natura non facit saltum, “nature does not take a leap.” While the emergentists such as Morgan were open to such things, the neo-Darwinians would only become open with the emergence of the idea of *punctuated equilibrium* in the work of Eldredge and Gould (1972), which continues to be resisted by many evolutionary biologists. As it was, our economics predecessors also split on this issue, with Marx open to revolutionary changes in the forces of production while Marshall explicitly quoted Darwin’s *natura non facit saltum* when he discussed evolutionary processes occurring in economic systems.

On this matter of central debate in evolutionary theory, for all their use of the Nelson and Winter approach to routines, SMT come squarely down on the side of the Darwin gradualists. For them and their model, “stationarity” is crucially important and a main focus of their analysis, although we shall consider that in more detail later. But certainly even as Nelson and Winter were followers of Schumpeter as they developed their ideas, it is not impossible to place their analysis into an approach that emphasizes continuity over discontinuity as do SMT.

1. **Alchian and Evolutionary Efficiency**

While Veblen challenged the pro-market thrust of Marshallian neoclassical economics and Schumpeter and his followers saw discontinuous disruptions arising from technological change, in an influential paper Armen Alchian (1950) identified evolution as a central part of the efficiency of market competition, with such competition between firms being directly analogous to the competitive process in nature that underlines natural selection. For Alchian market competition is directly comparable to natural selection, and indeed this can be seen as essentially a strong update of arguments in Malthus and Marshall. For Alchian, evolutionary market selection works, and is key to market efficiency.

This debate parallels one in biological evolutionary theory itself. This has focused on the matter of fitness and how rapidly and accurately natural selection processes change a population and species in their environment. The idea of adaptive efficiency has been central from the time of Darwin and Wallace, with various observers supporting strongly the idea of rapid adaptation through natural selection among populations to environmental changes (Dawkins, 1976). A famous case of rapid evolutionary adaptation has been the spread of darkness in Lepidoptera moths in Britain as a response to the industrial revolution (Kettlewell, 1958), even as most evolutionary biologists resist the arguments of Eldredge and Gould for dramatically rapid change to the point of discontinuity.

In contrast many evolutionary theorists have warned that there are important factors that can slow this rate of adaptation to evolutionary fitness (Crow and Kimura, 1970; Orr, 2009). An obvious element is how rapidly a species reproduces, with moths more rapidly doing so than large mammals, leading to many of the latter becoming endangered arguably due to an inability to adapt rapidly to changes. A framework has been provided by Sewall Wright (1931) with his fitness landscapes. But his analysis recognized that there can be multiple local optima. So even if there is rapid adaptation, it may go to a location that is not a global optimum. An even more subtle problem is that the changes in populations themselves can lead to changes in the fitness landscapes themselves. A general view is that while natural selection “works,” it does not necessarily do so rapidly and may not always do so fully optimally.

While Alchian held to a strong position on the effective efficiency of the evolutionary process of market competition, his view is viewed by many as being overly strong. Many elements of the economy are now viewed as slowing down how this process works. It operates, but is imperfect. As it is, SMT do not specifically address this, although they tend to posit a landscape that only changes gradually, so this makes it easier for adaptation to operate more as Alchian suggested, with firms figuring out efficient ways of operating better.

1. **Simon and Bounded Rationality**

Soon after Alchian’s argument appeared probably the sharpest challenge to it came from Herbert Simon (1955, 1957) when he initiated discussion of *bounded rationality*. Simon saw limits on rationality due to both imperfect information as well as limits on computational ability. He did not emphasize emotional biases, but these would become a major theme of behavioral economics that he founded and grew out of his foundation of bounded rationality (Rosser and Rosser, 2015; Velupillai, 2019). He saw procedural rationality, relying on heuristics and rule of thumb behaviors and emphasizing *satisficing*, as operating, even as substantive rationality is impossible. While many economists long resisted Simon’s arguments, they were taken up by management professionals, seeing their practicality. In any case, bounded rationality is a crucial element in muddying the adaptive process Alchian saw operating supposedly efficiently.

Curiously Simon himself did not emphasize bounded rationality that much in his own work on evolutionary processes (Simon, 1962). In this work he considered elements of evolution more tied to the perspectives of the emergentists, especially the problem of hierarchy and the emergence of new and higher levels of hierarchy, a central focus of the emergentists that would be downplayed and mostly ignored by the main developers of the neo-Darwinian synthesis. Indeed, Simon is widely considered to be the founder of the hierarchical complexity approach in broader systems analysis. But in this bounded rationality played a relatively minor role as he explicated the importance and nature of relations between the different levels of hierarchies.

