
Revista de la Facultad de Ciencias Económicas: Investigación y Reflexión
ISSN: 0121-6805
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Colombia

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CONTRIBUTIONS OF PHILOSOPHY OF SCIENCE, IN THE PERSPECTIVE OF POPPER AND LAKATOS, FOR THE STUDY OF INNOVATION: AN ANALYSIS OF THE NEOCLASSICAL SCHUMPETERIAN AND NEO-SCHUMPETERIAN THEORIES
Revista de la Facultad de Ciencias Económicas: Investigación y Reflexión, vol. XXVI, núm. 1, junio, 2018, pp. 9-25
Universidad Militar Nueva Granada
Bogotá, Colombia

# CONTRIBUTIONS OF PHILOSOPHY OF SCIENCE, IN THE PERSPECTIVE OF POPPER AND LAKATOS, FOR THE STUDY OF INNOVATION: AN ANALYSIS OF THE NEOCLASSICAL SCHUMPETERIAN AND NEO-SCHUMPETERIAN THEORIES*

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*Recibido/ Received/ Recebido: 03/02/2017 - Aceptado/ Accepted / Aprovado: 28/02/2017*

## Abstract

The Schumpeterian and neo-schumpeterian theories represent pillars on which the subject of innovation developed and gained expression. Moreover, innovation is an independent area both in national and international congresses. The objective of this essay is to investigate – from two criteria of delimitation (Popper and Lakatos) – the scientificity of innovation theory. Innovation is analyzed from three macro themes: (i) the neoclassical current of economic theory; (ii) the introduction of innovation theory and reviews of the more recent Schumpeter manuscripts; (iii) the contributions brought by the neo-chumpeterian innovation current. In concluding that the subject of innovation as analyzed meets the criteria listed to categorize the scientificity according to Popper and Lakatos, implications for the field of innovation studies are discussed, such as the construction/transmission of knowledge, the escape from "common sense", and the use of the "method" as a resource for building scientific knowledge.
**Keywords:** *Innovation; Economic theory; Criteria for Scientific Demarcation; Schumpeter; Falsificationism; Research Programs.*

# CONTRIBUCIONES DE LA FILOSOFÍA DE LA CIENCIA, EN LA PERSPECTIVA DE POPPER Y LAKATOS, PARA EL ESTUDIO DE LA INNOVACIÓN: UN ANÁLISIS DE LAS TEORÍAS NEOCLÁSICA SCHUMPETERIANA Y NEO-SCHUMPETERIANA

## Resumen

El objetivo de este artículo es investigar –a partir de dos criterios de delimitación (Popper y Lakatos) – la cientificidad de la teoría de la innovación. La innovación se analiza a partir de tres temas macro: (i) la corriente neoclásica de la teoría económica; (ii) la introducción de la teoría de la innovación y los manuscritos más recientes de Schumpeter; y (iii) las contribuciones aportadas por la

* This is a theoretical essay fruit of a discipline of the Administration course of the Business School Graduate Program (PPAD). Pontifical Catholic University of Parana (PUCPR). The work was done in 2016.

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corriente neo-chumpeteriana de la innovación. Se concluye que el tema de la innovación responde a los criterios para categorizar la cientificidad, encontrándose que esto tiene implicaciones en el campo de los estudios sobre el tema en aspectos como: la construcción / transmisión del conocimiento, la evasión del "sentido común", y el uso del "método" como recurso para construir el conocimiento científico.
**Palabras clave:** *Innovación; Teoría económica; Criterios de cientificidad; Schumpeter; Falsacionismo; Programas de investigación científica.*

# CONTRIBUIÇÕES DA FILOSOFIA DA CIÊNCIA, NA PERSPECTIVA DE POPPER E LAKATOS, PARA O ESTUDO DA INOVAÇÃO: UMA ANÁLISE DAS TEORIAS NEOCLÁSSICA SCHUMPETERIANA E NEO-SCHUMPETERIANA

## Resumo

O objetivo deste artigo é pesquisar – a partir de dois critérios de delimitação (Popper e Lakatos) – a cientificidade da teoria da inovação. Analisa-se a inovação a partir de três temas macro: (i) a corrente neoclássica da teoria econômica; (ii) a introdução da teoria da inovação e dos manuscritos mais recentes de Schumpeter; e (iii) as contribuições da corrente neo-chumpeteriana da inovação. Conclui-se que o tema da inovação responde aos critérios para categorizar a cientificidade, e que isto tem implicações no campo dos estudos sobre o tema em aspectos como: a construção / transmissão do conhecimento, a evasão do "sentido comum", e o uso do "método" como recurso para construir o conhecimento científico.
**Palavras chave:** *Inovação; Teoria econômica; Critérios de cientificidade; Schumpeter; Falsacionismo; Programas de investigação científica.*

*Mussi, F., Zembro, A. & Melo, A. (2018) Contributions of Philosophy of Science, in the Perspective of Popper and Lakatos, for the Study of Innovation: An Analysis of the Neoclassical Schumpeterian and Neo-schumpeterian Theories. En: Revista de la Facultad de Ciencias Económica: Investigación y Reflexión. rev.fac.cienc.econ, XXVI (1), DOI: https://doi.org/10.18359/rfce.2740*

**JEL:** *A12, B49, O39.*

## 1. Introduction

The theme of innovation has been forming in recent times as of importance for the analysis of the economic evolution of society (Fagerberg, 2004; Baregheh, Rowley & Sambrook, 2009), as it ties to the performance of organizations and economic growth of a country (Nelson, 2006). For these reasons, the relevance of the theme in the exact sciences and applied social sciences is recognized, with emphasis on the economy and administration.

The interest in the theme emerged from the writings of Schumpeter (1982) and brought the possibility of discussing innovation in interface with other fronts, in a range of business enterprises, as well as in disciplines in academia (Baregheh, Rowley & Sambrook, 2009).

Other evidence on the representativeness of the topic can be illustrated by the number of books in the "best management practices" model, in which one of the main recommendations is the need for the company to innovate to ensure its profitability, win slices of market, differentiate from its competitors and reduce costs. These are publications of a prescriptive nature, originated following the logic of induction, along the lines of "it worked well in my company, so it may work well on yours too" (De Mattos, 2003; 2009).

