INNOVATION AS A CREATIVE RESPONSE. A REAPPRAISAL OF THE SCHUMPETERIAN LEGACY[1]

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ABSTRACT. The paper uncovers the merits of the essay "The creative response in economic history" published by Joseph Alois Schumpeter in the *Journal of Economic History* in 1947 and 'almost' forgotten since then. The correct appreciation of this Schumpeterian contribution is important to for two reasons. It enables to better understand the evolution of Schumpeter's thinking. The 1947 contribution should be regarded as the final attempt to provide a synthesis of his evolving approaches to the understanding the origins, the causes and the consequences of innovation in economics and in the economy. This 1947 essay is most important also because it portrays innovation as the result of a creative reaction conditional to the characteristics of the context into which it takes place anticipating the notion of innovation as an emergent property of system dynamics.

Key Words: Creative response; Endogenous innovation; Knowledge externalities.

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1. INTRODUCTION

The appreciation of the Schumpeterian literature has been quite selective. The 1911 book, *The Theory of Economic Development* and the 1942 *Capitalism Socialism and Democracy* have attracted much attention and actually exhausted it. Other relevant Schumpeterian contributions have been

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gradually forgotten. The crucial essay "The creative response in economic history" published in the *Journal of Economic History* in 1947 received little attention after its publication and has been forgotten since then[2] [3]. According to the Social Science Indicator the essay has received no citation in the time span 1985-2012. The other contributions and mainly the two books by Schumpeter received a total of 2400 citations in the same time interval.

This exclusion impedes the correct appreciation of the evolution of the Schumpeterian analysis of the role of innovation in economic growth and deprives economics of a framework that can accommodate in more inclusive approach the important tools of analysis elaborated by Schumpeter in almost 40 years of activity dedicated to grasping the role of innovation in the economy and in economics.

The aim of this paper is twofold: i) to highlight the merits of the 1947 essay by Schumpeter articulating the view that it should be considered the result of the successful attempt by Schumpeter to synthesize, into a single integrated and coherent framework, the main results of his life work on the role of innovation in the economy and in economics; ii) to show how the notion of innovation as the result of a creative reaction, conditional to the characteristics of the system provides the foundations the new understanding of innovation as an emergent property of system dynamics.

The paper is organized as it follows. Section 2 summarizes the main contributions of the 1947 essay. Section 3 puts it in the context of the other Schumpeterian contributions and exhibits its coherence and complementarity providing the elements to regard it as the synthesis of Schumpeter's life long analysis of innovation. Section 4 shows its implications for understanding innovation as an emergent property of system dynamics. The conclusions summarize the main results of the analysis.

2. INNOVATION AS A CREATIVE RESPONSE

[2] The outstanding work of Esben Andersen (2009) and Clemence (1989) can be considered among the few exceptions. Clemence reprinted the 1947 article in 1989 (Clemence, 1989, 221-31).

[3] Together with the companion essay: Schumpeter, J.A. 1947a, Theoretical problems of economic growth, *Journal of Economic History* 7, (Suppl.), 1-9.

The 1947 essay proposes four crucial innovation arguments: a) the distinction between adaptive and creative responses; b) the role of the system as the source of externalities in determining whether the response will be creative or adaptive; c) analysis of the causes of mismatches; d) the historic and complex character of economic processes. Let us analyze them in turn.

Adaptive versus creative responses. As Schumpeter notes: “What has not been adequately appreciated among theorists is the distinction between different kinds of reaction to changes in "condition." Whenever an economy or a sector of an economy adapts itself to a change in its data in the way that traditional theory describes, whenever, that is, an economy reacts to an increase in population by simply adding the new brains and hands to the working force in the existing employments, or an industry reacts to a protective duty by expansion within its existing practice, we may speak of the development as adaptive response. And whenever the economy or an industry or some firms in an industry do something else, something that is outside of the range of existing practice, we may speak of creative response.” (Schumpeter, 1947,149-150).

