The Characteristics of Knowledge in Evolutionary Economics

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Abstract:

The main objective of this paper is to study the tacit and codified knowledge in evolutionary economic models. In these models, knowledge is defined as different from information, and as dynamic, path dependent and embedded in human actions, in other words, in habits or skills, and routines. Such a definition of knowledge, in fact, gives clues about the characteristics, tacit or codified, of knowledge in evolutionary economic models. From this perspective, tacit knowledge resides at the core of routines, and it is needed to interpret even codified information or messages. However tacit and codified knowledge is interrelated, continuous and complementary, furthermore they can turn into each other over time. Hence, the evolutionary perspective denies the bi-polar distinction between tacit and codified knowledge, and emphasizes on their collective presence as embedded in routines.

Keywords: evolutionary economics; tacit knowledge; codified knowledge; routines

> *"Where is the knowledge we have lost in information"*
>
> T.S. Eliot

1. Introduction

The age, we are passing through, is called as 'information age', and the prevailing economic structure of this era is defined with the term of 'knowledge economy' or

'knowledge – based economy'. Knowledge – based economy rationale is based on the argument that in our globalizing world, knowledge is the most strategic source for competition (Asheim and Coenen, 2005, 1174). Despite the given importance to knowledge and its role in economy, it is important to notice the limitations of what is referred by the term of knowledge in general economic understanding. Many supporters of knowledge-based economies, while deciding on the degree of knowledge-intensity in any economy, refer to high-tech industries or how intensively information and communication technologies (ICTs) are used.

The main presupposition behind the given importance to ICTs in this era as the basis of the knowledge-based economy can be found in the interchangeable usage of two terms; 'information' and 'knowledge'. In traditional understanding, knowledge is treated as a mere 'information-processing'. However, to emphasize differences between these two terms is necessary to understand the importance of knowledge in the economic structure, and how and in which conditions knowledge is produced in parallel with information. Knowledge is the essence of not only the economy of our age but also previous economies, "so-called primitive economies have relied upon the know-how of producers and consumers in order to make a living possible in adverse and difficult environment" (Lundvall and Johnson, 1994, 24). Cooke (2002, 3), in a similar manner, argues that all human activity involves knowledge, and therefore, "all economies are knowledge economies".

This paper is based on a pre-acceptance of that information and knowledge are interrelated and complementary, however, in the main sense, different notions. Towards a broader understanding of the role of knowledge in any economy, it is needed to state these differences and also complementarities between these notions. However my original aim, in this paper, is not to over emphasize the differences between information and knowledge; but to put these differences in a meaningful context to understand the economic value of knowledge. In this paper, the difference between information and knowledge is used a mere guidepost to stress on how different understandings of knowledge and information bring about changes in the understanding of economic value of knowledge, and its creation. Therefore stressing on differences between knowledge

and information will be used as a reference point to indicate one of the main deviations of modern economic perspectives from traditional ones.

After all, the main purpose of this paper is to discuss the notion of knowledge, its characteristics, tacit or codified, and its economic value from one of the modern economic perspectives, namely evolutionary economics. Even though the term of evolution is broader to be used in different disciplines from biology, sociology, psychology to economics, in consideration of the limits of this paper, this discussion will be restricted with the frame of evolutionary economics, yet it is broad enough. Through out this paper, I will try is to reclaim the fundamentality of knowledge and its tacit and / or codified characteristics in evolutionary economic models, and the possible theoretical and practical implications of how evolutionary economic models restate the knowledge in general economic structure.

In this paper, first the differences between data, information and knowledge will be stated. In the third part information and knowledge will be discussed from traditional economic perspectives, mainly neo-classical economy. In the following part these notions will be articulated from an evolutionary perspective. In the fifth part I will try to answer the question of where knowledge resides from an evolutionary viewpoint. Next part will discuss the tacit and codified characteristics of knowledge in evolutionary economics. In the following part, routines, knowledge, processes and firm competences will be articulated in relation to each other. Part eight concludes the article.