The purpose of this study is to investigate – from two criteria of demarcation (Karl Popper and Imre Lakatos) – the scientificity of innovation in Schumpeterian and neo-schumpeterian perspective. Innovation is analyzed from three conceptual milestones: (a) the current of neoclassical economic theory; (b) the introduction of innovation theory and reviews of the last Schumpeter manuscripts; (c) the unfolding of the theory, entitled neo-schumpeterian current.

Considering that this work has already begun in other fields of study in Administration (Albach, 1993; De Mattos, 2009) it is hoped that with this essay we can initiate the discussion in the field of innovation, (i) contributing to the strengthening of the bases of philosophy of science bases of these two authors (Popper and Lakatos); (ii) discussing and bringing improvements both to the reflection and understanding of the sub-area of innovation per se; (iii) and complementing a discussion already begun on how much administration (and the sub-areas that compose it) can or cannot be considered a science.

In the light of the above considerations, this paper begins by discussing the contributions of Karl Popper and Imre Lakatos to the philosophy of science, as well as the notes of their respective criteria of scientific demarcation. In the sequence, the macrothemes of innovation are presented and an analysis is carried out regarding its scientificity. Lastly, the final considerations are presented.

## 2. Theoretical framework

### 2.1. Karl Popper and falsificationism

Popper is among the most influential philosophers of science of the twentieth century. Its counterposition to Hume's induction, in which the number of consecutive confirmatory observations on a particular phenomenon would be sufficient condition for proposing a universal theory, has made the logic of scientific research not revolve around verifying the veracity of theories and laws, but in the verification of its falsifiability (Persson, 2016). Popper argues that it would be impossible to confirm that a law or theory would be true, even if its repetition would lead one to believe it. The scientist should then be guided by the denial of what was being observed. This perspective shift brought a reversal in the way of doing science (Popper, 1975).

This change responds the need for standard and systematic scientific methods so that the evolution of science could be accepted and confronted in a coherence way. Thus, Popper's writings influenced several scholars (Lakatos & Musgrave, 1979) and, in his words, "no test statement would justify the assertion that a universal explanatory theory is true" (Popper 1975, p.18). Popper, then, defends the hypothetical deductive method for the execution of theoretical work, which consists of testing laws or theories in order to try to falsify it. However, for this to be possible, it is important that general law, hypothesis, conjecture or supposition be falsifiable, in order that it must be clear and non-tautological (Popper, 1975).

The higher the numbers of unproven tests of a theory, the greater its degree of corroboration, making the theory in question be considered strong. However, all statements are provisional, and it can't be claim that such a theory will last forever. Thus, more falsification tests will continue to be made. To illustrate, Popper uses Darwinism with metaphor (Persson, 2016, p.3):

Organisms have expectations, if frustrated they die, unlike the cientists whose hypothesis dies in their stead. And just as a species cannot be assured of an infinite life, a scientific theory can never once and for all be verified, but its reliability is provisional.

According the concept of 'corroboration' of a theory established by Popper (1975), in a certain period 't', the following points are regarded: (a) the way in which the theory solves the problem; (B) the degree of testability ( the theory must be necessarily tested); (C) the rigor of the tests that the theory suffered (the more severe the tests, the more robust the theory); (D) how the theory reacted to the tests. After assessing those criteria, the theory is chosen - among its rivals - because it has a greater "degree of corroboration" than the others (Collodel, 2016).

However, the ideas defended by Popper had also evolved, seeking to improve the defined concepts

and fill the gaps. Lakatos & Musgrave (1979), admittedly adept at Popper's conceptions, had presented a series of concepts that guided the discussion of Popper's falsificationism, the progress of science, and its demarcation criteria. Among the concepts presented, we can highlight:

- Dogmatic falsificationism: admits the fallibility of all scientific theories without qualification, but maintains an infallible empirical basis (theories are judged from empirical evidence). In this perspective, the advance of science would happen on the basis of successive refutations of theories through the observation of concrete facts;

- Methodological falsificationism: the falsificationist understands that in the scientist's experimental techniques fallible theories are involved, in light of which he interprets the facts. This type of falsificationism, according to Lakatos and Musgrave (1979, p. 133) "opens new avenues for criticism: a much greater number of theories can be described as" scientific. "The question that reverberates here is that if the theory should not be discarded on the first time it is falsified, when it should be? Thus, "The falsificationist finds himself in a serious situation when it comes time to decide where to draw the boundaries" (Lakatos & Musgrave 1979, 135);

- Sophisticated falsificationism: considered a theoretical advance in relation to the previous item, it emphasizes the criteria of demarcation that will serve to classify a theory as scientific. The theory is scientific when it has a surplus of empirical content corroborated in relation to the theory that precedes it.

The formulation of research problems, according to Chalmers (1993), is related to the study of phenomena that should be understood from the formulation of hypotheses, which will be reviewed and tested. If a hypothesis remains successful for a long period of time and - eventually - becomes falsified, a new research problem arises. This shift, between one problem and another illustrates the advances of science. From the new problem, new hypotheses will be needed, and these will be retested. It is assumed, then, that science advances through successive attempts to explain concrete phenomena based on particular hypotheses (Chalmers, 1993). In addition, some requirements are necessary so that the hypotheses, in addition to being falsifiable, have the potential to evolve the research: (A) Based on Theories; (B) Have clarity and precision; (C) The amplitude level of the statement, considering that the best theory, behind the hypothesis, is one that presents more precise and broad statements about specific phenomena, and still resists falsification.

### 2.2. Imre Lakatos and the research programs

Lakatos is known for presenting a proposal to expand the scope of scientific research, extending the unit of analysis of an isolated scientific theory for the study of research programs, which, according to him, would be composed of a nucleus, hypotheses and heuristics. Although Lakatos is an follower of Popper's conceptions, the epistemological traits of the work of the philosopher of science Thomas Kuhn are observed in his reasoning, resembling the concept of paradigm breakdown (Kuhn, 2003):

For the sophisticated (falsificationist), a scientific theory T will only be falsified if another theory T 'has been proposed with the following characteristics: (1) T' presents an excess of empirical content with respect to T; That is, it provides for new facts, ie facts unlikely to be enlightened or even prohibited by T; (2) T 'explains the previous success of T, that is, all unrefutted content of T is included (within the limits of observational error) in the contents of T'; And (3) part of the excessive T 'content is corroborated (Lakatos & Musgrave, 1979, p.142).

