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Complexity in the theory of economic evolution of Thorstein Veblen: an introduction

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Abstract

Thorstein Veblen is a classic author, recognized for his writings on institutions and economic change. The complexity perspective, on the other hand, is a relatively contemporary approach for studying a considerable range of phenomena both in natural and social sciences. There are important issues concerning the relation between the two lines of inquiry, but, in comparison, few works that undertake the task of investigating those links. This paper attempts to take some introductory steps in that direction in two ways. First, it identifies zones of convergence between the complexity view and Veblen's theory of economic evolution. Secondly, it makes an effort to interpret the latter in terms of the former. Three major elements are emphasized in this regard, namely the psychology of the agents, the continuous evolution and adaptation of the institutional structure and the role of technology in this process. The conclusion is that, although being a preliminary effort, this paper establishes a good case for a more profound comprehension of Veblen's work as circumscribed in the more broad complexity approach, providing, moreover, some directions on how this ought to be accomplished.

Keywords

Complexity; Thorstein Veblen; evolutionary economics; institutional change; psychology of agents; technological innovation

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Introduction

The complexity perspective is not restricted to a specific theory. It is an interdisciplinary scientific movement liable to be utilized in a wide range of fields (Arthur, 2013). Referred to, in many occasions, as the theory of complex systems, it is possible to state that wherever there is a discipline of which subject matter can be analytically defined as a system, which, in turn, presents a complex behavior, the complexity approach constitutes a useful tool.

This is the case of economics, applied to the investigation of complex social systems. Popularized by the activities promoted in the borders of the Santa Fe Institute (SFI),[1] the application of the science of complexity to economic systems is receiving ever greater attention from the recent scientific literature, to the point of leading Holt *et al*. (2011) to concur to an emergence of the complexity era in economics.

Colander (2000) goes further to suggest a reassessment of the history of economic thought from the complexity angle. Shedding lights over the contributions of the most important authors and schools of thought, and over the procedure by which they anticipated the complexity theme, he demonstrates not only the feasibility, but also the relevance of such an exercise. This paper attempts to employ the same effort, although in an introductory manner, to the works of Thorstein Veblen, particularly to his theory of economic evolution.

The preference for the topic of economic evolution as the main subject of inquiry is due to at least two reasons. First, the vastness and density of Veblen's writings are indisputable. The same can be asserted with respect to the research dedicated to complexity in a more general fashion. Thus, the scope of the present study requires this initial cut. Second, the veblenian evolutionary theory consists of the most general level of analysis that animates his more specific theories (Edgell, 1975). The investigation proposal hereby launched can be greatly benefited from having such a theory as its starting point.

Veblen has been recurrently recognized as a pioneer in some paramount ideas to the complexity research program (Kilpatrick, 2001, 19; Boulton, 2010, 33), but little has been done towards a solid theoretical formulation possible of establishing this link. Rosser and Rosser (2016) stray, to a certain point, from this trend by identifying Veblen's concept of cumulative causation as the basis for the understanding of several elements found in complexity theories. If, on the one hand, cumulative causation indeed represents a key concept for the intended connection between the institutionalist and complexity, on the other hand, the contribution of the aforementioned authors, albeit important, is insufficient to sustain a more broad research project in this direction, inasmuch as they do not consider in more details the mechanisms by which Veblen's cumulative causation is related to complexity.

Even Geoffrey Hodgson, widely known for his writings on veblenian institutional economics, only hinted at the possibility of a nexus between Veblen and complexity. In *The Evolution of Institutional Economics*, Hodgson (2004) waved at a revival of the veblenian institutionalism (ch. 19), pointing at the theory of complexity as one of its pillars, especially in what concerns to the notion of emergence (p. 405-408). Indeed, Hodgson argues that the absence of a well-developed concept of emergent properties was crucial to make Veblen's general evolutionary theory vulnerable to reductionist interpretations which gradually ended up phasing it out (p. 139; ch. 11).

Nevertheless, apart from the sketch of a research project, a reduced effort has been undertaken to follow that orientation. In a recent paper, in which he aims to fill some of the gaps in the current literature on complex adaptive systems, Hodgson (2011) makes only brief remarks on Veblen. Moreover, that specific work addresses micro aspects of the referred systems, which, despite

[1] Rosser (1999) attributes the pioneering works on the science of complexity to the chemist Ilya Prigogine and to the theoretical physicist Hermann Haken. Wible (2000), in his turn, lists as the antecedents of the SFI the writings of Gregoire Nicolis and Ilya Prigogine and Friedrich Hayek's theory of complexity.

their relevance, are not sufficient to build a general theory of economic evolution from the complexity approach (p. 590).

