

Karl Popper and Evolutionary Economics: A review

Daniela Cialfi^[0000–0001–8953–062X]

Department of Philosophical, Pedagogical and Economic Quantitative Sciences, Section
of Economic and Quantitative Methods, University of Studies Gabriele d’Annunzio
Chieti-Pescara, Pescara, Italy
daniela.cialfi@unich.it

Abstract. After the end of the 2nd World War, within economics science rose a debate related to Solow investigation about the economic growth issue ([13], [14]). Specifically, he affirmed that technological and technical changes were not considered as an endogenous variable. After several attempts to find a valuable theory of innovation, Nelson and Winter ([3]) stated that the production function might not be a perfect approach for studying innovation due to its inability to fully include uncertainties and variety concepts present during innovation processes. So, following these understanding, the same authors in their work of 1982 [4] proposed a new theory to resolve the economic growth issue derived from Darwin evolution one. But, is it possible to analyse the Nelson and Winter’s economics evolutionary theory ([4]) under Karl Popper’s methodology and epistemology framework? The principal goal of the present research work is to provide an tentative answer to this reader dilemma discovering the philosophical foundations of Nelson and Winter theory. This is what, as we will see throughout the paper, Popper called the *method of situational logic* or *situational analysis*. In particular, it will be possible to conclude that Nelson and Winter’s evolutionary theory is based on *trial and error procedure* or *search and selection* like happens in Popper’s evolution theory.

Keywords: Philosophy of science, methodology, Karl Popper, Philosophy of social sciences, evolutionary theory, Nelson and Winter, Darwinism.

1 Introduction

The Austrian philosopher and epidemiologist Karl Popper showed through his entire life an ambivalent relationship with the evolutionary theory and Darwinism because, according to him, the latter was not testable theory but was, at least, a metaphysics programme. This was highlighted in his work *The Logic of Scientific Discovery* [5], translated in English in 1959, where he used a language closely linked to the Darwinian one, such as struggle, competition, fitness and survival; to characterize his methodological procedure for evaluate a theory (framed as a model of conjectures and refutations). As stated by Popper himself, ‘[...] *How and why do we accept one theory in preference to others?* [...]’ answering ‘[...] *We*

choose the theory which best holds its own in competition with other theories; the one which, by natural selection, proves itself the fit test to survive. This will be the one which not only has hitherto stood up to the severest tests, but the one which is also testable in the most rigorous way. [...]’ ([5], p. 108). As a consequence of this [...] instead of discussing the “probability” of a hypothesis we should try to assess what tests, what trials, it has withstood; that is, we should try to assess how far it has been able to prove its fitness to survive by standing up to tests [...]’ ([5], p. 251). In the same year of Popper’s *The Logic of Scientific Discovery*, within economics science rose a debate related to Solow investigation about the economic growth issue ([13], [14]). Specifically, he affirmed that technological and technical changes were not considered as an endogenous variable. After several attempts to find a valuable theory of innovation, Nelson and Winter ([3]) stated that the production function might not be a perfect approach for studying innovation due to its inability to fully include uncertainties and variety concepts present during innovation processes. So, following these understanding, the same authors in their work of 1982 [4] proposed a new theory to resolve the economic growth issue derived from Darwin evolution one. They explained, as the reader will see in ore details later in this work, the economic changes as a output of an evolutionary system in which specific firm routine’s feature, as the organisms in biology, become the new unity of analysis. Furthermore, through this theory they could explain the economic growth via the inclusion of of technical changes and innovation as endogenous variable.

The reader will surely be wondering how Popper’s evaluation theory conception and Nelson and Winter ([4]) could be related. Thus, the principal goal of the present research work is to provide an tentative answer to this reader dilemma discovering the philosophical foundations of Nelson and Winter theory. This is what, as we will see throughout the paper, Popper called the *method of situational logic* or *situational analysis*. A first and brief conclusion is that Nelson and Winter’s evolutionary theory is based on *trial and error procedure* or *search and selection elimination* like happens in Popper’s evolution theory. For doing so, the present paper is structured as follow. Next section 2 we present Popper approach to evolution theory. Furthermore, section 3, first describes Nelson and Winter [4] theory and, after, it will be shown as their theory should be linked to Popper view of Darwinism evolution one. Finally, the last section provides some conclusion remarks.