For SMT Simon is an important figure, and attention is paid to him up front early in the first chapter of the book, with this being labeled as the problem of “myopia” on the part of economic agents. This fits with their approach that calls for loosely connected management systems with buffers that are able to handle external shocks in a resilient way. But they to some extent downplay Simon and his innovations in favor of the less well-known earlier figure, von Üxküll (1920) and his biosemiotics approach, who was arguably more in touch with biological evolutionary arguments than was Simon. Oddly they also emphasize computational complexity aspects of bounded rationality while not noticing not only the importance that Simon placed on this factor but the role he played in computer science and artificial intelligence motivated precisely by trying to understand more profoundly how bounded rationality works.

1. **Evolutionary Game Theory**

Finally in our brief survey of evolutionary economics we have an approach that came initially out of biology itself (Selten, 1980; Maynard-Smith, 1982), but that has since seen further development and application in economics (Hofbauer and Sigmund, 1988; Weibull, 1995; Samuelson, 1997). The crucial idea coming from this approach is that of the *evolutionarily stable strategy* (ESS), initially introduced the evolutionary biologists John Maynard-Smith and George R. Price (1973). This poses that a large population engages in repeated games with random matching. The games involved have degrees of evolutionary fitness as the outcomes of choices made in the game so that over time one expects to see outcomes converging on an ESS, although it must be noted that the players involved are not consciously thinking about their choices. For Maynard-Smith (1982) gave as an example the hawk-dove game, where there is a particular mixed strategy that is an optimal approach.

More generally he argued that population dynamics involving reproduction of animals playing a game that has a mixed strategy as an optimal solution will evolve so as to exhibit proportions of the population playing the strategies in the proportions predicted as optimal based on the probabilities of each strategy in the optimal mixed strategy outcome. Assuming that conditions due not change so that the evolutionary fitness landscape (Wright, 1931) does not change, such an outcome will be stable and will persist. When applied to economics, one must introduce a *replicator dynamics* to effectuate such a process and outcome if one wishes to explain dynamic processes involving firms or other kinds of economic agents over longer periods of time.

This approach appealed to economists using game theory more generally as it offers a possible solution to a longstanding problem in game theory, namely the ubiquity of multiple Nash equilibria in many game theory problems. All ESSs happen to be Nash equilibria, even though not all Nash equilibria happen to exhibit ESS. Game theorists have long studied ways to eliminate some Nash equilibria in situations, and the ESS now provided a way of doing so for repeated games in many situations (Binmore and Samuelson, 1992; Robson and Vega-Redondo, 1996).

It must be noted that ESS does not necessarily provide a way of eliminating all such equilibria when they may occur. But it does allow both a reduction in the number of such possible equilibria as well as a way of determining how frequently one might see each equilibrium occur over time as a game is repeatedly played. William Sandholm (2010) developed this thoroughly by studying basins of attraction in evolutionary games and how these can be used to determine the probabilities for each outcome to occur over time in such repeated games, with this being driven by how frequently the initial conditions in each round of the game puts the players into each basin of attraction associated with a particular outcome. While this approach does not resolve all such problems in game theory, it has become widely adopted as an important and useful approach for many game theory problems.

We must note that SMT do not use or even discuss at all this part of evolutionary economics. They criticize most of evolutionary economics for lacking a rigorous approach and especially a rigorous microfoundation. However, this is a part of evolutionary economics that does provide rigorous solutions, and it can be seen as a way to formalize the approach made by Alchian, which in turn can be seen as an extension of Marshall’s somewhat vaguer arguments regarding the evolution of industry and market structures, although neither Alchian nor Marshall thought specifically about the problems associated with possible multiple equilibria outcomes in such evolutionary processes. But this is a rigorous approach that SMT do not consider, with theirs then arguably being an alternative rigorous approach to evolutionary economics, although they do once use the term “evolutionary stable strategy” at one point (SMT, p. 48) in connection with their discussion of *micro-macro loops*. But they do not discuss this further in connection with the broader evolutionary game theory approach.

1. **The Shiozawa-Morioka-Taniguchi Argument**
2. **Their Approach to Evolutionary Economics**

In contrast to most jointly authored books, Shiozawa-Morioka-Taniguchi (2019) (or SMT) individual chapters are identified in the Preface to be by one or another of the authors specifically. The Preface by Taniguchi explains how the basic ideas developed and how the authors came together. Yoshinori Shiozawa is the senior them and initiated their approach and developed its general outline, although not developing a complete model (1983, 1990). This would be done by the other two subsequently, with Masashi Morioka (2005) providing more details of their specific model with supporting theorems, and Kazuhisa Taniguchi (1991, 1997a) further developing crucial elements, notably specific of inventory dynamics as studied using simulation methods. A curious aspect of this development is that important papers and books (including those just cited) they developed these ideas in initially were published in Japanese.