The present paper acknowledges Hodgson's efforts to promote an adequate and relevant consideration of the relation between the complexity view and the veblenian evolutionary economics. His "considerations open up the possibility of a meta-theoretical evolutionary framework for understanding complex adaptive systems" (Hodgson, 2011, 590). Still, considering that Veblen (1898) was the first to explicitly support the application of the darwinian theory of evolution to economics, we admit the necessity of an appraisal of his work from the standpoint of the history of economic thought.

Our hypothesis is that the complexity approach and the veblenian theory of economic evolution touch each other in at least three aspects, allowing for an interpretation of the latter to arise from the former. The first aspect deals with the psychology of the agents and its consequences regarding their reaction and adaptation to changes in the environment. The second one encompasses the constant evolution and adaptation of the institutional structure and the ways by which they come to the fore. The third aspect covers the role of technology in the wider process of economic evolution.

This paper is organized along the lines drew by those aspects, with each section being assigned to each one of them in the presented order. In each section, it will be exposed initially the claims of the complexity view concerning the element at issue, followed by Veblen's understanding of the same point. Yet another effort will be undertaken, in each section, to translate the veblenian theory in terms of the complexity theory. The fourth and last section will attend some concluding remarks, indicating the most important gaps in the preceding analysis, which comprise some possibilities for future research.

The psychology of the agents in a mutating environment

The complexity approach

Before proceeding to the specific matter of the psychology of the agents, a precise definition of complexity is required. As observed earlier, complexity is a label given not to a particular theory or subject, but to a far-reaching scientific approach through which is possible to cope with a series of topics in a still large range of fields. Among a myriad of identifiable definitions (Rosser, 1999; Holt, Rosser and Colander, 2011; Rosser and Rosser, 2016), disciplines, schools of thought and authors involved and expressions already adopted (Beinhocker, 2006, 96), it is possible to comprehend why "despite the generation of a number of important insights, it is increasingly acknowledged that there is no unified and coherent narrative worthy of the title of 'complexity theory'" (Hodgson, 2011, 591).

Holt *et al*. (2011) provide a tentative way of organizing the different definitions of complexity. While the complexity approach does not impose a unique definition, there are three of them that may be considered the most relevant ones. The first is the general definition,[2] devised by Herbert Simon:

> Roughly by a complex system I mean one made up of a large number of parts that interact in a non-simple way. In such systems, the whole is more than the sum of the parts, not in an ultimate metaphysical sense, but in the important pragmatic sense that, given the properties of the parts and the laws of their interaction, it is not a trivial matter to infer the properties of the whole (Simon, 1962, 468).

[2] Rosser and Rosser (2016) name this definition "hierarchical complexity", highlighting issues of emergent properties and different levels of ontological complexity.

The second definition, more directly based on Rosser (1999), regards the dynamic complexity: "a dynamical system is complex if it endogenously does not tend asymptotically to a fixed point, a limit cycle, or an explosion" (p. 170). As a "broad tent view", this definition aggregates the nonlinear dynamics predecessors of complexity: cybernetics, catastrophe theory, chaos theory[3] and the "small tent view" of complexity, which emphasizes the interaction between heterogeneous and dispersed agents and is more directly linked to the SFI and its predecessors (see footnote 1 above). The third and last definition is computational complexity, which relates to "descriptions of the minimum length of a computer program that will describe the information or system or some variation of this" (Holt, Rosser and Colander, 2011, 361-362).

This demarcation is methodologically convenient, but does not imply that preference for one of the three definitions constrains the analyst to neglect the others, considering that all of them explain complexity from a specific angle. Even thus, the present work will make use of the second definition, dynamic complexity. The first one, despite its merits (and precisely because of them), mainly in what concerns the issue of emergent properties of social interaction, involves concepts that, as explained before, were not explored by Veblen. The third definition, although advocated by economists as the most precise and being worthy of attention from Veblen himself (Rosser and Rosser, 2016, 4), bears at most an indirect relation to the theme of economic evolution.

Positively, the reasons for favoring the dynamic view of complexity stem from the fact that most of the research that identifies itself with complexity take into account this variety (Holt, Rosser and Colander, 2011, 362) and from the more clearly distinguishable relation between the dynamic definition and Veblen's concept of cumulative causation (Rosser and Rosser, 2016, 4), which, as we will see, is central to his theory of economic evolution.

Since the dynamic aspect of complexity is intimately connected to the important works advanced by the SFI since the last decades of the past century, it is important to investigate complexity from the perspectives of its authors. Among them, Brian Arthur appears as the most prominent, being responsible for a great sum of seminal publications on the topic (Arthur *et al*., 1997; Arthur, 1999, 2013, 2014). In these, his basic aim was to move beyond the abundance of empirical works already produced to the construction of the theoretical and methodological foundations of the complexity approach, rendering Arthur's writings a reliable starting point to a more broad understanding of the theme in discussion.