2 Karl Popper on the evolutionary theory

As stated in the Introduction, Karl Popper never explicitly talked about an evolutionary theory, but the characterized it other terms: *Does an theory of evolution*¹ *exist*? To answer to this question, according to him, we have to evaluate if it could be interpreted as a tautology or not. Using Popper’s words,

¹ It is important to remind to the reader the principal features of the evolutionary theory in biology: i) **Evolution**: theory in which world is neither constant nor perpetually cycling but, instead, it is considered steadily changing and at the same

te problem is '[...] Quite apart from evolutionary philosophies, the trouble about evolutionary theory is its tautological, or almost tautological, character: the difficulty is that Darwinism and natural selection, though extremely important, explain evolution by 'the survival of the fit test' (a term due to Herbert Spencer). Yet there does not seem to be much difference, if any, between the assertion 'those that survive are the fit test' and the tautology 'those that survive are those that survive'. For we have, I am afraid, no other criterion of fitness than actual survival, so that we conclude from the fact that some organisms have survived that they were the fit test, or those best adapted to the conditions of life.[...]' ([9], 241-242). So, from that emerges four interesting points as follows

1. All individual **always** engages in *problem-solving* situation.
2. The derived problems, according to Popper, could be defined as a problem in an objective sense, or, in other words, it might produce a conscious counter-example or counter-part.
3. Problem solving situation can be only solved by **trial-and-error** procedures or, with Popper words, protocols. This happens because new hypotheses, new models, new way of thinking, new behaviour temporarily rise and only after **error-elimination** procedure could be eliminated.

In what consist this error-elimination procedure. They might be either elimination of unsuccessful weaker forms or organisms or in a sort of control protocol over the evolution (e.g. hypothesis modification).

4 Organism itself could be considered as a **solution** of a **specific** problem.

As a consequence, it is possible to describe the above characteristics in the following way. If we use P for problem, TS for tentative solution, and EE as error-elimination we have

$$P \rightarrow TS \rightarrow EE \rightarrow P \quad (1)$$

But, as we know, we are not in presence of a cycle so we can modify the above one as follows

$$P_1 \rightarrow TS \rightarrow EE \rightarrow P_2 \quad (2)$$

where P_1 and P_2 are two different problems which derive from the use of a specific tentative solution and error-elimination protocols. Furthermore, in this last cycle the reader might have noticed the absence of the multiplicative effect relative to the tentative solution procedure. Thus, to include this effect, scheme 2 becomes

time organisms transfer themselves over time, ii) **Common Descent**: theory in which every group of organism descended from a common ancestor, iii) **Multiplication of Species**: theory where it is explained the origin of the present and observed species, iv) **Gradualism**: evolutionary changes takes places via gradual changes of population itself; and v) **Natural selection**: all the previous features derives from a genetic variations in every individual generation (e.g. every survived generation posses a well-adapted combination factors which will represent the starting point of the next one).

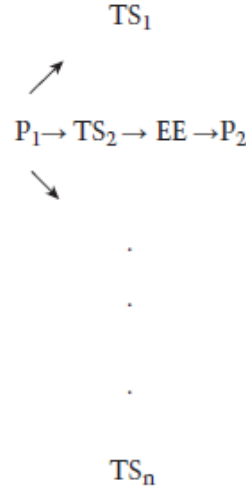


Fig. 1. source: [1]

What follows is the existence of another missing problem: the problem of survival. In particular, we are in presence of multiple tentative solutions and only one error-elimination procedure. Why does this problem arise? We have many specific problem and sub-problem because problem P_1 could be reproduced and its solution could lead to P_1 and P_2 because new organisms derived from its own evolution process. So Popper, as it is possible to stress out from his own word of 1974 [9], said to *'[...] have always been extremely interested in the theory of evolution, and very ready to accept evolution as a fact. I have also been fascinated by Darwin as well as by Darwinism – though somewhat unimpressed by most of the evolutionary philosophers; with the one great exception, that is, of Samuel Butler [...]' ([10],133).*