Given their relationship it is not surprising that the first two chapters are written by Shiozawa, with the long opening one bearing the same title as the entire book. In it Shiozawa presents their general argument regarding evolutionary economics while in the second one he outlines a set of postulates that underlie their specific model of the economy. But the first chapter contains much of the substantive meat of the book, certainly their view of evolutionary economics and laying the groundwork for how their model arguably provides their promised microfoundation for evolutionary economics.

Given that they consider themselves to be substantially revising evolutionary economics they approach the existing schools of evolutionary economics in a critical way, even as they adopt some of ideas from the schools they criticize. First on the chopping block are the neo-Schumpeterians, especially Nelson and Winter (1982). They are taken to task for having “no theory of value” in the very first sentence of the chapter. Nevertheless, they are also criticized because they supposedly “imported reasoning and results of neoclassical economics,” even as their 1982 book was a “magnificent achievement.” SMT are out to fix their failures.

Following his self-styled “manifesto” (Shiozawa, 2004), he introduces seven supposedly foundational categories for evolutionary economics: behavior, commodities, technology, institutions, organizations, systems, and knowledge. Each of these can evolve and obviously several of them interact with each other in significant ways, such as knowledge and technology and also institutions and organizations.

He then introduces three “moments” of evolutionary process: retention, mutation, and selection. These indeed parallel a standard trio from evolutionary biology (Dawkins, 1976) of mutation, selection, and reproduction. Shiozawa recognizes that he is altering this traditional trio by replacing reproduction with retention, although he refers to reproduction as “replication,” which he says is difficult for “economic entities,” and that what is more important for them is the retention of that which is successful in the natural selection of economic competition. As will be seen this fits with a concern for *stationarity* and not having variation due to mutations or exogenous shocks be too great within their model structure. Process and complexity dominate equilibrium, an outdated neoclassical concept for them, but change must remain within certain limits in their view of evolution, which involves the ongoing gradual development of skills and capabilities.

Ultimately that which is to be retained if successful are *routines* (“teikei kodo” in Japanese), which also happen to be what Nelson and Winter say should be the central focus of natural selection in firms and organizations. Indeed, Shiozawa recognizes that March and Simon (1958) introduced the importance of routines for organizations, which would be picked up by Nelson and Winter (1982) and further developed in the context of complexity simulations by John Holland (1992).

Next on the chopping block is Herbert Simon’s bounded rationality, for which Shiozawa prefers the term “myopia.” Perhaps even more than with Nelson and Winter, he expresses admiration for Simon’s development of this concept and such important ideas as satisficing, which fits well into their approach. He even says that this deserves the Nobel Prize. But Simon is also found wanting in his approach. First he is seen as failing by granting a separateness to economics and management science when these should be integrated in order to achieve a proper evolutionary economics. Furthermore, he is found wanting in his conceptualization of the nature of the foundation of rationality and the nature of its boundedness, although I must confess that on this latter point I think Shiozawa himself underestimates what Simon knew and did.

In particular Shiozawa emphasizes computational complexity and goes into an extended discussion of the P ≠ NP (polynomial does not equal non-polynomial) problem that many consider to be the most important difficult unresolved problem of computer science (da Costa and Doria, 2016). For Shiozawa NP-hard problems are “ubiquitous” in the decisionmaking processes of firms, from their engineers through their managers. The great difficulty of solving such problems provides a crucial bound on the rationality of their decisionmaking. This underlies the need for “looseness” in both the structure and the relationships within firms and organizations so as to be able to absorb the ongoing fluctuations of exogenous changes in effective demand and other pressures and forces.

He grants much to Simon, supporting satisficing as part of this looseness of organization and behavior, but also citing his analysis of the structure of hierarchies and their “decomposability” (Simon, 1962). But he seems to dismiss Simon’s analysis of computational complexity. It is true that Simon did not specifically consider the P ≠ NP problem in connection with bounded rationality. But he did in fact emphasize the limits of computational abilities by humans as a key part of their cognitive limits, which join with their inability to obtain perfect or complete information to become the foundation for bounded rationality. Indeed, his eventual move into computer science and seminal work on artificial intelligence was motivated substantially by wanting to understand more deeply the computational problems that humans face in their thinking and decisionmaking (Simon, 1969). But this is hardly the only way in which Simon’s achievements have been less than fully appreciated by others (Velupillai, 2019).

A more interesting argument is that Simon was really substantially preceded and by von Üxküll (1920) with his *biosemiotics* approach, which Shiozawa sees as not only preceding Simon but in some ways already encompassing him. This was drawn on studying animal behavior but can be applied to humans as well and involves an interaction between a perceiving and acting being and its environment. The being perceives phenomena from the world, while suffering from myopia and limited information, which indeed Simon emphasized. There is then the matter of judgment the being makes concerning this perception, which is where supposedly bounded rationality comes in, although for Simon he saw all of this as part of bounded rationality. Judgment then leads to action, but action is always limited in its influence on the outside world.