In general lines, Arthur (2013, 2) conceives complexity as studying the means by which the interaction between the elements of a system creates general patterns that, in their turn, affect the same elements that created them, causing these elements to change and adapt. Complexity is basically about the formation of structures and a "recursive loop" of interaction between said structures and their forming elements. In economics, it involves analyzing how the interaction between the individual behaviors of the agents generates an outcome that alters those same behaviors.

Hence, the question of how the agents react to change resides in the core of the study of complexity as applied to the economy. A direct result of this perception is that a richer view of the psychology of the agents than the one assumed by the neoclassical economics, the current orthodoxy,[4] is demanded. Prasch (2000, 217) maintains that the mechanism of expectations formation of the agents is an important factor in the scrutiny of complex adaptive systems. To fully apprehend this process, the SFI has been arguing for a better integration of psychology, especially the evolutionary branch, into the foundation of economics.

[3] From each one of these, the complexity approach derives an important idea, notion or concept: from cybernetics, the ideas of self-organization and emergence of higher order structures from lower order systems; from catastrophe theory, the modeling of discontinuities in dynamical systems; from chaos theory, the notions of dependence on initial conditions and strange attractors. For more details, see Rosser (1999, 171-175).

[4] I refer to the concepts of "neoclassical economics" and "orthodoxy" as suggested by Dequech (2007).

An excellent example of the contribution that the modern evolutionary psychology can entail is that the human behavior in group contexts follows a distinct logic, which cannot be explained by appealing to the observed behavior of the isolated individual (Prasch, 2000, 219). This idea stablishes an immediate connection with the study of complexity in economics as it emphasizes the importance of interaction between individuals.

Axtell (2007, 108-109) also points to the relevance of psychology by claiming that a general model of cognition is a necessary precondition for a solid scientific account of human behavior, upon which economics is grounded. He proposes that a promising starting point is to conceive agents as purposive, rather than merely rational. This position would lead to a shift from a global and unconstrained rationality to a local and bounded rationality, limited to a satisficing – rather than optimal – behavior.[5] Additionally, the purposive agents would be characterized as having a bounded rationality in respect to their preferences, "discovering" them in a continuous learning process.

Veblen's approach

The roots of Veblen's discussion on economic evolution are in his groundbreaking paper titled "*Why is economics not an evolutionary science?*" and published in 1898. Veblen's primary motivation here is a belief that the economics of his time was inexorably "behind the times" compared to the natural sciences, notably the biological science, being unable to deal with its subject of interest in a way to justify its position as a "modern science" (Veblen, 1898, 373).

The fundamental reason for this delay is a "difference in the basis of valuation of the facts for the scientific purpose". While the modern (evolutionary) scientist takes the causal relation test to the last consequences, the pre-evolutionary scientist, albeit also resorting to relations of cause and effect, departs from this mindset when it comes to the final formulation of his theory, recurring instead to the notion of a normal propensity for the phenomena in view. In other words, whereas for the modern science the key concept is that of "cumulative causation", for the pre-evolutionary science it is "natural law". Therefore, the pre-modern scientist is satisfied only to the extent that he imputes this "spiritual purpose" to his subject matter and builds his body of knowledge over the logical congruence between the former and the latter (*ibid*., 377-379).

The mental processes that characterize the classical economics as a pre-evolutionary science, at least in what refers to the final generalizations of theories, can be understood as a "ceremonial adequacy" to the *zeitgeist*. This derives from the fact that the discipline's theoretical conclusions are construed taking as a basis the preconception, attributed to the subject matter, that everything tends to what the common sense of "the times" accepts as adequate or valuable: "it is a projection of the accepted ideal of conduct" (*ibid*., 382).

Oppositely, the habit of thought that marks the modern science emphasizes sequences of cause and effect, or cumulative causation. In economics, this means that the process of cumulative change worthy of being studied is the change in the methods of dealing with the material means of life. This change cannot be in the physical properties of those means, as they are fixed. Inasmuch as it is the human agent – or the way by which he ponders and analyzes how those material means are to be employed – that changes in the course of time, the motor force of the process of economic change is the "human material" itself, which is, accordingly, the focus of economic study. In Veblen's words, "economic action must be the subject-matter" (*ibid*., 387-388).

[5] Simon (1979) is admittedly a pioneer on the theorization on bounded rationality and on satisficing behavior as opposed to the optimizing one, traditionally associated with the neoclassical agent: "Two concepts are central to the characterization [of the mechanisms of choice under conditions of bounded rationality]: search and satisficing. If the alternatives for choice are not given initially to the decision maker, then he must search for them" (p. 502).