It is observed that the analysis fails in focus a sequence of isolated theories and turns its focus to the examination of a series of theories (T, T ', T "). According to this approach, the empirical criterion changes from agreement with the facts observed and is replaced by a better theory, referring to the one that presents new information, when compared with the previous theory, so that at least part of the informational surplus be corroborated (Collodel, 2016). This is the idea defended by Kuhn,

the difference proposed by Lakatos consists in the establishment of certain requirements attributed to the sets of theories, called by him of research programmes, in order to lead the belief that this substitution is not done in an unsystematic and irrational way. These criteria were therefore aimed at overcoming the weaknesses of the Kuhnian paradigm shift (García Jiménez, 2008).

Regarding Lakatos' observations on the differences between naive and sophisticated methodological falsificationists, it is possible to observe that one of the relevant points of the latter is to replace the concept of a theory with a series of theories. In the words of Lakatos and Musgrave (1979, p. 161), "it is a succession of theories and not an isolated theory that is evaluated as scientific or pseudo-scientific." The continuity and the set of articulated / connected concepts between theories (precursors and successors) helps to compose what is called "research programmes".

The research programme consists of methodological rules that guide researchers about which research paths need to be avoided (negative heuristics) and those that should be addressed (positive heuristics). It represents a structure formed by an irreducible nucleus of basic hypotheses of the theories that compose it, nucleus that is protected by a belt of auxiliary hypotheses and by the heuristics. The heuristic principle consists in discouraging the work on incompatible scientific theories and stimulating the work with auxiliary hypotheses (Silva, 2009).

Positive heuristics refer to an articulated set of suggestions on how to change and develop the "refuted variants" of the research programme and how to modify and improve the protective belt, that is, it points to researchers as the irreducible core of a research Program must be completed. Negative heuristics are the auxiliary hypotheses formulated to solve the anomalies and initial conditions that form the "protective belt" of the program. In this case, falsifiability can never overthrow the nucleus, but only in some auxiliary hypothesis that forms part of the protective belt (Lakatos and Musgrave, 1979).

The evaluation of the research programmes progressive when the changes in the auxiliary hypotheses that compose the protection belt give origin to the prediction of new facts.A program is degenerative when the adjustments made in the protection belt do not present the possibility of predicting a new fact, or the forecast is not confirmed. According to Lakatos and Musgrave (1979, p.164), "we only need to see, at least once in a while, that the increase in content has been corroborated retrospectively". This citation indicates a less severe and more flexible criterion (as regards the deadline, since it is not an immediate conclusion) for the evaluation of the programs. In this context, scientific revolutions occur if there are two rival research programmes and one of them progresses while the other degenerates, leading the researchers to opt for the progressive program. The following are the demarcation criteria in this paper (Table 1):

**Table 1.** Criteria of scientific demarcation of Popper (1975) and Lakatos & Musgrave (1979)

| | **Criteria** |
|---|---|
| Popper | Presentation of Scientific Problems |
| | Presentation of Problems related to Theories |
| | Presence of Hypotheses |
| | Test of Theories |
| | Promotion to criticism |
| Lakatos | Presence of related theories that form a guiding research program<br>The ability of the research program to predict new facts |

**Source:** prepared by the authors based on the references cited above

### 2.3. Analysis of Science in the Social Sciences Field

Although the scientific demarcation criteria of Popper and Lakatos are widely accepted, both authors were not exempt from harsh criticism, which, after all, is a salutary practice for the development of science. A first caveat to be made was with regard to what was understood by the authors as a science, for many of their assumptions seemed essentially directed to the field of natural sciences, which was strongly denied by Popper. However, the fact that Popper had linked falsificationism to empirical tests of hypotheses related to concrete facts, made the Social Sciences seem to be relegated to the back-

ground. Lakatos has attempted to overcome this weakness by arguing that empirical tests of reality could not be the only counterfeit method, since once counterfeiting was not proven, this would not automatically imply acceptance of theory, hypothesis, or assumption, for the error could be in the own method used. For Lakatos, the best solution would be to resort to logic, in which through the analysis of propositions, falsification could be found and this method would cover the previous one proposed by Popper (Silva, 2009).

Thus, many areas of knowledge in the social sciences field have passed (and still pass) by debates whose focus is to understand whether such areas may or may not be considered scientific, given the classical demarcation criteria. In the field of Administration, for example, there are discussions about what has been produced, about the epistemological coherence of research and of its scientific nature. Another point of this analysis lies in the fact that the Administration uses research methods and techniques from other areas of knowledge (Bunge, 1980). Albach (1993) addresses issues that prevent the Administration from being considered a science and points out the requirements that could make it a scientific area: revision of the types of enunciation and selection of objects of study, validity, objectivity and the possibility of (re) application by third parties. Some other studies that came to debate the theme are listed in table 2:

**Table 2.** Synthesis of studies that address the scientificity of Administration

| Tittle / author (s) | Objective | Results |
|---|---|---|
| Management as practice-oriented science<br><br>(Johann & Duclós, 2013) | Discuss the feasibility of conceptualizing Administration as a science. | It was not possible to claim the hypothesis that Administration is a science. |
| Is the Administration a science? Epistemological reflections on his scientificity (Damke, Walter & da Silva, 2010) | It discusses the scientificity of the Administration. | It was concluded that Administration, as a theory of knowledge, can be considered a science before the possibility of distorting the existing studies, according to Popper´s sophisticated falsificationism theory; to meet the assumptions of Kuhn's paradigmatic science, although there is no consensus about the stage that the field is. |
| The scientificity of<br><br>Administration in debate (Taffarel & da Silva, 2015) | The main arguments regarding the recognition of scientificity in Administration are presented with the objective of deepening the discussions and clarifying the possible contradictions. | Reasons for some authors not to recognize the scientificity of Administration: (a) the area consists of only an application of other sciences; (B) its theories are vague and haslittle applicability; (C) its scholarship is directed only at practice. Reasons for the area to be considered a science: it is an area based on the philosophy of science and the criteria of scientific demarcation. |
| Administration: reflections on ts scientificity<br><br>(Dos Reis, Colla & Cruz, 2013) | Investigate what needs to be taken into account in order for Administration to be considered a science. | It is suggested that the current stage is of a near-science or pre-science. |
| Rethingking Administration as a science: a theoretical essay (Gomes et al., 2013) | Rethinking Social Sciences and especially Administration as a scientific field. | It can be said that Administration is a science, and must enjoy the same status of Natural Sciences. |
| A critical-epistemological analysis of Administration: construction, reconstruction and deconstruction? (Martins, Rocha & Cruz, 2011) | Answer if Administration is a science. | One can not say that there is a proper theory of administrative knowledge, in Kuhn´s paradigmatic sense or in the hard core following Lakatos, in which case, it can not be considered a science. |