One element deriving from the emphasis on “looseness” in relations and organizational structure in order to maintain stationarity in the evolutionary process is that Shiozawa denies a hardline Dawkins-type view of a perfect efficiency or optimization arising from natural selection. This is consistent with the emphasis on bounded rationality and myopia and routines. Nothing is perfect. What matters is that the system operates well enough to continue, to be retained. This can happen because none of the firms or entities or organizations competing with an entity are perfect or optimizing either. They are all trying to get by in an ever-changing environment they can neither perfectly perceive nor forecast, so something less than perfect is good enough.

A final element of their approach is the idea of a *micro-macro loop* as a crucial part of the process of evolution in economies. In biology this shows up in the fitness landscape analysis of Wright (1931) who understood that the behavior of species in a fitness landscape, trying to climb local hills of fitness or seeking higher hills to climb can itself alter the landscape itself. For Shiozawa this involves criticizing methodological individualism because individual actions only matter in connection with the feedbacks coming from the larger system in response to them. These loops can be both stabilizing and destabilizing, with indeed a routine or even a whole system that has been an evolutionary stable strategy (their only use of this term) within such a loop coming to break down and become unstable as the system evolves.

Interestingly at this point Shiozawa draws on examples from the Japanese economy. For the case of a once stable strategy that breaks down eventually he cites the vaunted “Japanese management system” as characterized by its “three sacred treasures” (Rosser and Rosser, 2018, Chap. 6). These are (or were) 1) lifetime employment, 2) seniority based wages and promotion, and 3) labor-management cooperation through company unions. Shiozawa notes that from 1945 to 1990 in the rapidly growing Japanese economy these fit into the macroeconomy as part of a self-reinforcing system. However, after 1990 when the Japanese economic growth noticeably slowed for various reasons, this undercut these parts of the system, and some of them have since broken down and changed, notably the seniority wage system in particular.

But in articulating the importance of micro-macro loops and how a system can exhibit an evolutionary stable strategy, Shiozawa digs deep into Japanese economic history to 1673 and the introduction of the fixed price system of non-negotiated universal prices by Mitsui Takatoshi, the founder of what would become the Mitsui *zaibatsu* before and during World War II and now tis he Mitsui *keiretsu* group of firms. This replaced the previous system and remains in place today, and Shiozawa introduces it in order also to illustrate a central element of the model SMT present in which prices operate separately from quantities, remaining fixed most of the time as most short-term adjustments operate through quantities. Thus micro-macro loops play a central role in the evolutionary process.

1. **The SMT Model**

In Chapter 2 Shiozawa lays out the background and underpinnings of their model, a set of postulates along with some theorems, including one due to his coauthors. In Chapter 3 Morioka gets more specific about the nature of the model and proves some theorems about it in Chapter 4, with more development of it in Chapter 5, especially details about the inventory adjustment part of it, which is the centerpiece of it. In Chapter 6, Taniguchi delves further into the details and background for their inventory adjustment model. Chapter 7 is really a kind of disconnected add-on that does not further present the model and deals with topics that do not seem all that central to the book’s argument, notably about arbitrage, with this being the part of the book that draws heavily on Hayek and the Austrians, in contrast with earlier parts, with the model drawing much more on Sraffa and neo-Ricardian foundations for the production part of the model and on Keynes for the role of aggregate demand.

Shiozawa presents the following 18 postulates in Chapter 2. “A Large Economic System with Minimally Rational Agents.” The first is that all exchanges are made between products and money. The second is that for a certain period of time there will be a single price for each commodity. Following Kalecki (1954), prices are set by a markup from costs according to the third postulate. The fourth is that demand for a product follows a non-stationary stochastic time series limited by aggregate demand. The fifth is that firms sell products at the fixed price up to their stock level. The sixth is that differences between production and sales are adjusted by the use of stocks, and the related seventh is that firms produce as much product as sells. The eighth is that production takes time.

The next several postulates show the neo-Ricardian elements of this model. The ninth postulate defines the set of available production techniques available to each firm. The tenth explicitly comes from Piero Sraffa (1960) and declares that except for labor all production of commodities is by means of commodities. The eleventh declares that labor is the only unproduced input and that it is directly or indirectly necessary for the production of any product. The twelfth defines technology as the set of realizable production techniques. The thirteenth rules out joint production, and the fourteenth asserts the homogeneity of labor, which is paid a unique wage rate. The fifteenth postulate asserts that the technology is productive if positive net product is possible if labor is supplied. The sixteenth is that except “exceptional situations” firms can produce any amount at a fixed price, with this then being tied to the seventeenth postulate that if a firm faces a stable increase in demand it will invest in greater production capacity.