In conclusion of this section, it is possible to affirm that Popper used his *trial-and-error* and *error-elimination* procedures to understanding the importance of Darwin's theory of evolution ² because this mechanism could serve as a *'[...] possible framework for testable scientific theories' guiding and directing research in certain directions and not in others [...]' ([10], 134).*

3 Karl Popper's approach to Evolutionary economics

As briefly explained in the Introduction, the evolutionary theory of a economic change, developed by [4], was inspired by an exigent to include into the neoclassical production function technology and the technical changes with the scope to

² It is possible to notice that Popper compared Darwin's theory with his deductivism and error-elimination procedure way of falsify a theory.

provide a better explanation to the economic growth data. As we will see in the first part of the section, this theory was a result of a combination of two different regards. From Nelson's side, the starting point is the long-run economic development processes and in particular the role of technological change and policy; and from Winter's side, instead, we have the exigent of applying the strength of Darwin's theory of evolution to the way the firms behave³. The reader will surely be wondering how Popper's evaluation theory conception and Nelson and Winter ([4]) could be related. To answer this question, in the second part of the present section, we provide the philosophical foundation throughout what Popper called the *method of situational logic* or *situational analysis*.

3.1 What is the Evolutionary Economics?

As just said Nelson and Winter's evolutionary theory is composed by two parts: i) a theory in which firm's behaviour is in open contrast with the Neo-Classical firm view making it the key point of the analysis as in biology is the organism and ii) a contrast again the orthodox idea of equilibrium model: the replacement of the maximisation model with firm's routines considering, consequently, the dynamical evolution mechanism and not the equilibrium concept because the evolution process derived from back-and-forward feedback between firm and the external environment where firm acts within it and react upon it.⁴ Furthermore, their scope is to replace the maximisation model with firm's routines. They could be described as the predictable and real firm's behaviour or, in other terms, they describe the decisional and behavioural firms' rule of action.⁵ So, routine could be associated with the general searching rule by which firm interacts with external environment (or in other terms, the selection role between different number of mutations). Consequently, it interprets as the linkage between firms, micro driver, and the external environment, the macro framework of the entire economy, that have the scope to select the successful mutations and reject the weaker ones.

Moving on, in Nelson and Winter theory we have three types of routine which have the goal to modify/eliminate the current ones or establish new ones: i) *behavioural routine* that manage the short-run firm's behaviour (the so-called operating characteristics), ii) *periodical routine* linked to firm's capital stock (the so-called firm's investment behaviour), and iii) *search routine* which behaviour

³ From this first explanation, the reader might have noticed that Nelson and Winter took inspiration from Schumpeter, the economic change is driven by the technological one, and Simon, the individual and firm's behaviour.

⁴ It is important to remind the three main elements of the maximizing models of firms in the Neoclassical approach: i) firms want to maximize, ii) the existence of a well-known set of things from which firm can choose and iii) firm's action is the result of its choice of action.

⁵ In Nelson and Winter[4] theory this new tool has the scope to mark a distinction between the neoclassical firm's set of choices and the action of choosing them. Moving on if we want to make a comparison with the biology, it could be assimilated with a gene that has the aim to bring its features to next generation.

is similar to mutation process in biology. Based on the above prerequisites, the Nelson and Winter evolutionary model could be synthesised as follows (see also Fig. 2):

- The firm current operating feature determines its present input and output level characteristics along with its current magnitude or size.
- The above together with market demand and supply conditions will identify the optimal market price of inputs and output. Furthermore, this mechanism will find the firm's profitability.
- The previous stage interacts with the firm's investment rules deciding the expansion or contraction of the firm.
- This new firm size interacts with the old operating feature giving rise to new input and output.