2. Data, Information and Knowledge

Before starting to discuss the importance of knowledge and the role of tacit and codified knowledge from an evolutionary perspective, it is needed to state the differences between data, information and knowledge.

Data can be treated as originating in discernable differences in the physical world in terms of time, space and energy (Boisot and Canals, 2004, 46). It is fact that an agent receives a lot of stimuli from the outside world but an agent registers not all of which as data. On the other hand, "information may be defined as data relating to states of the

world and the state-contingent consequences that follow from events in the world that are either naturally or socially caused" (Fransman, 1994, 714). Information can be evaluated as a flow of messages that initiates and formalize knowledge. Even though knowledge is created and organized by the flow of information, it is anchored on the commitment and beliefs of its holder. This perspective on knowledge emphasizes on the relation of knowledge to human action (Nanoka, 1994, 15). Since knowledge is related to human action and commitment, knowledge can be understood as socially constructed (Kogut and Zanger, 1992, 385).

It can be drawn from the definition of information and knowledge that information can be interpreted in relation to knowledge, and information by itself refers to nothing without knowledge, which is needed to interpret information. As argued by Dretske (1981, 86), "[the] information a person receives is relative to what he or she knows about the possibilities at the source". As stated by Nonaka (1994, 17), a person cannot understand the meaning of information without some frame of value judgment. According to him, the meaning of information changes according to the aim of a system and the context, therefore "the activity of knowing and understanding… occurs in the context of purposeful activity" (ibid.). Therefore, knowledge is associated with a process that involves cognitive structures which can assimilate information to put that information into a wider context (Howells, 2002, 872). In this sense, such an understanding of knowledge and knowledge processing is incompatible with mechanistic information processing models. In these models, the mind is defined as a fixed capacity device for converting meaningless information into conscious perception (Nonaka, 1994, 17). As it is also emphasized by Frasman (1994, 716), information is a closed-set but knowledge is essentially open, hence knowledge cannot be analyzed in terms of the information processing paradigm.

Howells (2002, 872), on the other hand, emphasizes on the dynamic character of knowledge. According to him, knowledge is a dynamic framework or structure and, through this process information can be stored, processed and understood. Howells (ibid.) also states that memory is the fundamental component of knowledge; "an enduring brain state… must exist to allow the bridging of the time gap between events that have occurred and any claim to know about them".

To sum up, it can be stated that knowledge and information are complementary, interrelated but very different notions. First of all, knowledge is a prerequisite to understand, interpret and store any kind of information. Information is a closed-set and hence static, at least in any given moment, whereas knowledge is open, dynamic and context specific. As emphasized by Howells (2002), since knowledge needs memory, it is not only context specific but also path dependent.

3. Knowledge and / or information in traditional economic models

In traditional economic models, there is no inclination to discuss the notions of knowledge and information, and the differences, interrelations and complementarities between them. In this literature, the terms of information and knowledge are generally used interchangeably.

In the economic system of Adam Smith, there are two mechanisms. The first one is related to division of labor and the use of specialized knowledge, the second mechanism is the market which drives "the growth of knowledge by restructuring the system of knowledge" (Potts, 2001, 414). In this traditional economic model, knowledge is seen as a mechanism just like the market.

On the other hand, in neo-classical economic models of the twentieth century, the economic system is reduced to a market mechanism which "is a rule system for communicating price information" (ibid., 415). Therefore, in neo-classical economic models, the market is "viewed as an information-processing mechanism" (ibid., 414). This is why knowledge and information are used interchangeably and static. In neo-classical sense, since the market is an information processing mechanism, by definition, it is a closed-mechanism. "In a closed – form mechanism, knowledge is either a synonym of information or it is meaningless" (ibid., 417).