**Source:** Prepared by the authors based on literature review

From the studies cited, it is perceived that the debate still seems far from a consensus and this is not something restricted to the field of Administration. In Economics, the discussion about its scientific nature and the need to follow a standard of norms is not very different either. Like most fields of knowledge, there is a concern with standardization in order to have valid results as is expected of a science field. However, some authors criticize this exacerbated concern, emphasizing that Economics should prioritize other issues (Boldyrev, 2012, p.3):

> *There are authors who (tend to) analyse economics in order to produce a coherent conceptual model of scientific practice and amend the general philosophical ideas of scientific knowledge, causality etc., and the authors who are primarily interested in how economics is embedded in the social world and influences it.*

Thus, some authors argue that, because Economics is a field of social knowledge, external philosophical questions should be relegated to the background. Boldyrev (2012, p. 5) goes on to make an even more compelling criticism:

> *Whenever one advances a normative account (i.e. states how science should proceed to achieve the best results), one implicitly presupposes that one in fact possesses these results. The same applies to the external criterion of truthfulness: if one can judge what is true, it means that the truth has been found and that one does not need to continue searching. Of course, one must break this familiar circle […]*

In any case, there is still no accepted understanding in the field of economics as to what would be the correct way to set aside external philosophical norms. For the time being, the criteria of Popper and Lakatos are still accepted by the great majority of scientific communities, since it still argues the need to define directions that are common to all (Silva, 2009).

With respect to the classical theories of innovation, in view of its trajectory, some of its properties also fit into the frameworks of scientificity analysis proposed by the classical theoreticians of the philosophy of science studied here: Popper and Lakatos. The next sections proposed macro-themes of innovation in the light of contributions from the abovementioned authors, seeking - where possible - interpreting them.

## 3. Macro Themes

### 3.1. Historical context and the neoclassical theory

The idea of circular flow, predominant in the periods prior to Schumpeter, belongs to the current of thought of the neoclassical theory. Approximately in the mid-nineteenth century, not only England, but much of the European continent was undergoing a phase of maturation and evolution of its industrialization process. At this stage, known as the "Second Industrial Revolution", the companies were characterized as a single plant firm, specialized in a narrow range of activities (Tigre, 1998; 2006).

Despite the innumerable implications of using innovations in the productive sphere, the prevailing theory still regarded technology as exogenous. The industrial dynamics of this period constituted the reference for the development of the neoclassical theory of (nearly) perfect competition and economic development. Some points, taken as premises of the theory (Pindyck & Rubinfeld, 2002), reinforced the concept of linearity in economic development and circular flow.

Considering Walrasian general equilibrium theory, one of the first attempts by neoclassical economists to explain the dynamics of supply, demand and price formation for a complete economy, Weintraub (1988) identified what could be considered the irreducible nucleus of this specific theory, in addition to the positive heuristics and the negative heuristics, which according to Lakatos could form a research program, which can be verified in Table 3:

**Table 3.** Suggestion of composition of the research program of neoclassical microeconomic theory

| | |
|---|---|
| **The hard nucleus assumptions** | HC1. There are economic agents;<br>HC2. Agents have preferences over outcomes;<br>HC3. Agents independently optimize subject to constraints;<br>HC4. Choices are made in interrelated markets;<br>HC5. Agents have full relevant knowledge;<br>HC6. Observable economic outcomes are coordinated, so they must be discussed with reference to equilibrium theories. |
| **Positive heuristics** | PH1. Go forth and construct theories in which economic agents optimize;<br>PH2. Build theories that make predictions about changes in equilibrium states; |
| **Negative heuristics** | NH1. Do not build theories in which irrational behavior plays any role;<br>NH2. Do not build theories in which equilibrium has no meaning;<br>NH3. Do not test hard core propositions. |

**Source:** Weintraub (1988, pp. 166-167).

Under these conditions, the absence of the agent that promotes innovation can be observed (Schumpeter, 1982), given the admission of hypotheses HC1, HC2, HC3, HC4, HC5 e HC6. According to Martini (2014: 8), *"empirical evidence would test the possibilities of applying the general equilibrium, but not its basic hypotheses"*. Considering the lakatosian logic, while this irreducible nucleus remains intact, the research program remains valid. For the progress of economics, as a science, the researcher must be guided by heuristics. When changes occur in the auxiliary hypotheses (heuristics) capable of predicting new facts, Lakatos says that the program is progressive.

The microeconomic foundations highlighted – at the time – could be transplanted into the macro sphere. The first neoclassical author explaining macroeconomic growth was Solow (1956). In his model, he focuses on the causes of growth *per capita*: population growth would reduce the balance, savings would enable the increase of growth *per capita*, but not economic development as a whole. The only way to enable sustainable growth, both *per capita* and total, would be technological development, which would take place exogenously (Solow, 1956). It is valid to assert, then, that economic growth could only occur through the natural growth of the population and of aggregated savings, should a technology foreign to the industries not emerge.

From the perspective of Popper's (1975) criteria, it is observed that the Walrasian general equilibrium theory, one of the foundations of classical microeconomic theory, has gaps that could not possibly be falsified. In addition, the research program showed signs of degeneration, also because it could not explain new facts (Lakatos & Musgrave, 1979). Even so, neoclassical theory remained the main explanation for economic growth in the absence of a new theory / new research program. In this respect, it can be deduced that there is some convergence between the thinking of the authors used in this essay, in the sense that the abandonment of the theory / program can only occur when another theory / program demonstrates greater corroboration power.