These 17 are all presented prior to any theorems. After several theorems are presented an eighteenth postulate is added later after quantity adjustment ideas are presented drawing on Masahiko Aoki (1977) and Herbert Scarf (1958). It states that inventory policy follows a moving average over periods based on experience. This inventory policy and the details of how it operates are a central focus of much of this model and its version of an evolutionary approach to economics. Works in Japanese by Taniguchi (1991, 1997) are cited as the source of this approach to inventory policy, and Taniguchi himself develops the details further in Chapter 6 of this book.

The theorems presented in this chapter come in three groups. The first group include two “minimal price theorems,” which are essentially variations on the non-substitution theorem due to Paul Samuelson (1961) and depend on the assumptions of a single homogeneous primary factor paid a single wage rate and no joint production. This leads to a single production technique being used that minimizes product price according to a specified value equation. The concept of *spanning* is then introduced for a set S of production techniques such that for any good j S has a technique that produces j, and if there is only one technique for each product, that is a *minimal spanning set*. A second version of the minimal price theorem is then applied to such sets and is also shown to have a covering property. It is then noted that all these assure the stability of production coefficients in the “Leontief” (or Sraffa) technology.

Shiozawa then elaborates on implications of this approach and introduces an alternative view of the system as a whole as not representing an equilibrium of maximizing agents but rather a complexity *dissipative structure* as defined by Prigogine and Nicolis (1977) of the Brussels School of disequilibrium thermodynamics. This is tied to the slackness and adjustability of the system through its inventory adjustments and relation to Keynesian unemployment theory.

He then presents a set of theorems we shall not consider in detail that extend this to a multi-country Ricardian trade system. In this he draws on graph theory ideas using “exotic algebras” (Shiozawa, 2015). Essentially this group of theorems ends up detailing conditions under which nations following assumptions made above will end up with a set of unique international values that are allowed by a tree of spanning technologies.

The final two theorems involve quantity adjustment. The first draws on Scarf (1958) to allow a min-max solution for inventory policy in the face of a stochastic process, after which the eighteenth postulate is introduced. The final theorem is credited to both the work in Japanese by Taniguchi (1991, 1997) as well as some also in Japanese by Morioka (1991-1992, 2005). This final theorem applies to the quantity adjustment process of the system as a whole and states that “The quantity adjustment process of firms is convergent as a whole when the span of the moving average is taken appropriately.” This is then described as the central key to the SMT model, and much of the next four chapters essentially amounts to an elaboration of and examination of the details of how this works. We shall not go through these chapters in as great detail but rather provide a more general summary of each.

Chapter 3 by Morioka, “The Basic Theory of Quantity Adjustment” introduces the concept of *stockout avoidance behavior*, which essentially describes how firms try to avoid running into capacity constraints through inventory policy. Three different kinds of inventories are considered: raw materials inventory, work-in-process inventory, and product inventory, each of which has its own fluctuation pattern although they are interrelated. He derives a Keynesian multiplier from this and shows how oscillatory behavior can arise, drawing on Richard Goodwin (1949) and John Chipman (1950). He also relates this to debates over socialist planning, drawing heavily on ideas from Kornai and Liptak (1965), Kornai (1971, 1980), and Kornai and Martos (1973).

Chapter 4, “Dynamic Properties of Quantity Adjustment Process Under Demand Forecast Formed by Moving Average of Past Demands” presents the analytical core of the model with nine theorems. A major focus is on the conditions under which there will be stability or instability and various oscillatory patterns are examined. The important role of managing buffer stocks is emphasized. Crucial work drawn on for this chapter comes from Metzler (1941), Hawkins and Simon (1949), and Lovell (1962). As its title suggests, Chapter 5, “Extensions of Model Analysis of the Quantity Adjustment Process in Several Directions” does just that, most especially to consider in detail the adjustment patterns of the three different kinds of inventories.

The final two chapters are by Taniguchi. Chapter 6, “Significance of Nonlinearity and Many Goods Models: Feasibility of the (S, *s*) Inventory Control Policy in the Economy as a Whole,” focuses on a particular variation of inventory control policy due to Scarf (1959). This involves a target amount of inventory, *s*, when *z* is the actual amount of inventory. This leads to a firm ordering in a particular time period an amount S – *z* when the inventory is less than the target. If the inventory is equal to or greater than the target the order is zero. In contrast to the analytical approach of Morioka, Taniguchi studies this using simulations to show the resulting dynamic patterns of oscillations. His use of simulations also arises from his interest in the complexity approach to economics (Taniguchi, 1995).