An expressive obstacle to a genetic description[6] of the process of economic life is an inaccurate conception of the "human material", based on psychological and anthropological perspectives that interpret it as being passive and substantially immutable. According to this view, the human nature cannot be the result of a long process of development, but only tossed from one place to another by external forces that end up leaving it intact. For the evolutionary psychology, on the other hand, the habits and desires of men are a product of hereditary traits and past experience, expressed via a variety of traditions and conventions. Consequently, the economic life of the individual is a cumulative process of adaptation of means to ends that also experience cumulative change through time (*ibid*., 389-391).

In a discussion regarding possible analogies between economics and biology, set to explain human behavior, Picton (2000) reminds that the evolutionary psychology considers the concept of "ancestral environment" of paramount importance to the comprehension of decision-making processes among contemporary humans. This concept recognizes that the circumstances in which the human evolution occurred and, thereupon, for which they are adapted, are different than the circumstances which environ us today, affecting to a significant degree the mental and emotional faculties of individuals (*ibid*., 201).

Hodgson (2004) follows the same direction. To cope with the apparent dualism between volition and intentionality and scientific explanation in terms of material causes, Veblen, as Hodgson argues, places the deliberation capacity of the human being in an evolutionary framework, claiming that the very possibility of acting towards an end is a result of natural selection (*ibid*., 153). Hodgson names the principle by which our assumptions about human behavior in social sciences must be passible of causal explanation in evolutionary terms, that is, must be in conformity with our understanding of human evolution, the "principle of evolutionary explanation". The relevance of this principle lies on the fact that even though the social science is not a mere appendix of biology, it must be consistent with the latter (*ibid*., 159).

Thus, the fact that human beings had evolved in a specific social context – the ancestral environment – entails that their rational capacities, logical rules, mental categories and knowledge in general have a more tangible potential when situated and appreciated in that same context: "The human mind bears the marks of its evolutionary context and origins" (*ibid*., 160-161). Any unqualified dissociation between rationality and its material background – not only the social environment, but the material structure of the brain and its functioning – will not make justice to the best available understanding of human evolution.

Complexity versus economic evolution in Veblen

The central question in what touches the psychology of the agents is the importance of, taking as a starting point the tools and conclusions offered by evolutionary psychology, not conceiving agents as static in their nature, habits, proclivities and rationality, but as resulting from a long process of evolution. This development occurred in the past and is still unfolding, causing agents to react to mutations in their institutional context and, in virtue of adaptation and learning processes, to transform their habits of thought and behavior in such a way to influence the very institutional structures in which they live.

When Veblen's theoretical effort of introducing the psychological formation of human beings in an evolutionary scheme is seriously considered, the analyst is fatally led to accept the incompatibility between the assumption of optimizing behavior of the neoclassical economics and

[6] The genetic method is described by Veblen himself in such a way to clarify his proposal of seeing the economy as a process: "This method is the genetic one, which deals with the forces and sequence of development and seeks to understand the outcome by finding how and why it has come about. The aim is to organize social phenomena into a theoretical structure in causal terms" (Veblen, 1973, 655 *apud* Hodgson, 2004, 152).

the evolutionary interpretation of human psychology, a fundamental corollary of complex models applied to the economy.

This incompatibility is acknowledged by Picton (2000) as stemming from the identification of significant problems that emerge when the nature of information and correlated issues are reflected upon. Questions like "the overwhelming amount of sense data; limits on the ability to process information; the costs involved in processing information; and the necessity of interpreting information so as to make it meaningful" (p. 203) imply a behavior that emphasizes rule-following rather than optimization in decision-making situations. Generally speaking, agents will halt due to intrinsic limits to information discovery, wherein the appropriate way to proceed will be to literally "guess" the alternatives, or, in other words, to make use of practical rules to achieve a satisficing outcome.

The cited micro aspects with which Hodgson (2011) is concerned, and which he accuses the current literature on complexity of neglecting, are precisely "the complexity facing agents and the psychological or other mechanisms that are required to deal with it" (p. 600). Bringing the darwinian framework to the fore and allocating social evolution to it, the author provides a detailed and accurate description of the mechanisms operating in the adaptive processes of learning and knowledge transferring that allow the agents to handle the complex and mutating environment surrounding them. His conclusion is that those mechanisms comprise simple heuristics ("rules of thumb"), instincts (phylogenetically inherited) and habits (ontogenetically inherited).