One of the main assumptions behind these traditional economic models is that knowledge is embedded in capital goods (Saviotti, 1998, 843). This assumption can easily be observed in technology policies employed by governments in these days on the issue of digital divide. Governments expect that investment on capital goods, such as

facilities enabling internet connection or information and communication technologies, by themselves, is adequate to solve the problem of digital divide and information imperfections, and to bring about the desired economic and social development.

Another traditional assumption of neo-classical economics is based on the idea of perfect information. These economic models focus on individuals and prices as the principle source of market information (Lambooy, 2005, 1139), and assume that all agents in the market share the same information, and act in a fully rational manner (ibid., 1141). In these models, market economies are composed of "autonomous mildly self-reflective individuals optimizing their objective function subject to constraints, and these individuals have been assumed to know what they wanted and to know their environment" (Paquet, 1998, 344). Since neo-classical economic models equate information and knowledge, and ignore the cognitive dimension, the economists in this discipline think of "knowledge as a public good which is easily produced and diffused" (Cowan, Jonard, Özman, 2004, 469) and it is "impossible for its creator to prevent it being used by economic agents who do not pay anything in exchange for it" (Saviotti, 1998, 875). In neo-classical paradigm, information (or knowledge) is available to every individual agent in the market, and an agent makes its choice to optimize its objective function according to this available information in the market. The decision-making process, in this paradigm, is fully rational.

 The three assumptions of neo-classical economic models, namely (i) perfect information, (ii) perfect competition, and (iii) focus on resource allocation in a static environment, create many problems for economists to struggle. Some economists prefer to be stuck into the assumptions of neo-classical economics, and try to make some slight amendments in traditional analytical tools of this economic perspective. On the other hand, some economists have left the presuppositions of neo-classical economic models "in favor of the study of adaptive or Schumpeterian efficiency and chaotic evolutionary processes" (Paquet, 1998, 344-45).

Ronald Coase and Oliver Williamson are among the people who follow the first way to struggle with the problems created by neo-classical assumptions. According to Williamson, modern enterprise is a response to "market imperfections" (Lazonick, 2002, 6). Even though he accepts the role of cognitive abilities and behavioral incentives in an

organization, he does not step forward from constrained-optimization methodology to analyze the cognitive abilities and behavioral incentives (ibid., 12). He accepts that "in entering into transactions, economic actors have incomplete access to information and a limited ability to absorb that information to which they do have access" (ibid., 9), however he presupposes that "cognitive, behavioral and technological conditions as given", and he tries to find an answer the question of "how those who control corporate resources optimize subject to these conditions as constraints" (ibid., 12).

After all, it can be summarized that in neo-classical economic tradition, knowledge is reduced to information, they are synonyms and used interchangeably. Reasons for this attitude mainly based on the argument that market is just a mechanism to exchange price information, it is closed and static, and moreover the information in the market is available to every agent in the market as unbounded, costless and unbiased. In this tradition, information is fully available to agents, and information imperfections are constraints for agents to optimize their objective functions.

However, evolutionary perspective in economics appreciates the difference between information and knowledge, and treated knowledge as a social product and endogenous to the agent. In evolutionary perspective, "knowledge generation and accumulation are also seen as endogenous components of economic development" (Saviotti, 1998, 843). In this respect, knowledge has a central role in evolutionary economic models as a crucial part of competence-building process which is necessary to be competitive in the market. In the next section the role of knowledge in evolutionary perspective will be discussed in detail.

4. Knowledge in evolutionary models

Dugger and Sherman (2000, 7) restate the fundamental dimensions of evolutionary perspectives. They emphasize that evolution means, first of all, "not only incremental change in all aspects of society, but also structural change in the basic institutions and relationships of society". Second, evolution means endogenous change; the change is created by internal dynamics rather than external causes. Third, evolution is not a

consequence of a single factor, but instead, of "the operation of the relationships of the whole of society". Finally, evolution involves conflict between groups, especially in all stratified and class divided societies.