As already noted, the final chapter, 7, “Exchange and Arbitrage: Price, Evaluation, and the Principle of Exchange,” stands somewhat apart from the rest of the book. It does not draw specifically on the SMT model discussed above but goes after broader questions of the emergence of money and prices, with the crucial role of arbitrage emphasized. While it does cite Keynes (1936) and Morishima (1984) it draws more heavily on Austrian sources (Menger, 1923; Hayek, 1967, 1973, 1988).

1. **How Japanese is their Approach?**
2. **Is the SMT Model a Model of the Japanese Economy?**

There is a certain tension in this book over what is being presented with the SMT model is a description of an ideal system or an actual system or is simply an abstract theoretical model. Which of these it is supposed to represent is not addressed anywhere in the book. Of course, part of what is involved here is not just a matter of whether this model reflects an ideal model or describes an actual economy, but may really be more about economics and economic theory. Certainly it is supposed to pose a way to think about economics and economies in an evolutionary way. It also clearly favors the use of certain approaches to economics, such as a Sraffian/neo-Ricardian view of production.

One reason why we might not be surprised that the authors would focus a lot on the Japanese economy as a model for their model is that so much of their early work on their model was written in Japanese. Of course, this does not prove the case. Nothing can stop someone writing in one language to use the economy of a nation that speaks another language as an object of study or a model for their theoretical contemplations. But it is clear that the main audience for this work was Japanese economists as few economists outside of Japan read economics published in the Japanese language. The authors have more recently written about their model in English, with this book probably their leading effort to do so and make their view known to the broader economics community around the world. But the initial focus of writing in Japanese for Japanese economists does suggest that they might well be more inclined to use the Japanese economy itself as the model for their model.

Nevertheless, it is tempting to consider if it is at least partly modeled on an actual economy, and the leading candidate here is indeed the economy of Japan itself, or at least a certain version of that economy. Even before considering more detailed aspects of the model, we can note some signs that at a minimum the Japanese economy and elements of it have been on the minds of the authors. The most obvious is the central role of their minimum price theorem, which is a variation on the non-substitution theorem. Shiozawa in particular links this to appearance in the 1673 of a unified price policy by Mitsui Takatoshi, the founder of what is now the Mitsui *keiretsu* group of firms in Japan. It is not clear that Mitsui’s unified price was a minimum price, but Shiozawa clearly identifies Mitsui’s policy with the theorem in his discussion. It is posed as an example and justification for the relevance of the theorem.

It is arguably less tied to the SMT model itself, but there is also Shiozawa’s invocation of the “three sacred treasures” of traditional Japanese labor-management policy. He brings these in as a case of evolution in the micro-macro loop portion of their broader conceptualization of evolutionary economics. The argument was that these treasures reinforced each other and the broader growing Japanese economy, which supported them in turn. This then was presented as an example of how these micro-macro loop relations that can change substantially as the parts of this system change. So the slowdown of the Japanese economy after its crisis in 1990 undercut these treasures, with their decline in turn feeding back into the stagnation that appeared and continued in the Japanese economy.

Digging deeper into their model, there are details that may be identified as possibly motivated or inspired by actual structures and practices in the Japanese economy. This would appear to be the case h holding prices low and constant while focusing on expanding quantity. This fits with a view of Japanese firms, especially in the rapidly growing pre-1990 economy, that firms did not maximize short run profits but had a longer term perspective in their efforts to expand their markets (Aoki, 1990). And SMT indeed emphasize that the firms in their model do not maximize profits but are looking at other broader goals, stability as well as quantity sold.

Another element is their emphasis on gradualism, including with respect to technology. This is in a way curious given that many have viewed Japanese firms as emphasizing advanced technology, and having introduced many important innovations. But it has also long been argued that Japan has less emphasized dramatically new or different technologies, those that would generate lots of the destruction that can come with Schumpeterian “creative destruction.” Indeed SMT rather play down technological change in their approach. It occurs and is ongoing, but it is gradual, mostly involving process improvements that reduce costs rather than large and sudden changes. Here they fit in with the Darwin-Marshall anti-saltationalist view of continuous evolutionary processes. But indeed many see that an aspect of the special Japanese labor-management system led to ongoing gradual improvements in production technology arising from the consultative processes involved in their system. The technological gradualism inherent in the SMT model reflects the approach of many Japanese firms.

Another element is the degree of discussion of planning and planning methods by the authors, although there is no economy-wide planning appearing in their model. But firms clearly plan. The discussion of planning does have them rejecting the command planning of the old Soviet model. But there is clear sympathy expressed for the softer form of indicative planning, and this was long practiced and thought to be important in the growth of the Japanese economy prior to 1990, although now it is officially gone, despite some ongoing efforts at coordination by the Japanese government (Rosser and Rosser, 2018, Chapter 6).