### *3.1.1. Breakup of the circular flow*

At the heart of economic neoclassical thinking, marked by the functionalist view of its epistemological paradigm, were the technicist and traditionalist

visions. This functionalist epistemological paradigm posited neoclassical perspective as a super-simplification of reality. Thus the more dynamic and organic visions of organizations as open systems in constant interaction with the surrounding environment and interacting with other already implanted organizations seem simply non-existant. This interpretive limitation was latent, as Winter & Nelson (1982, p. 147) point out when stating that "[...] the way formal economic theory was developing at the beginning of the century tended to exclude interest in innovation and economic development ", focusing only on solutions and explanations of static economic problems. Sraffa (1988) posed solid questions about neoclassical theory, observing in some industrial configurations the presence of differentiated products, economies of scale, and consequently individual decreasing costs.

The hypothesis raised by Schumpeter is that every development process rests on a preceding evolution, based on spontaneous and non-linear alterations that unbalance the state of the existing flow. This hypothesis contained in itself a content of corroboration superior to neoclassical theory (Popper, 1975). Lekachman (1973, p. 365) interpreting Schumpeter's work, stated that economic progress and wars, revolutions and discoveries of gold could cause changes in the invariable course of circular flow, but "the dynamizing agent of the economic cycle was innovation".

Briefly, the ruptures of the circular flow were, in the first instance, authored by the innovative entrepreneur who identified opportunities that emerged in the economic environment and undertook them. Therefore, the flow is not static, it is involved in a dynamic process of evolution. It is observed that the neoclassical theory of circular flow has been replaced by the theory that the flow is neither linear nor circular, it is dynamic and has, at times, abrupt ruptures that extend its reach (with respect to economic productivity, and also about uncertainty and imbalance, for example with regard to unemployment) through the introduction of one of the forms of innovation (Schumpeter, 1982). It is important to note that these abrupt changes occur under certain circumstances and at some times, most likely after long periods of incremental change. However, the great legacy here is to admit that these abrupt changes also occur and that development can not be regarded as uniquely linear. Such changes in perspectives evidence the substitution of the theory T by T' (Popper, 1975).

### 3.2. Schumpeterian innovation theory

Innovation is understood, in essence, as the introduction of new combinations of products or economically viable processes (Schumpeter, 1982), as well as the dynamising mechanism of the economic cycle (Lekachman, 1973). Regarding the definition of the Kotsemir innovation concept, Abroskin and Meissner add:

> *Innovation is related to changes (on large (radical) or small (incremental) scales) that have a significant impact on structural changes in individual industries and market segments. In this approach, new production methods are not necessarily based on new scientific discoveries.* (Kotsemir, Abroskin & Meissner, 2013, p.4)

In this way, not only the introduction of new technologies will motivate the entrepreneur to innovate, but also the search for solutions or other incremental improvements.

Although the new combinations may come from firms that control the production process, Schumpeter (1982) argues that it is often the new firms that disrupt the existing models, influencing not only economic but also social discontinuities. From the consolidation of Schumpeter's proposals, it is possible to replace the neoclassical research program with the research program based on innovation. The new assumptions would then be (Table 4):

**Table 4.** New search program

| | |
|---|---|
| **The hard nucleus suppositions** | HC1: Technology is not exogenous to the firm;<br>HC2: Innovation can take place inside the firm;<br>HC3: Innovation involves risks and uncertainties;<br>HC4: To be an innovation, the product / service or process must be economically / commercially viable;<br>HC5: Innovation allows product differentiation;<br>HC6: Innovation is not a static but a dynamic process;<br>HC7: Innovation can lead to productivity gains;<br>HC8: Innovation can generate a temporary monopoly for the firm, enabling it to earn monopoly profits for a given period. |
| **Positive heuristics** | PH1. Work on theories by considering that organizations take risks to get into privileged positions in certain markets;<br>PH2. Work with theories that consider market balance as something temporary and fragile; |
| **Negative heuristics** | NH1. Do not work with theories that consider the market as static. |

**Source:** Based on the premises and definitions of Schumpeterian Innovation Theory (Schumpeter, 1982)

The hard nucleus assumptions of Schumpeter's Theory of Innovation correspond to the immutable aspect of the theory, hence the nucleus designation and the need for it to be protected by heuristics. Unlike the Neoclassical Theory, technology no longer appears in this theory as something so exogenous to the company. From this theory, it is understood that the technology is developed by the company as well, which gives it a greater capacity for innovation (at that time the paradigm of open innovation was not yet used). Further assumptions reflect the importance that innovation can have for companies, emphasizing its benefits, as well as the emphasis on the risks involved in the innovation process. According to Schumpeter (1982), the simultaneous and uninterrupted diffusion and penetration of innovations of a technical nature among sectors, evaluated from the economic sphere, contributes to the promotion of imbalances in the trajectory of economic growth.