At each point in time, firms make plans, based on expectations, related to organizing their production activity. When and if expectations are not fulfilled because product and factor market conditions differ from the expected ones, the firm will experience mismatch. These mismatches can be both positive and negative for performance: firms may discover they are losing money or making extra profits. Both affect the viability of existing routines. Schumpeterian firms, similar to any textbook firm, have the capability to try to react. The capability to react is a basic component of the standard theory of production. In the received tradition of standard microeconomics, however, this reaction can be only passive or adaptive. The reaction of Schumpeterian firms can be both adaptive and creative.

The textbook adaptive response consists of technical changes to the existing map of isoquants. Textbook firms adjust to the new conditions in the market place by changing the levels of their outputs and inputs and their combinations. They relocate on the existing map either to adjust factor intensity if changes affect relative factor costs, or to adjust output levels if

changes affect the desired levels of output, or both. The outcome of an adaptive response is compatible with a standard general equilibrium. An adaptive response is nothing more than a textbook adjustment to an exogenous shock.

A creative response assumes that the firm can change its technology, and hence reshape the map of isoquants. Technological change is a consequence of an augmented and empowered reaction capability. Schumpeter extends the standard textbook argument that firms can react beyond the limits of technical change, to include technological change. The outcome and the viability of the creative reaction, and hence the likelihood that the reaction will lead to the introduction of innovation, does not depend only on the intrinsic characteristics of the firm. The likelihood that the reaction is actually creative is not portrayed as a deterministic attribute, but rather as the result of a stochastic process that is influenced by the specific interaction between the action of the firm and the characteristics of the system.

There is a continuum between technical and technological change. Technical change is the extreme case that emerges when responses are fully adaptive. Radical technological change emerges when responses are fully creative. Between the two extremes there is a mix of technical cum technological change. The notion of response accommodates technical and technological change within a single framework as possible outcomes of the firm's reaction conditional on the characteristics of the system, and as such 'localized' (Antonelli, 2009).

Rivalry, aggregate demand and factors costs cause mismatches. As Schumpeter (1947) notes*:"* Sometimes an increase in population actually has no other effect than that predicated by classical theory-a fall in per capita real income;' but, at other times, it may have an energizing effect that induces new developments with the result that per capita real income rises. Or a protective duty may have no other effect than to increase the price of the protected commodity and, in consequence its output; but it may also induce a complete reorganization of the protected industry which eventually results in an increase in output so great as to reduce the price below its initial level." (Schumpeter, 1947, 149)

Agents may face surprises and unexpected events in both factor and product markets. Unexpected changes in factor markets, seldom considered by Schumpeter in his previous works, play a major role alongside and in combination with changes in product markets. Also, changes in the level of aggregate demand are now regarded as major causes of mismatches. Here, Schumpeter considerably extends the possible causes of the mismatches, and hence the inducement to introduce innovations. The traditional Schumpeterian emphasis on oligopolistic rivalry in product markets and consequent demand changes for each firm, as the single factor of change, is now relaxed. In addition to oligopolistic rivalry, Schumpeter (1947) includes unexpected changes in aggregate levels of demand and in factor markets, among the possible causes of mismatches.

The key role of system characteristics. As Schumpeter notes: ”Thirdly, creative response-the frequency of its occurrence in a group, its intensity and success or failure has obviously something, be that much or little, to do (a) with quality of the personnel available in a society, (b) with relative quality of personnel, that is, with quality available to a particular field of activity relative to quality available, at the same time, to others, and (c) with individual decisions, actions, and patterns of behavior.” (Schumpeter, 1947,150).