Even though evolution is a biological term, this does not mean that evolutionary perspectives are consequences of "biological reductionism or imperialism" (Hodgson and Knudsen, 2004, 284). Darwinian mechanisms, which are referred in evolutionary perspectives, do not always mean the process of genetic variation and selection; however evolutionary perspectives share "the common features of variation, inheritance and selection" (ibid.).

According to Klaes (2004, 360), "at its object level, evolutionary economics refers to evolutionary phenomena", because it deals with endogenously caused change. Besides its concern with endogenous change, evolutionary economic models also concern the three processes of evolution, namely, selection, inheritance and selection (Metcalfe, 1998, 22). However Metcalfe emphasizes on two additional processes: replication and interaction (ibid., 30).

Before any discussion on how knowledge can be resided in these processes, it is preferred to restate the differences between neo-classical and evolutionary economic models in terms of knowledge and information. Different from neo-classical economic models, evolutionary economics describes a dynamic world. The general concept of evolutionary theory covers an attention to variable or a set of variables that changes over time and "a theoretical quest" towards "an understanding of the dynamic process behind the observed change" (Nelson, 1995, 54).

Evolutionary economics emphasizes on the importance of structures and contexts, and accepts the interaction between individuals and groups of individuals (Lambooy, 2005, 1140). Hence, in this perspective the knowledge is a consequence of interaction between individuals and groups of individuals, and between individuals and their environment. Evolutionary economic models, while denying the argument that firms gradually evolve towards a more profitable ways of doing things, and towards an equilibrium, emphasize on four major considerations: "variety, behavioral continuity, profit-induced growth and limited path dependency" (Nelson and Winter, 2002, 27).

As it is noted before, neo-classical economic models emphasize on the rationality of choice. In this sense, the neo-classical economic models treated rationality as undifferentiated and inherent in all actors in the market. However, the evolutionary economics argues that real actors do not have the vast computational and cognitive powers to employ optimization – based theories (ibid., 29). In evolutionary theory, rational decision making processes are replaced by experimental ones, and in such a case the search for rationality reflect to the inferior choices (Metcalfe, 1994, 933). Therefore competences of agents in evolutionary approach are based not on rationality but on skills and routines which are learned and perfected through practice (Nelson and Winter, 2002, 29).

5. Where does the knowledge reside?

The question of where the knowledge resides depend on the level of research. From the stand point of evolutionary economics, the levels of research can be restricted with two: individual and organization. Hodgson (2004, 286-87) put habits as the repository of knowledge on the individual level, and he claims that through replication of habits, which are the basis of reflective and non-reflective behavior, and repositories of potential behavior, tacit or other kind of knowledge is transferred from person to person. Hodgson (2004) accepts that the knowledge resided in habits has both tacit and codified dimensions.

On the other hand Nelson and Winter (1982) put skills as the repository of knowledge on individual level. While studying on individual skills, they highlight three distinctive features of individual skilled performance. The first feature they emphasize is that skills are programmatic, "in that [skills] involve a sequence of steps with each successive steps triggered by and following closely on the completion of the preceding one" (ibid., 73). The second one is important for our aim to understand the importance of tacit knowledge in evolutionary perspective, because it emphasizes on the tacit character of the knowledge underlying a skillful performance. "The performer is not fully aware of the details of the performance and finds it difficult or impossible to articulate…" (ibid.).

The third feature stated by Nelson and Winter emphasizes that skills involve making numerous choices, however these choices are made automatically and without consciousness (ibid).

On the organizational level, it is commonly accepted that routines are the repository of knowledge (Metcalfe, 1998; Frasman, 1994; Hodgson, 2004; Nelson and Winter, 1982). In Nelson and Winter's analysis (1982, 73) routines are stated as the analogue of individual skills. Hodgson (2004, 290) emphasizes on that "routines are… manifestations of human cognition and interactions of individual minds", and tacit and other kinds of information associated with routine are important to understand how routines work, and are preserved and replicated.