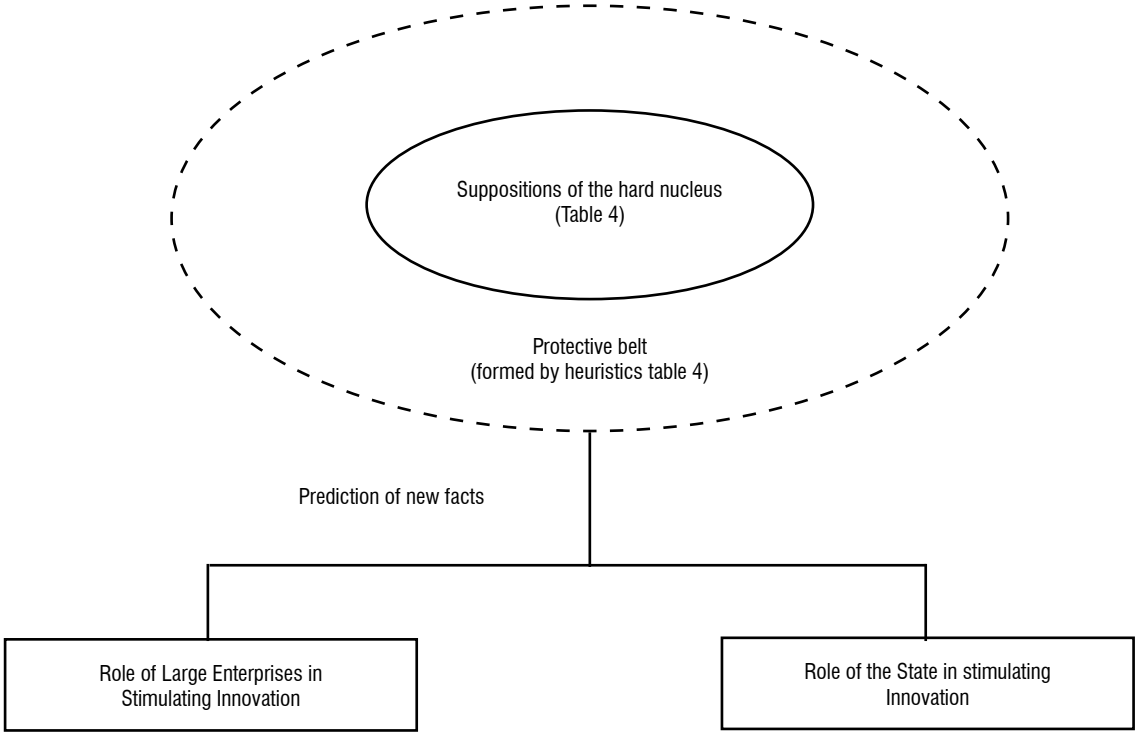
### *3.2.1. Introduction of hypotheses: the role of the State and that of large companies*

In the article entitled *Economic Theory and Entrepreneurial History*, Schumpeter (1982) revisits his writings on the subject of innovation. The author noted that crediting the innovative capacity of small entrepreneurial companies as the exclusive agents of revolution in productivity and efficiency of economies would be a fallacy, since variables such as the distance from the country, to the location of the company in the technological frontier or its degree of financial development affect directly the design of structural and macroeconomic policies designed to promote growth (Aghion & Festré, 2017). Thus, even in free market countries, the structure and economic development can influence subsequent economic and technological growth, which will naturally affect companies. Therefore, these issues cannot be considered as the only driving force of the innovation process.

However, it is important to note that there is no consensus on this argument. There are many studies (Aghion & Festré, 2017), whose cross-country regression finds no relation between state policy and economic growth, as well as jumps caused by the introduction of innovations. Analyzing the classical theory of Schumpeterian Innovation from a lakatosian perspective, the research program can

be considered progressive, since changes in the auxiliary hypotheses that make up the protection belt gave rise to the prediction of new facts. That is to say, themes such as "Role of big companies in stimulating innovation" and "Role of the State in stimulating innovation", which were not a priori defined in the basic assumptions of the Schumpeterian Innovation Theory, started to be discussed, due the evolution of the research program has made this debate relevant, demonstrating the potential of the program to discuss new developments, as image 1 demonstrates, the following:

**Image 1.** Progressive Research Program - Schumpeterian Innovation Theory




**Source:** prepared by authors based on Lakatos and Musgrave (1979)

### 3.3. Neo-Schumpeterian thinking

In Neo-Schumpeterian thought, in addition to the evolution of assumptions in the sense of no longer crediting innovation to factors essentially exogenous to companies (Neoclassical Theory), there is an evolution in relation to Schumpeterian thinking, in the sense of recognizing other aspects related to the innovation process.

One of the analyzes related to the neo-Schumpeterian theory, concerns the idea that there are no entrepreneurs or business organizations in isolation: both are inserted in a broader context, expanding to the notion of systemic reality: innovation is treated as a Systemic phenomenon, with a more complex, non-linear and interactive approach that allows technological evolution in spheres that transcend the individual scope of the organization. This systemic notion, in turn, leads to the belief that any change in the system, even if only by the action of one company, could have repercussion in all others, at least in those that are part of the same industry (Erixon, 2014).

The systemic view of Innovation has given way to so-called evolutionary economists, also adept at Darwin's conceptions. According this conception, companies that were not adapted to the new challenges of the market, like, for example, the need for innovation, would be more likely to disappear from the environment, because the system would be in charge of selecting the most suitable companies (Erixon, 2014). Differently from the biological criteria, in this case companies could adapt if they were dedicated to this through investment in knowledge and other attributes also necessary for that process of change to occur. In this way, external factors (competition, new technologies, market pressure, etc.) as well as internal factors (crises and low profits, for example), can influence the company to undertake this process of change,. Thus, the neo-Schumpeterian conception does not advocate environmental determinism; on the contrary, the decision to undertake an innovation process depends on the characteristics of the selective environment, which in turn is influenced by the technological change itself, then introducing the perception of a co- Evolution between the technological change and the selective environment (Winter & Nelsson, 1982).

Winter & Nelson (1982) use, as an assumption, the dynamism of the economic environment, which forces business organizations to work in conditions of uncertainty and, at the same time, creates the need to maximize their choices. This dynamic implies changes in the company's routines, illustrating the evolutionary process that is likely to occur. This evolutionary process concerns the way in which the company behaves in the industry in which it operates. The idea is based on the argument advocated by the evolutionary economists, which is to say that the companies that most respond to market demands and the influences of the system will be better able to survive. As discussed earlier, this is not deterministic since any firm may decide to try to participate in the adaptive process, provided it is willing to invest and endure the inherent risks presents in the process. In addition to Darwin's conceptions, another assumption present in neo-Schumpeterian theory is the limited rationality (Simon, 1965), which concerns the limitations of individuals and companies in the decision-making process. That is, the neo-Schumpeterian theory assert that there is no perfect knowledge about economic structure and access to information does not occur uniformly either. These differences should be evaluated by companies as they influence the risks inherent in innovation processes.