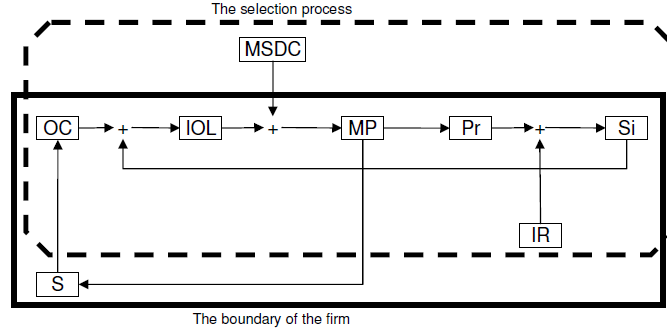


Fig. 2. The evolutionary firm process. Source: [2]

We can summarise all the above explanation, with Nelson and Winter's words, as follows '[...] through the joint action of search and selection, the firms evolve over time, with the condition of the industry in each period bearing the seeds of its condition in the following period [...]' ([4], 19).⁶ Moving on, the implication of this is the following:

Proposition 1. *If within firm organisation it is not present a search process or it does not work properly in relation to the external environment's feedback, the operating feature will not rightly improve in relation to the selection process.*

In the next part of the section, we will discuss the philosophical foundation of Nelson and Winter theory via Karl Popper philosophy.

⁶ As stated in the Introduction, this theory emerges by the exigence to give an answer to some new problems within economic literature such as the firm's response to the changing market conditions and the problem that concerns the economic growth and the competition via innovation process.

3.2 Popper's approach

In this section, we show that the Nelson and Winter's evolutionary theory could be explained by Popper's methodology of situational analysis because it links the social situation to the agent action's logic. In more depth, situational analysis is the methodological way to analysis social phenomenon because '[...] *The fundamental problem of both the theoretical and the historical social sciences is to explain and understand events in terms of human actions and social situations. The key term here is 'social situation'. [...]*' ([11], p.166). In an analogy with natural sciences, the initial condition is the social situation and the model is typical social situation. Therefore, this derives from Popper's view of the idea that a social situation is '[...] *the fundamental category of the methodology of the social sciences. I should even be inclined to say that almost every problem of explanation in the social sciences requires an analysis of a social situation [...]*' ([11], p.166).

Hence, the logic of a social situation composed of, according to Popper [12] '[...] 1- some physical bodies, which set certain physical limits, 2- the social institutions that are intervening in the agent's behavior. They could be physical laws, such as the momentum law, or social laws, such as the rules and regulations. 3- institutions are not obstacles, or opportunities, by themselves, but to pose an impact, also there is a need to assign an aim or aims in addition of certain elements of knowledge or information (for example, his information of these social institutions) to the agent. They are not his general, for instance knowledge, but are those that are relevant to the situation 4- finally, it might be some other agents The attributed characteristics to the agent – aim, information, knowledge etc – are not psychological facts; instead they are “ elements of the objective social situation [...]" ([12], p. 166-167). In other words '[...] *it is not confined ... to the re-enactment of conscious thought processes, but makes allowance for the reconstruction of problem situations [...]* Furthermore, it makes room for the reconstruction and analysis of situations that arise as the unintended and unforeseen consequences of our actions – a very important point indeed. And it allows us to give full weight, in our situational analysis, not only to individuals but also to institutions [...]' ([12], p.149)

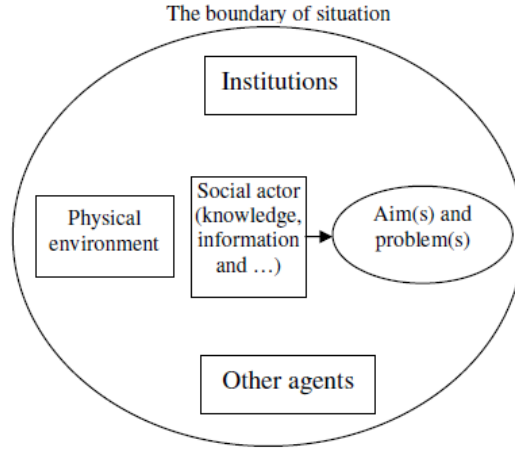


Fig. 3. Situational logic methodology. Source: [2]