Finally, we have their emphasis on inventory management that is associated with a “slackness” policy that allows for the firms to survive shocks rather than necessarily to maximize profits. The goal is an overall stability of the economy as well as of the firms in the economy, and again the SMT model makes inventory management to achieve these goals in a world of ongoing exogenous shocks possibly the most central feature of their model. Certainly both in the period when Japanese indicative planners worked to ensure relatively stable near full employment in their rapidly growing economy and more recently as well when the planners no longer play such a role and such stability has become harder to maintain in the more stagnant economy that Japan now has, firms have continued to follow such policies of maintaining flexibility through slackness to accommodate shocks. Perhaps in this more than anything else the SMT model does resemble important features of the Japanese economy.

1. **To What Extent does the SMT Model Represent Japanese Economic Thought?**

Along with considering whether or not SMT’s model reflects a vision of the Japanese economy, there is also the related question that is to what extent does it also reflect Japanese economic thought? This question is also inspired to some degree by the fact that so much of the early public appearances of the pieces of their model initially appeared in Japanese language publications, with Morioka in particular continuing especially often and until quite recently to do so (Morioka, 2005).

This can also be seen by their considerable reliance on the writings in Japanese of various figures for support for various of their ideas, including some of those that lead to their model resembling the Japanese economy itself to some extent (Nikaido, 1961; Nakaoka, 1971; Aoki, 1978; Yoshino, 1983; T. Yohsida, 1990; M. Yoshida, 1997; Higuchi and Sato, 2010), with some of these never appearing in English. Of these, Nakaoka presents a model of the Japanese firm, Yoshiino emphasizes the role of Keynesian demand in the economy, Yoshida presents ideas related to complexity and the economy, and the Higuchi and Sano paper is the source of Shiozawa’s finding an origin of the minimal price theorem in the price policy of Mitsui Takatoshi in the 1673.

Their publishing in the Japanese language and relying on works that appeared in Japanese highlights the degree to which Japan has a tradition still going on of economics being written and published in a language aside from English. This shows some resistance in Japan to the trend towards most economics being written and published in English around the world. Many nations have had national traditions of economics that developed within their own languages, with economists in those nations eventually largely shifting to writing solely in English eventually, with this happening at different times, although occasionally some would write in other languages aside from English, such as Swedish economists writing in German or Italian economists writing in French in the early 20th century. But nations with such strong traditions within their own languages that have essentially stopped include France, Germany, Italy, Sweden, and the Netherlands, among others (Rosser, Holt, and Colander, 2009), with France probably being the only nation beside Japan to maintain such a local language tradition for so long.

Quite aside from their reliance on sources coming out of the Japanese language economics literature, all three of them exhibit a concern for the history of economic thought and draw on a variety of figures from older schools of economic thought from around the world, as the many sources discussed above show, with Shiozawa showing this especially. The question that arises is to what extent their concerns reflect the concerns emphasized in the history of Japanese economic thought. It is also the case that Japanese economists have had a high interest in the history of economic thought, possibly rivaling Italian economists in such an emphasis as seen by the numbers of economists in each nation involved in their societies devoted to the topic.

Drawing on Morris-Suzuki (1989) and Aiko Ikeo (2014) we can identify certain patterns and interests that Japanese economists have had especially and see the extent to which these appear in the discussions by SMT of their model and its influences. One theme that has been stronger than most outside economists have been aware of has been the strength of its Marxist tradition. Part of this has been that the vast majority of this has appeared strictly in Japanese (Uno, 1950, 1952). This parallels the persistence of the Japanese Communist Party (JCP), which has long been quite orthodox in its views and has held seats continuously since 1949 to the present time, if only in small numbers. If anything the strength of the Marxist tradition in Japanese academic economics has been stronger than that of the JCP in political life, with a number of departments long dominated by it, even as its influence has weakened over time. While some of these economists have been associated with the JCP, many, especially the influential Kozo Uno, eschewed political activity and adopted a purely theoretical stance. Given the pervasiveness of this tradition, it is unsurprising that even many non-Marxist economists would feel its influence to some degree, which can be argued for our authors, especially the older Shiozawa.

The most intellectually influential branch of this tradition has been its mathematical one as highlighted by such figures as Nobuo Okishio (1961) and MIchio Morishima (1973), although the latter did much work that was not Marxist and ended up in Great Britain writing in English. Several of Morishima’s works are cited by the authors, especially by Shiozawa, both of the Marxist variety as well as the non-Marxist variety. While Okishio is never cited by SMT they share a similarity in that the model Okishio uses in his famous theorem of 1961 is built on an explicitly Sraffian foundation as is the SMT model, with his theorem being used by some of the neo-Ricardian critics of older Marxist economic views such as Ian Steedman (1977), who does get cited in this book.