Another relevant contribution to the neo-schumpeterian current is given by Dosi (2006). The author presents a series of criticisms of the classic approaches to the emergence of innovation, especially about the linearity (or unidirectionality) of the scientific explanations concerning the innovative process, particularly those that assume that the market is determinant for the emergence of these innovations. The alternative proposal of interpretation of Dosi (2006) starts from the understanding of the current technological paradigms, which in turn, were not consolidated exclusively by any of the two approaches above, but by the role played by economic and institutional factors. In addition to the discussion about what motivates the emergence of the innovation process and how it develops or how it affects economic growth, Dosi, Fagiolo & Roventini (2010) point out the problems that this type of growth may cause. For these authors, economic growth can not be maintained exclusively by a "Schumpeterian" motor, since in general terms the answer is negative, especially considering the unemployment rates that this ungoverned growth may cause. Therefore, they argue that this growth must also have a "Keynesian" engine, in order to generate a demand for this economic growth, so that growth occurs together, in order to have a long-term vision that can to sustain. One of the forces with which this "Keynesian" engine can manifest itself is through fiscal public policies.

Thus, due the new ideas considered in the neo-Schumpeterian view, the main features can be summarized in the following points: (A) technological change is a fundamental force inshaping the patterns of economic transformation; (B) there are some dynamic adjustment mechanisms, which are radically different in nature from the referred allocation mechanisms postulated by the neoclassical theory; (C) there will always be socio-institu-

tional influences, which can - at times - facilitate or delay a given dynamic process of technological and structural change, and these acceleration or delay effects are related not only to market imperfections, but to the very nature of the markets themselves.

From the consolidation of the neo-schumpeterian proposals, complements and substitutions are suggested to the Schumpeterian research program, whose new assumptions added to the hard nucleus of the Theory (Lakatos & Musgrave, 1979) would be (Table 5):

**Table 5.** Suppositions complementary to the neo-Schumpterian research program

| | |
|---|---|
| **The additional hard nucleus suppositions** | HC 1: The rationality of agents is limited;<br>HC 2: The access and processing of information are costly;<br>HC 3: There is no perfect knowledge about the economic structure;<br>HC 4: Totally planned behavior is not consistent with free will;<br>HC 5: The idea of maximization ignores the decision-making structure of firms;<br>HC 6: The agents do not have uniform access to technology, nor the ability to launch innovations;<br>HC 7: Technical and institutional changes come to be addressed at the heart of economic analysis and policy formation, and no longer as exogenous and residual matters;<br>HC 8: Innovation is seen as related to research, discovery, experimentation, development, imitation and adoption of new products, new production processes, and even new organizational arrangements;<br>HC 9: Innovative activities and technological complexity point to the attribution of innovation in favor of more formal organizations (universities, research and development laboratories, and large corporations) as opposed to innovative individuals;<br>HC10: In an evolutionary environment, an industry will never achieve neoclassical balance and perfect knowledge, even in the long run. |

**Note:** HC1, HC3, HC4 and HC10: Simon's contribution (1965) is that the risks inherent in the limitations of the lack of knowledge or training of agents and companies to undertake the processes are admitted in this theory of innovation; HC2, HC5 and HC6: In addition to the limited rationality, the structure of the companies is not always adequate to endure all the costs and risks inherent to the innovation process, since even the capture of information and the processing of information are costly acts (Dosi, Fagiolo & Roventini, 2010); HC7, HC8 and HC9: Assumptions arising from the observation of how the innovation process has developed, according to Winter & Nelson (1982)

**Source:** Prepared based on Simon (1965); Dosi, Fagiolo & Roventini (2010) and Winter & Nelson (1982)

## 4. Final Considerations and Notes

This paper aimed to analyze the Theory of Innovation, based on the discussion of the macro themes suggested, referenced as principles (pillars) of the theory of innovation, from the perspective of the classic criteria of scientific demarcation, established by Popper and Lakatos. It is suggested here that the demarcation criteria discussed may facilitate the task of defining whether or not a particular subject has scientific characteristics.

The following questions may help scholars to rediscover the construction / transmission of scientific knowledge in the management disciplines that make use of this theme, as well as verify how the interface operates bewteen this theme and others, whose development has occurred based on the Schumpeterian theory or the unfolding of the Neoschumpterian current: (i) as a precursor theory as analyzed in this study, how have its developments preserved the traces of identified scientificity? (ii) how does the transmission of this knowledge takes

place in disciplines predominantly elaborated under the perspective of problem solving, which seeks achieving efficiency and effectiveness? Still in this context, we discuss the problem of the flight from 'common sense', and from the use of the 'method' as a resource for building scientific knowledge with rigor, be it as regards the tests by which the theories must pass to assure its robustness (Popper, 1975) or be it in the prediction of new facts through applied research programs (Lakatos & Musgrave, 1979).

From thePopper's perspective, the use of the hypothetical deductive method could corroborate statements linked to the Schumpeterian and neo-chumpeterian theory of innovation and reject statements related to neoclassical theory. According Popper suggests in the continuity of his work, new facts are corroborated by the theory of innovation in its beginning and during its evolution. Following Popper's proposal, this theory should be undergo more rigorous testing. In this way, and considering the dynamicity of the tests in the 'Popperian´ conception, the *Schumpeterian* and neo-chumpeterian theory can still be considered scientific.

Based on Lakatos' point of view, the theme addressed here contemplates the characteristics that the author uses to conceptualize a progressive research program, which possesses an excess of corroborated contents in relation to the program of which the neoclassical theory is inserted. It is also added the demosntration of how auxiliary hypotheses, from the writings of Schumpeter, such as the role of the state and of large companies expanded the explanatory capacity of this program. From this perspective, it can be affirmed that the innovation research program meets the 'lakatosian' criteria of scientificity. Subsequently, the neo-schumpeterian theory is recognized as a source of new hypotheses. The question to be answered refers to (i) considering the neo-schumpeterins contributions to the theory of innovation as being a new research program. In the words of Lakatos (1971, p.117), "if a research program progressively explains more facts than a rival program, it 'beats' the latter, which can then be eliminated (or if preferred, archived)". Based on the analysis undertaken, the neo-schumpeterian contributions are understood as a source of expansion of the explanatory bases of innovation, its effects on the incorporation, and the adaptation of activities by companies, as well as their unfolding in the economic structure, considering for this the technical and institutional implications on the industrial framework of the sector.