6. Characteristics of knowledge embedded in routines

The discussion of characteristics of knowledge embodied in routines needs a clear distinction made among knowledge characteristics. In the absolute framework of this paper, types of knowledge to be discussed will be limited with tacit and codified knowledge.

Tacit knowledge can be defined as "non-codified, disembodied know-how that is acquired via the informal take-up of learned behavior and procedures" (Howells, 1996, 92). As the most prominent author working on tacit knowledge, Michael Polanyi (1962, 49) emphasizes that "the aim of the skillful performance is achieved by the observance of set of rules which are not known as such to the person following them". He also adds that "rules of art can be useful, but they do not determine the practice of an art; they are maxims, which can serve as a guide to an art only if they can be integrated into the practical knowledge of the art" (ibid., 50). He emphasizes that rules of art cannot replace tacit knowledge (ibid). This quotation from Polanyi reflects to the importance and vitality of human action and practice in knowledge creation and the connection between practice and tacit knowledge.

As emphasized by Howells (1996, 95) tacitness of a knowledge is strictly related with direct experience. Tacit knowledge is situational and context specific (Howells,

2002, 876) and it represents disembodied know how that is not codified via artifacts (ibid., 872). Polanyi emphasizes on "tacit knowledge as an act of indwelling, the process of assimilating to ourselves things from outside" (ibid.). Nonaka (1994, 16) states two elements of tacit knowledge: cognitive and technical. Cognitive elements help human beings to form working models of the world. These models include paradigms, beliefs and viewpoints that provide perspectives to human beings to perceive the world. However technical elements of tacit knowledge are related to concrete know-how, crafts and skills which can be applied to specific contexts.

On the other hand, codified knowledge can be defined as know-how that is transmitted in formal systematic language" and it does not need direct experience to be acquired by an individual, and it can be transferred in blueprints, manuals etc. (Howells, 2002, 872). The importance of codified knowledge is mainly based on the advantages it provides to reduce the transmission cost of knowledge (Saviotti, 1998, 845) and to weaken the need for geographical proximity for the efficient knowledge transmission (Cowan, Jonard, Özman, 2004, 471).

Even though the definitions of tacit and codified knowledge may indicate a misperception regarding to the bi-polar distinction between these two types of knowledge, as stressed by Polanyi, tacit and codified knowledge are not divided but continuum between wholly codified and pure tacit form of knowledge, moreover the tacit knowledge is needed to interpret the codified one (Howells, 2002, 873). In a similar manner, Nightingale (1998, 693) emphasizes that tacit knowledge is the background to which codified transmitted information is compared.

A detailed analysis of routines in evolutionary economic models and the knowledge resided in routines supports the argument that there is no wholly codified and pure tacit knowledge in these models. Even codified, there is a tacit dimension of knowledge embedded in routines and this tacit side, in fact, constructs the basis of variety and selection processes in evolutionary economic models. In the next part, routines will be discussed in the extent of knowledge; and the importance of tacit and codified dimensions of knowledge in different processes of evolutionary economics, and in the competence building process will be detailed.

7. Routines, knowledge, processes and firm competence

As the analogue of individual skill, routine refers to "a repetitive pattern of activity in an entire organization" (Nelson and Winter, 1982, 97) and it is remembered by doing or practicing (ibid., 99). All members in an organization have some certain skills and routines, these set of skills and routines performed in an appropriate environment called as the "repertoire" of an organization member (ibid., 98). Any message coming from the environment in which the organization operates or from other organizational members is interpreted according to the selection and performance of an appropriate routine in the repertoire of the organization member (ibid., 100). Messages coming from inside or outside the organization require an interpretation in "a manner that is quite specific to the organizational context" (ibid., 102).