The continuous evolution and adaptation of the institutional structure

The complexity approach

The inevitability of an ongoing discovering and learning process by the agents recalls Arthur's (2013) insistence on the idea of economy as an ecology, constituted by agents and structures in constant interaction and movement. For him, there are two inexpugnable factors of a moving economy: fundamental uncertainty[7] and technological innovation. Both elements, in a mutually reinforcing relation, render the economy a space in which is impossible to exist deterministic ways for the agents to make a decision. Rather, in this type of world, the beliefs, actions and strategies of the agents are being perpetually tested against an ecology created and transformed by those same beliefs, actions and strategies (*ibid*., 3-5). That is, as the agents adapt to the recurring changes across which they come, the ecology of which they are part also follows an adaptive process.

This stablishes the notion of "nonequilibrium" as the fulcrum of the investigation. This aspect of complex systems can be considered as the "natural state" of economy, as it is endogenously generated from fundamental uncertainty and the introduction of novel technology, inherent to the economic process (*ibid*., 3). The constant change brought about by the nonequilibrium state in which the economy unfolds is easily connected with the definition of complexity:

> Complexity studies how change play out. Or, to put it another way, complexity studies the propagation of change through interconnected behavior. [...] We can now say why nonequilibrium connects with complexity. Nonequilibrium in the economy forces us to study the propagation of the changes it causes; and complexity is very much the study of such propagations. It follows that this economics properly lies within the purview of complexity (Arthur, 2013, 11).

Prasch (2000), likewise, highlights the continuous mutation of the economy when he states that, in economics, the focus of the complexity approach is on adaptive complex systems, which

[7] Arthur (2013, 3) applies, in a somewhat vague fashion, the term "fundamental uncertainty" to the ordinary situation of simply not being possible to know everything that will come to pass in the future. For an excellent systematization and refinement of the numerous concepts of uncertainty, see Dequech (2011).

require the notion of equilibrium and parallel ideas to back away before the central notions of adaptation in mutating environments, learning processes by the agents, coevolution of structures and individuals and the rise of an emerging order.

In this sense, the concepts of "increasing returns" and "path-dependence" become very useful.[8] Prasch (2000, 220-222) demonstrates that, as opposed to the mechanical systems envisaged by the neoclassical economics, which are laid upon diminishing returns, complex systems operate via increasing returns, what engenders path-dependence processes. This means that in those systems, once expectations are formed and decisions are taken, a new set of facts are created in a trajectory that, henceforth, becomes ever harder to leave or diverge from. That is, the structures, problems and phenomena which an agent meets depend upon the decisions that multiple agents made on previous periods.

In processes characterized by path-dependence, the current trajectory is consolidated in such a way to generate a historical "lock-in", particularly in technologies and institutions. Along the evolution of human society, several social rules, formal and informal, were developed to support the agents in their dealings with problems that were specific to that time and space. Notwithstanding, owing to the effects of historical lock-in, such institutions end up reproducing themselves over time and surviving the circumstances that would otherwise undermine them, even after they have served the objectives in view of which they were created, or emerged spontaneously.

Another fundamental category is that of "positive feedbacks", which describe the self-reinforcing interactions between elements (agents) of a complex system (economy), and between elements and the structure in which they are circumscribed. By force of disturbances around which possible trajectories start to accumulate, the positive feedbacks also generate lock-in effects in some of them, fomenting nonequilibrium and the consequent formation of structures. Systems which present positive feedbacks exhibit, in the same manner, increasing returns and path-dependence, in addition to unpredictability and possible inefficiencies in virtue of the lock-in effects (Arthur, 2013, 12-13).

Veblen's approach

Intending to define "evolutionary economics" more precisely, Veblen (1898, 392-393) starts from the observation that the history of the economic life of a society is the history of the own society to the extent that the latter is molded by men's interests in the material means of life – the economic interests.[9] There is, however, a further hindrance in defining economic institutions from the identification of economic interests, owing to the fact that the latter is interconnected with the entire organic complex of habits of thought inhabiting the human agent. Inasmuch as, regardless of the stage at which an economic process is found, the starting point is always that complex – since the subject matter of economics is the "human material" and its "economic action" –, it is extremely difficult to isolate human interests from one another in such a way to identify which are economic which are not. Correspondingly, there is not a single sphere of cultural phenomena that can be easily called "economic institutions".

[8] These concepts were more explicitly utilized by economists in the field of technology studies (Dosi, 1982; Arthur, 1989). There is considerable confusion in respect to the exact definition and the difference between each of these concepts and others, like positive network externalities and self-reinforcing processes. Since an examination of the details on each of these terms would eschew from the scope of this paper, which concentrates instead on the general process of cumulative and sequential change, an extremely rigorous distinction between those definitions will not be attempted, granting, however, that they will not be treated as absolutely interchangeable.