Given the above, we suggest that the neo-schumpeterian current of innovation predicts new facts. For example, the competition matter is: for Szmrecsányi (2009) a central aspect of competition and some companies deliberately strive to be leaders in technological innovation, whilst others imitate the success of the leader; for Winter & Nelson (1982), competition is a dynamic process and these choices are not given, as much as their consequences are unknown, once other factors external to the firm (of technical and institutional nature) also interfere in the positioning firms will take. The Table 6 below summarizes the notes of this essay.

**Table 6.** Suggestion of demarcation for the macro themes of innovation based on Schumpeterian theory

| Conception of scientificity criterion / Author | Neoclassical theory and Schumpeterian theory | Schumpeterian theory and neo-schumpeterian theory |
|---|---|---|
| The hypothetical-deductive method proposed by falsificationism as a way of generating scientific knowledge involves the identification of a problem (to initiate the research), followed by the formulation of hypotheses that will be tested. In face of a possible rejection, a new theory will emerge (the theory's ability to be refuted or empirically tested) (Popper, 1975) | Considering the sophisticated falsificationism, it can be said that - for the conditions of the time - neoclassical theory was empirically distorted and replaced by Schumpeter's theory of innovation. Although this falsification did not imply in its complete rejection (since it serves as reference for innumerable other themes of research), innovation in the Schumpeterian perspective became the predominant theory in the theme of innovation. | Still considering the sophisticated falsificationism, it can be affirmed that the neo-schumpeterian theory, based on the contributions of Winter and Nelson (1982), and Dosi (2006), presented excess of empirical content in relation to the findings of Schumpeter, especially with respect to the technological change as a determinant force in the formation of economic transformation patterns; routines as recurrent patterns of behavior subject to change in the face of context variations; and the recognition of socio-institutional influences as facilitating forces or even hindering certain processes of technological and structural change. |
| A theory to be considered as scientific must be contained in Research Programmes, which are structures that guide future research (Lakatos & Musgrave, 1979) | Both the neoclassical (micro and macroeconomic) theory of development and the theory that replaces it (the theory of innovation), are part of research programmes, supported by a set of auxiliary hypotheses. In the case of the theory of innovation, the label of belonging to a progressive research program is also attributed, and the inclusion of new hypotheses, from later writings of Schumpeter, helped in the prediction of new facts. In this case, it's stand out the recognition of technological innovation as endogenous, capable of being conceived by the company itself. | We can affirm that the neo-schumpeterian theory of innovation replaced - without necessarily contradicting - some of the protective hypotheses of the Schumpeterian research program from, among other facts, the inclusion of the impact of technical and institutional changes at the core of the economic analysis. The expansion of its explanatory bases (elucidating new facts) is thus supported, recognizing: the impacts of technological change on industrial structures; the effects of uncertainty in companies´ decision-making as regards innovation; the mechanisms of dynamic adjustment resulting from technical and institutional changes; the importance of private ownership of innovative activities; and the use of technological opportunities by companies. |

**Source:** Prepared by the authors.

From the analysis made on this subarea of Administration, it is possible to credit scientificity to the innovation theme, by the analisys of its beginnings starting with the neoclassical theory, followed by the *Schumpeterian* theory, and finally with the *neo-schumpeterian* theory. The initial steps of the theory reproduced here illustrate part of Popper's writings on sophisticated falsificationism and of Lakatos' writings on the competition of research programmes, as well as their structure of hypotheses.

Considering, therefore, the scientific demarcation criteria used, it is verified that the pillars of the Theory of Innovation studied have the following characteristics: (a) observation and test (in a trial and error model) do not generate knowledge in the field of innovation; (B) the tests and observations are evaluated in the light of theories, so that - at the beginning of the research - they are already impregnated by theory; (C) there being no observation without theory, the impartiality of the researcher on this subject cannot be achieved; (D) confirmation of the scientificity of innovation theories is always provisional and subject to reformulation; (E) the substitution of one theory for another, or one research program for another, implies recognizing, for example, that neoclassical theory explains less than the Schumpeterian theory and that it in turn explains less and

predicts less than neo-schumpeterian theory. The fact that the Theory guides the entire process of seeking knowledge in this area does not contradict the fact that the results are scientific. This is a vital feature of the hypothetical-deductive method, followed by practically all fields of knowledge. Go to the field without a theory is something common to researchers since Induction has fallen into disuse in the scientific world. However, this predisposes the researcher to a greater need for attention so that he does not go to the field simply with the task of confirming the Theory studied, once the attempt of falsification proposed by Popper (1975), the objective is exactly the opposite.

Another necessary point is the need to consider the historical perspective of the trajectories of each theory / research program and the lens by which it is being evaluated. Such an observation is illustrated with Lowenberg (1989), who defended neoclassical economics as pertaining to a progressive research program when compared to Marxism and Institutionalism, because the latter theoretical currents do not have its explanatory power, nor do they predict new facts.

In general, this study was not intended as a final scientific answer to the analysis on the scientificity of these theories, but to arouse the debate about the construction of scientific knowledge and its demarcation criteria in this subarea of Administration, recognizing that there is a multiplicity of perspectives to evaluate the subject, and that they may all be provisional. Hands (1985, p. 83) had already recognized, for example, the problems arising from the use of Popper's unique contributions to the field of economics when he asserted:

In this literature, there seem to be two fundamental points of agreement about Popper. First, most economists take Popper's falsificationist method of bold conjecture and severe test to be the correct characterization of scientific conduct in the physical sciences. Second, most economists admit that economic theory fails miserably when judged by these same falsificationist standards.

As limitations of this research, it is worth noting that the analysis is anchored on the classical theoretical currents of Innovation Theory: Neoclassical Theory, Schumpeterian Theory and Neo-Schumpeterian Theory. However, new strands are being detected, which makes it important to study how these contemporary trends have been evolving and have been impacting Innovation Theories, from the perspective of the classic criteria of scientific demarcation. Thus, as a proposal for future research, we suggest the continuation of this research and the examination of new researches and models in the area of contemporary innovation, which demonstrate evolutions in Neo-Scumpeterian Theory thinking, as the paradigm of Open innovation, for example, without renouncing the rigor imposed by the hypothetical-deductive method and by investigating the prediction of new facts.

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