While making an analogue between individual skills and routines, which are specific to organizations, Nelson and Winter (1982) emphasize the tacit character of routines. Since they appreciate the role of routines and skills in interpreting messages and information coming from both inside and outside of organization, they deploy the tacit knowledge at the core of routines. They state that even if it is codified and articulated any message must be interpreted by the organization member, and "the internal language of communication in an organization is never plain English: it is a dialect full of locally understood nouns standing for particular products, parts, customers, plant locations, and individuals and involving very localized meanings for 'promptly', 'slower', 'too hot', and so on" (ibid.). In this way, it is very similar to the argument stated by Cowan et al. (2000, 225) that information written in a code can only perform the functions embodied in it when people are able to interpret the code, and the "context –temporal, spatial, cultural and social- becomes an important consideration in any discussion of codified knowledge".

Nelson and Winter (1982, 103) does not ignore the codified knowledge, and analyze it with the terms of "list of ingredients" and "recipe" levels. However they emphasize that an organization's actual productive performance does not depend on the acquisition of all the ingredients, "even if it also has the recipe" (ibid., 104). According to them, the central component of productive organizational performance is coordination,

and coordination is carried out by individual members who know their jobs, correctly interpret and respond the messages they receive (ibid.). In a similar way they argue that 'blueprints' are only a small part of organizational routines that are needed to carry out an efficient production performance. Furthermore, according to them, after the routines are set in memory by using and performing, blueprints are not necessary to keep, they are useful in the case of a problem in routines (ibid.)

Dosi (1998, 1125) emphasizes that innovation is a problem-solving activity, and solution to a problem requires a knowledge base which involves both tacit and codified knowledge, and "each problem solving activity implies the development and refinement of models and specific procedures" (ibid., 1127). These models and procedures are called by Dosi as "technological paradigms", in reference to Kuhn's (1962) "scientific paradigms". As emphasized by Nonaka (1994, 16) paradigms, beliefs and viewpoints are the cognitive elements of tacit knowledge, and in reference to paradigms, knowledge base needed to solve problems has an undeniable tacit dimension. Therefore, routines, as an established problem-solving activity at core, involve a tacit dimension; routines are needed to understand, and interpret the outside world and automatically response to the changes coming from outside in a pre-established pattern of behavior.

However routines are not mere patterns of behavior; however they are the storage of behavioral capabilities and capacities (or 'repertoire' in Nelson and Winter's analysis), they are shaped in time, and as a consequence of past experiences and trial-and error. This indicates and explains varieties between different organizations and different firms. Thus, the sources of variety in evolutionary economic models are routines and the knowledge embedded in these routines. Of course, the knowledge resided in routines involve both tacit and codified dimension, however since tacit knowledge is much more difficult to replicate and diffuse, the variety is basically as a consequence of tacit dimension; and without tacit dimension, it is impossible for codified knowledge to be interpreted. They are, in this sense, complementary and continuous. On the other hand, routines may be equated to competences of a firm which determine the capability of that firm to compete with its rivals in the market, and to adapt itself according to new conditions in its environment. Therefore, competences work as the determinants of selection process in evolutionary economic models.

Metcalfe (1998, 30) argues, as similar to Hodgson and Knudsen (1994, 31), that what is replicated, and hence inherited is routines and practices. The knowledge, tacit or codified, is transferred and replicated via routines and practices in which it resides. However copying process is not always perfect and it is expected to have some errors in the replication process. In fact these errors increase the variety; some favorable errors are added to the routines whereas unfavorable ones are forgotten (ibid.). These trial-and-error attempts support the idea of path-dependency. Since beliefs are depended upon past experience and all these trial-and-error attempts, beliefs give rise to the possibility of path dependence (ibid., 36-37). If beliefs are taken into account in any model, tacit knowledge should also be intrinsic to that model. Here, it can be claimed that choices are also based on beliefs, and so they are not taken as a consequence of perfect information but of the knowledge which is tacit at core.