[9] "In so far as it is a science in the current sense of the term, any science, such as economics, which has to do with human conduct, becomes a genetic inquiry into the human scheme of life; and where, as in economics, the subject of inquiry is the conduct of man in his dealings with the material means of life, the science is necessarily an inquiry into the life-history of material civilization, on a more or less extended or restricted plan" (Veblen, 1909, 627-628).

Nonetheless, this expression can be analytically distinguished to characterize those institutions in which the economic interest is more immediately and consistently identified and which bear a more tangible economic weight. Therefore, "an evolutionary economics must be the theory of a process of cultural growth as determined by the economic interest, a theory of a cumulative sequence of economic institutions stated in terms of the process itself" (*ibid*., 393).

It is possible to read Veblen's evolutionary economics from Hodgson's (2004) perspective. Institutions arise out of social interaction as its emergent properties, and appear as actual "repositories of social knowledge". Those are expressed by the material structure in which the interactions between individuals take place and which is affected by these same interactions (*ibid*., 181-184).

The causality, however, also takes the opposite direction. Hodgson (*ibid*., 184-188) employs a term known in social science as "reconstitutive downward causation", which translates Veblen's idea of a cumulative interaction between social structure and individual, although Veblen himself never utilized it. This concept can appear in a weak and in a strong form. In its weak version, named simply "downward causation", institutions operate as mere constraints to human action, without altering the preferences and dispositions. In the stronger version, though, they exert a deeper influence on individuals. It is only by mutating human preferences and dispositions – a stronger view – that social structures can affect the actions of individuals.

Hodgson, as he takes upon Veblen's writings, maintains that it is through habits that the social power of institutions is exercised. Namely, institutions transform habits, which by their turn change the dispositions and preferences of the agents, which will finally guide their actions. This constant feedback between social structure (institutions) and individual excludes the possibility of a reductionist explanation that insists on a univocal direction of influence:

> By acting not directly on individual decisions, but on habitual dispositions, institutions exert downward causation without reducing individual agency to their effects. Furthermore, upward causation, from individuals to institutions, is still possible, without assuming that the individual is given or immanently conceived (Hodgson, 2004, 187).

Similarly, Edgell (1975) interprets the evolutionary theory established by Veblen as orbiting around key concepts, like "instincts", "habits" and "institutions".[10] Instincts, as different from tropismatic actions, involve intelligence and action directed to an end. Habits refer to ways of acting and thinking that are affected by particular economic conditions and, hence, not only reflect, but also modifies the instinctive proclivities of the agent. Finally, institutions are habits that were solidified, standardized and consolidated throughout time by way of constant adoption.[11]

Thus, in Veblen's own words:

> [...] institutions are an outgrowth of habit. The growth of culture is a cumulative sequence of habituation, and the ways and means of it are the habitual response of human nature to exigencies that vary incontinently, cumulatively, but with something of a consistent sequence in the cumulative variations that so go forward (Veblen, 1909, 628).

[10] Hodgson (2004, 162-175) also disserts about Veblen's theory of instincts and its relation to habits, but putting an emphasis on an evolutionary framework as an appropriate set for that relation, as explained above, and on the primacy of instincts and habits, as propensities inherited hereditarily and by cultural evolution, respectively, over the human capacity of deliberately utilizing reason.

[11] "Under the discipline of habituation this logic and apparatus of ways and means falls into conventional lines, acquires the consistency of custom and prescription, and so takes on an institutional character and force. The accustomed ways of doing and thinking not only become an habitual matter of course [...] but they come likewise to be sanctioned by social convention, and so become right and proper and give rise to principles of conduct. By use and wont they are incorporated into the current scheme of common sense" (Veblen, 1914, 7 *apud* Hodgson, 2004, 167).

Edgell (1975) also brings to the surface the idea of feedbacks operating between institutional environment and individuals, arguing that institutions that originated from established habits acquire a certain degree of autonomy and come to play an important role in the process of individual selection, acting upon their habits and dispositions via the need for adaptation. Once again, according to Veblen:

> Institutions are not only themselves the result of a selective and adaptive process which shapes the prevailing or dominant types of spiritual attitude and aptitudes; they are at the same time special methods of life and of human relations, and are therefore in their turn efficient factors of selection. So that the changing institutions in their turn make for a further selection of individuals endowed with the fittest temperament, and a further adaptation of individual temperament and habits to the changing environment through the formation of new institutions (Veblen, 2007, 125).