Thus, with Popper's way of thinking about Darwinism, seen in section 2, our scope is doing the same with Nelson and Winter economic evolution theory. Thereby, we conclude that their methodological part are in accordance to Popper's critical rationalism. As introduced in section 2, Popper writes '*[...] let there be a world ... in which there are entities of limited variability. Then some of the entities produced by variation (those which 'fit' into the condition of framework) may 'survive' , while others (those which clash with the condition) may be eliminated. Add to this the assumption of the existence of a special framework ... in which there can be life ... then a situation is given in which the idea of trial and error elimination, or of Darwinism, becomes not merely applicable, but almost logically necessary ... what is meant is that if a life-permitting situation occurs, and if life originates, then this total situation makes the Darwinian idea one of a situational logic ... once life and its framework are assumed to constitute our situation" [...]'*' ([9], 168). So, why, in this context, the search and selection is necessary for the situational logic? From Popper we have

Proposition 2. – *Living organisms are sensitive to environmental changes and conditions changing.*

From that derived that there is no coordination between organisms and environment. Furthermore, we have

– *Living organisms live in changing world*

→ *There is a mutation and selection's processes which corresponds to Popper's error-elimination procedure. Thus, this situation is subjected of empirical investigations.*

From that it is possible to affirm that this situation has all the requisite of Popper methodology of situational logic. Moreover, it attributed an aim to the

species due to a new problem of environmental change, as their aim is to adapt to the changing environment.

Based on all the above premises, this paper want demonstrate how the evolutionary theory of economic change is highly rooted in the methodology of situational logic, or in other words, the search and selection of the Nelson and Winter theory is the logic of the situation, would follows the same argument as follows

- Living firms are sensitive to the given external environmental changes. So, only if firms produce innovation can survive
- Exist living firms in changing environment. So, we are in presence of innovation processes, or with Popper terms, mutation and selection processes.

Therefore, the evolutionary view to this situation could be assimilated by the logic of the assumed situation and the empirical work is to investigate the existence of this situation with these features.

In conclusion it is possible to affirm that the above Popper's proposition can explain the existence of different objective models to describing agents' behaviour because it takes into consideration the differences between situations and agents, as the firm could be much more complex in comparison to the organism in nature.

4 Conclusions

What can we say about the significance of Popper's thinking about theory of evolution into Nelson and Winter [4]'s evolutionary economics? During the entire paper, firstly emerged a strictly connection between Darwin's theory of evolution and Popper's epistemology and secondly how his type of epistemology can be considered the philosophical foundation of [4] evolutionary economics theory.

Regarding the first point, Popper distinguished the relation between evolutionary theory and epistemology. On one hand, we have Neo-Darwinism which represents the best clarification about the origin of creatures able of knowledge and critical reflection (some modern structures, such as nervous system and brain, are the result of natural selection and environment influence). On the other one, we can observe some similarities, bur not more than these, between Popper's epistemology theory of evolution and the one proposed by Darwin. In particular, according to Popper, '[...] *I t seems that the question [of whether there is evidence of "divine design" in nature] may not be within the reach of science. And yet I do think that science has taught us a lot about the universe that bears in an interesting way on Paley's and Darwin's problem of creative design.*' *The interesting bearing comes from construing Darwinism as a metaphysical research programme that strongly supports, for Popper, the story of the evolution of the universe and the emergence and distinctive creative nature of World 2 and World 3[...]*' ([11], p.342).

Furthermore, this paper moved on in the investigation of the philosophy foundations of Nelson and Winter [4] economic evolutionary theory and in particular on Popper's methodology of situational analysis which itself is based on his metaphysical and epistemological views. In more detail, their economic theory is

composed by a theoretical framework that tries to offer an explanation of the dynamic of the economic changes by the means of empirical investigation. For this reason it is possible to apply Karl Popper's view of philosophy of science because Nelson part of the economics evolutionary theory is focused on the importance of empirical investigation and the Winter part inspired by Hodgson, indeed, is on the necessity to built up a testable hypotheses. In conclusion, it is possible to affirm that these two spirits of their economic evolutionary theory could be seen complementary in theorizing social science.

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