Nelson and Winter (1982, 83) emphasize that as a part of skill, choice is not always a conscious behavior. Hence, it can be argued that our choices in many situations based on our tacit knowledge. They give the skillful act of driving in their book to illustrate how choices are not, in general, consequences of deliberate act but automatic actions. They introduce the term of "programmed choice" to define the choice made during a skillful performance. They state that the novice really chooses not to drive off the edge of the road but "the skilled driver does not (deliberately) choose to keep the vehicle on the road, but merely accomplishes this result incidental to a choice to exercise his driving skill for the purpose of getting from one place to another" (ibid.).

Consequently, it can be stated that routines are crucial for the processes (variety, inheritance, selection, replication and interaction) in the evolutionary economic models. They are also the repository of knowledge, tacit or codified. However, the knowledge embedded in routines is not pure tacit or wholly codified, it has both tacit and codified dimensions. Therefore, the knowledge in evolutionary economic exclude the idea of bi-polar distinction between these types of knowledge; instead evolutionary economic models offer a new model of knowledge, in which tacit and codified knowledge are not two extremes of the same linear definition or subcategories of a taxonomy, in which they are relational, continuous and complementary processes. They are not differentiated from each other. Even codified, knowledge needs a tacit dimension to understand the codes of

codification and interpret it. McKelvey (198, 162) emphasizes that "the collective aspect of knowledge includes codified knowledge, which can be shared with skilled others". In this quotation the stress on "skilled others" presupposes the tacit dimension. In evolutionary economic models, tacit knowledge turns into codified knowledge and codified knowledge turns into tacit knowledge or improves the tacit dimension (ibid.,163).

8. Conclusion

This paper was started with an attempt to clarify the differences between knowledge and information. The aim of this attempt, in fact, is to reclaim and emphasize the fundamental deviations of evolutionary economics from neo-classical economic models. I personally believe that on the basis of the theoretical implications of evolutionary economics, understanding the notion of knowledge, and its role in evolutionary economic models is vital.

It was stated that, in contrast to neo-classical attempt to equalize information and knowledge, and to treat information as a commodity form (because it is embedded in capital goods) available to every agent in the market, evolutionary economic models prefer to make a distinction between knowledge and information. In these models, information is interpreted via knowledge, and knowledge is embedded in human action, namely routines and it is connected to memory. Therefore in evolutionary models, knowledge is seen as dynamic and path dependent. It is path dependent because routines change continuously in a trial-and-error process, and the experiences collected through this process determines future routines. Since knowledge is embedded in routines and, routines are, in the simplest way, a problem-solving activity, routines are paradigmatic, and hence, likewise paradigms, beliefs and viewpoints have a tacit dimension. Furthermore, this tacit dimension constructs the core of a routine and the knowledge embedded in this routine, even codified the embedded knowledge has a tacit dimension at least to interpret codes and understand the codified knowledge.

In the last parts of this paper, the interrelatedness of codified and tacit knowledge was emphasized. The fact is that, in evolutionary economic models, it is impossible to separate codified knowledge from the tacit one, and moreover tacit and codified knowledge feed back each other. They are, at the same time, continuous. The distinction between the codified and the tacit is not bi-polar, evolutionary perspective appreciates that there is no wholly codified and pure tacit knowledge, instead the knowledge resides between these two polar, and therefore the degree of tacitness vary among individuals and organizations.

Consequently, how knowledge is defined and resided in the general economic structure from the perspective of evolutionary economics, have some strong theoretical implications, especially to understand how knowledge is diffused, how firm competences are built and what determines the variety among firms in the market, how selection mechanism works, etc. On the other hand, the analysis of knowledge from evolutionary perspective has also strong practical implications. This analysis is capable to open the way for the researches which focus on the real conditions of knowledge creation, accumulation and diffusion on the firm level as well as industrial and national levels. The understanding of knowledge and its tacit and codified processes provide evolutionary economic models a strong guidepost for further theoretical and practical studies.

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