Complexity versus economic evolution in Veblen

The simplest method to apply the complexity approach to Veblen's theory of institutional evolution is to appeal to the definitions employed by both sides. Veblen viewed economics as evolutionary. In other words, the economy can only be studied resorting to the genetic method, which turns to the description of the process of cumulative development of economic institutions. If, in its turn, complexity is precisely the study of the propagation of change, as postulated by Arthur (2013), it is possible to infer that institutional change, as pictured by Veblen, is a complex phenomenon, which demands the use of complexity tools if one wishes to study it.

In the same manner as Arthur (2013), it is possible to argue that Veblen places the notion of nonequilibrium in the center of the investigation when formulating his evolutionary theory. This can be clearly seen in the critique he addresses to the economics of his time, of which he extracted the concept of cumulative causation, and in more direct critiques present in his 1898 paper (Veblen, 1898, 383, 389) and in a later article titled *The Limitations of Marginal Utility*, in which he composes a similar argument, but taking the theory of marginal utility, especially its static aspect, as a more direct target (Veblen, 1909, 620).

The notion of an economy in constant evolution is, for that reason, cherished by Veblen and by the SFI alike. Both emphasize ideas like the coevolution of individuals and social structure and the adaptation of agents to mutating environments and of institutions to the behavior and interactions between said agents. Processes characterized by increasing returns, positive feedbacks, path-dependence, historical lock-in and reconstitutive downward causation permeate the genetic description of the economy elaborated by the SFI and Veblen, even though those specific terms were never used by the latter.

The role of technology

The complexity approach

Arthur (2013) claims that "technology isn't the only agent of change in the economy but it is by far the main one" (p. 13), attributing an important part to technology in the whole process of institutional change. He understands technology, in a broader fashion, as the means to satisfy the ends determined by the people. The essential point here is that technology is about the combination of pre-existing technologies, which constitute the components of new technologies. If we define, moreover, the economy as a set of arrangements and activities by which society satisfies its material needs, and grasping those arrangements as technologies themselves, we arrive at the conclusion that the economy is, again, a kind of ecology that emerges from the mutual support and economically consistent interaction between technologies (*ibid.*, 13-14).

In this sense, the economy functions like an algorithm that follows a relatively clear routine:

> A few simple properties of technology yield a system of changing elements (technologies), each new element created from previous elements, each causing replacements, and all bringing on an ever-changing set of demands for further elements, the whole channeled and structured by the properties and possibilities of the dominant families of phenomena recently captured (Arthur, 2013, 15).

Technological innovation is, in this scenario, a more disruptive process than it is normally accepted. Contrary to the spread vision of the introduction of novel technology as generating a unique disturbance in an equilibrium state, towards a new equilibrium point, this process must be seen as possessing a self-reinforcing nature, according to which a technology creates a demand for novel technologies, which demand still other technologies, in a continuous propagation that scales with the economy movement itself (*ibid*., 5).

This autopoietic nature of technology is linked to the same self-producing nature of the economy in a highly complex relation, considering that the economy is shaped by technology, but it additionally mediates the creation of novel technology, which will construct novel structures in the economy and so forth. Major clusters of technology will, in the long term, delineate a "thematic way" on which operations in the economy will unfold and which imposes challenges whose solutions will consist, themselves, of innovations. This is the case of the railroad and the digital eras.[12] The outcome of this process is a deep structural transformation in the economy, altering its own organizations and institutions, which will lead to new changes (*ibid*., 15-16).

Veblen's approach

Veblen (1898) confers to technology, or technological change, a prominent role in his general theory of economic evolution. The first course by which he justifies this position is through anthropology. Under primitive conditions, all of the attention and strength of the individual are applied to promote the material means of life. In this context, there is no effort to understand and explain the regular phenomena which they encounter, mainly the natural events. There is nothing that compels the human agent to stop perceiving facts and events in terms of personality, that is, as consequences of design and purpose by a superior mind (*ibid*., 379-380).

To the degree that men's knowledge becomes ever more detailed, and his search for knowledge more persistent, tracing events and phenomena to a supposedly spiritual agency and discerning a natural propensity among them becomes more problematic. This rupture can be experimented in the branches of knowledge related to technology and engineering, on account of the fact that those are the spheres where the notions of process and sequence are more easily apprehended through our senses. In moral and social sciences, in turn, the previous mindset still holds sway over the researcher, since those same notions of process are less tangible (*ibid*., 380-381).

Rutherford (1984) also emphasizes the role of technology. According to him, Veblen, albeit affirming the function of instincts in providing a stable set of basic ends to human action, did not accept them as having an important role in explaining human behavior, since the latter, for the most part, results from institutions, traditions and customs that do not stem directly from the innate inclinations of human nature. Instead, Rutherford (*ibid*., 333) argues that Veblen identified the basis of human behavior with the material means of life – technology –, which generate habitual ways of thinking and acting. These, through recurrent and patterned use, acquire an institutional character. And those institutions, once established, come to act as the central determinants of behavior, overcoming instincts in that function.