Another sign of the influence, although also of their not being within the tradition, is the extended discussion of planning and the socialist planning controversy. They come down on the side of the critics of command central planning, with Taniguchi in particular citing much work by anti-Marxist Austrian economists. But they also clearly favor indicative planning of the sort Japan used to engage in and cite much work on how carry out planning practically, especially that of Janos Kornai (1971, 1980) and Kornai and LIptak (1965). They also cite Michal Kalecki (1954) who while more post-Keynesian was strongly influenced by Marx and they use his markup pricing approach. And, Morioka cites the first two volumes of Marx’s *Capital* as well (Marx, 1990, 1992), if only briefly, perhaps reflecting his own apparently greater immersion in the strictly Japanese language economics literature.

Unsurprisingly their study of the theory of the firm and their resulting model of firm behavior reflects ideas found in the Japanese literature, which has appeared both in the Japanese language (Nakaoka, 1971; Aoki, 1978) as well as in English (Aoki, 1990). Likewise their strong reliance on Keynes and the role of effective demand reflects much literature that has appeared in both Japanese (Yoshino, 1983) as well as many sources in English, including Keynes himself, whose *General Theory* (1936) may be the work cited in more of the chapters than any other.

Finally we have the obvious matter of evolutionary economics itself, which has long been taken seriously by Japanese economists in both their Japanese language literature as well as in English. One sign of this was the founding of the journal *Evolutionary and Institutional Economic Review*, which Shiozawa contributed the opening paper to (Shiozawa, 2004) and that Morioka has also published in (Morioka, 2018), whose papers are in English. Another is that the very large history of economic thought society in Japan is named after Schumpeter, with their long having been a strong interest in his work among Japanese economists.

This great interest in Schumpeter among Japanese economists brings us back to a central issue of evolutionary economics, where SMT may be in some degree of disagreement, even as they cite his work (Schumpeter, 1950) as well as that of leading neo-Schumpeterians as Nelson and Winter (1982). But they focus more on his institutional ideas and less on his ideas about the disruptive nature of technological change. Here we come back to their emphasis on a gradualist approach to evolution following Darwin and Marshall rather than the saltationalist view of Schumpeter that emphasizes the importance of discontinuous and abrupt change. While they do recognize that large changes can become manifested in relatively short periods of time, particularly the change in the Japanese economic system after 1990, the focus of their model is on how a firm by using moving averages and flexible inventory management policies can survive and persist and grow, even in an environment subject to ongoing exogenous shocks to demand. In this regard their theory of value for evolutionary economics ultimately becomes classical, despite all the influence of Keynes on their thinking and models.

1. **Conclusions**

Shiozawa, Morioka, and Taniguchi (2019) have challenged evolutionary economics as it has developed in its various forms to have a rigorous foundation that that provides values without an equilibrium based on fully rational agents. Their effort draws most substantially on the neo-Schumpeterian approach of Nelson and Winter (1974, 1982) as well as the bounded rationality approach of Herbert Simon (1955, 1957). However, they go beyond both of these lines of development to add their own elements, especially more formal rigor as well as looking more deeply into biosemiotics foundations for bounded rationality.

They develop a model of firm behavior within a more broadly established macroeconomics framework that assumes a Sraffian production underpinning that is driven exogenous demand shocks in a Keynesian manner. Firms set prices according to a minimal price theorem and make quantity adjustments. Crucial to these adjustments are inventory adjustments drawing on ideas of Scarf (1958, 1959), breaking inventories down into three types. Crucial is maintaining looseness and relying on moving averages of past data. Use of these in this framework is summarized in a crucial convergence theorem, arguably the centerpiece of their model. This leads to a gradualistic evolutionary process in which new techniques are gradually absorbed, and the nature of firm behavior links to the total economy in a micro-macro loop that is usually self-sustaining, although it can break down and change more dramatically in a crisis situation.

Their vision of a new evolutionary economics looks to draw heavily on their Japanese background in two ways. One is that their model of the firm and how the larger economy operates has many similarities with how the actual Japanese economy operates. The other is that their work draws heavily on traditions developing within the Japanese language history of economic thought, showing influences both from Japanese economists not known well outside of Japan as well as foreign economists who have long had influence within Japanese economic thought.

Arguably they have ignored certain currents and views in evolutionary economics, such as evolutionary game theory and approaches focusing more on saltationalist, discontinuous processes. They have probably not replaced or redefined all of evolutionary economics with their critique and their model. But they have certainly provided a fresh and innovative view of how evolutionary economics should be done and how it should proceed, as well as an intriguing approach to understanding how economies are structured and develop. They should be applauded for this effort.

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