[12] Such depiction corresponds expressively to what Dosi (1982) meant by technological paradigm and trajectory.

The reach of institutions is so stretched that through a process that Veblen named "crossing and grafting", they come to develop an "internally coherent and highly interrelated" institutional system via the implementation, in a considerable range of areas, of principles, traditions and customs derived from the particular activities dedicated to technology:

> Institutional systems grow and develop on a basis provided by those conventions derived from the system of livelihood, and each system develops its own internal logic around these central conventions. Institutional systems cannot, therefore, be regarded as entirely static or unchanging, although the internal development of the system is only one step in a cumulative sequence which may ultimately lead to changes in the institutional base (Rutherford, 1984, 335).

Complexity versus economic evolution in Veblen

In what respects the issue of technology, it is possible to observe the first contiguity between complexity and Veblen in its definition. There is a consensus as to defining technology in an ample manner, as being the set of available material means directed to the fulfillment of the ends of individuals in a society. The rejection of reductionist definitions, which limit technology to a specific technique of production, employed by a firm with the purpose of a more efficient usage of resources, allows for a clearer grasp of the role of technology in economic change.

Similarly, the discernible autopoiesis in processes deflagrated by technological innovation constitute a common theme for both lines of inquiry. Veblen's focus on the notion of sequence and on bidirectional causation between technology and institutions can be interpreted as the continual formation of structures originating in the introduction of novel technology that distinguishes complex economic systems, as comprehended by complexity economics.

A related question is the operation of habits of thought generated in technological experience in other spaces of social life. Veblen advocated the view that technology gives birth to conventions that compose the internal logic of an institutional system passible of transposition to activities that are not specifically related with the system of material means of life. The mechanical industry of Veblen's time was his best example, being capable of, in the long run, to transform the very *modus operandi* of economics. The same energy of the effects of technological change in social structure can be noticed in the discussion presented by the complexity approach, in which the autopoietic process of technological development amasses to great blocs of technology that demand solution, transformation and adaptation by the economic structure, which includes its very organizations and institutions.

In sum, it is reserved to technology, understood as the specific arrangement of material means of life of which society will make use to satisfy its needs, a position of prominence in what touches the mechanisms of economic evolution. It is never indicated that technology is the sole determinant of institutional change. Rather, in a constant interaction with prior institutions and with the performance of agents, technology is advanced as the essential medium of novelty introduction, which sets off a new process of mutation, urging the adaptation of other social variables in its trail.

Concluding remarks

This paper undertook the task of not only listing possible points of contact between complexity and the veblenian evolutionary theory, but establishing a relation between both approaches by attempting to read the latter with the lenses furnished by the former. Three major topics were emphasized: the psychology of the agents, the continuous adaptation and evolution of the institutional structure and the role of technology in this process. Additionally, it is recognized that there is a juxtaposition of the three aspects, being an intricate endeavor to analytically isolate one from the others. Nevertheless, it is possible to argue that the analytical segmentation of the three

factors in view resulted in the elaboration of concepts and ideas that were unique to the operating logic of each one of them, justifying, thus, the approach chosen by this study.

It is not difficult to realize that a number of elements were neglected by the present work. Among important mechanisms and concepts pertaining both to complexity and to Veblen's theory of institutional change, the issue of emergent properties and of an emergentist philosophy that considers different ontological and explanatory levels in social research is of primary importance. This absence is owed to a real gap in Veblen's thought, as Hodgson (2004) insists, but the possibility of including those categories would turn viable the employment of powerful analytical and explanatory resources, rendering this task indispensable for an eventual follow up study.

Furthermore, the option for the dynamic definition of complexity can be loosened to include the computational and hierarchical definitions (Rosser and Rosser, 2016). By reason of the virtual impossibility of an absolute disconnection of the various complexity perspectives, it is possible to detect a superposition of categories and concepts that work for definitions of complexity other than the dynamic one. Once more, the inclusion of a larger number of those definitions contributes significantly to a reassessment of the veblenian theory of institutional evolution: in what concerns the computational complexity, the idea of procedural uncertainty arising from the limited cognitive capacity of agents taking decisions in a complex environment (Dequech, 2011); and in the case of hierarchical complexity, the idea of emergent properties.

Notwithstanding, the intention of this paper was to sustain a preliminary appraisal of a seriously complex theme and to establish a direction for future inquiry. By listing specific intersection domains between a contemporary approach and a canonical author in the field of economic evolution, it is expected that this work has contributed to a deeper understanding of Veblen's writings and to demonstrate the relevance and applicability range of complexity studies.

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