Firms are able to implement a creative response if the externalities made available by the system are sufficient to support their innovative efforts. If the system is unable to support the firm, its reaction will be adaptive. The quality of the system in terms of externalities is the crucial sorting device. The characteristics of the system determine whether the adaptive or creative response will fail or succeed. The inclusion of system characteristics as a key factor in determining the outcome of individual behavior seems to be a late discovery for Schumpeter, and the result of a final effort to bring together the different threads of his analysis in an integrated framework. The late Schumpeter is more of a system thinker than acknowledged by the received tradition according to which Schumpeter highlights the central role of entrepreneurial individuals as determining the innovation process, and the chances of economic growth and system change. The intrinsic characteristics of the system dictate the ability to innovate. Innovation depends not only on the supply of entrepreneurial agents but also on the structure and architecture of interactions and transactions of the system. The

very provision of knowledge externalities, however, is the endogenous product of the generalized participation of a large number of firms in the collective generation of technological innovation. The gales of innovations are the result of that collective and accelerated effort to react creatively to the generalized out-of-equilibrium conditions of the system. As such, these gales are as much the result of the conditions of the system as of the entrepreneurial efforts of firms.

History matters. As Schumpeter notes: “First, from the standpoint of the observer who is in full possession of all relevant facts, it can always be understood ex post; but it can practically never be understood ex ante; that is to say, it cannot be predicted by applying the ordinary rules of inference from the pre-existing acts. This is why the "how" in what has been called above the "mechanisms" must be investigated in each case. Secondly, creative response shapes the whole course of subsequent events and their "long-run" outcome. It is not true that both types of responses dominate only what the economist loves to call "transitions” leaving the ultimate outcome to be determined by the initial data. Creative response changes social and economic situations for good, or, to put it differently, it creates situations from which there is no bridge to those situations that might have emerged in its absence. This is why creative response is an essential element in the historical process; no deterministic credo avails against this.” (Schumpeter, 1947,150).

Economic and historical analyses are strictly complementary and cannot be practiced separately without major and mutual losses. It is only the combination of economics and historical analysis that makes it possible to investigate “the sadly neglected area of economic change” (1947,149). Economic processes are definitely characterized by non-ergodic dynamics. Irreversibility is an intrinsic characteristic of economic processes. Technological change is the cause of irreversibility: the equilibrium conditions before the introduction of innovation differ from the new equilibrium conditions (Antonelli, 2015).

More specifically, it is clear that for Schumpeter economic processes that necessarily consider innovation as an integral and irreducible component, are path dependent as distinct from past dependent. A process is past dependent when its non-ergodic dynamics is defined at the onset. No

characteristic of the dynamics based on irreversibility can be changed along the process. Past dependence is different from path dependence. A process is indeed path dependent when it is shaped by and affected by irreversibility. However, events along the process can affect it to change its direction, speed, intensity, and general characteristics. In all non-ergodic processes history matters. Yet it plays different roles according to the relevance of the initial conditions and the events that take place along the historic time of the process. A past dependent process is deterministic. A path dependent process in inherently stochastic (David, 2005, 2007).

3. THE GREAT SYNTHESIS

Careful reading of Schumpeter's 1947 essay suggests that this essay was a relevant attempt by Schumpeter to elaborate the final synthesis of his various contributions. From this perspective, an appreciation of the 1947 contribution opens discussion of the asserted divides and contradictions in his earlier contributions.

Inclusive reading of the full set of works by Schumpeter, suggests that the 1947 essay provides crucial clues to integrate his previous, different contributions as sequential steps that can be articulated in a single framework that enables to appreciate their complementarities rather than their contrasts. The notion of innovation as creative reaction that can take place when appropriate externalities are available does not come as a surprise in the context of the large set of Schumpeterian contributions. The notion of creative reaction conditional upon the characteristics of the system can be regarded as the result of a major attempt to synthesize within a consistent and coherent frame, the main achievements of his lifelong analysis of the role played by innovation in the economy and in economics.

This hypothesis contrasts with the dichotomist interpretation made in much of the literature, of a divide between the so-called Schumpeter Mark One and Schumpeter Mark Two. According to this body of work, Schumpeter had a radical change of mind. While his 1911 contribution considered the key characteristics of the European innovation system based on entrepreneurs and innovative bankers, the 1942 contribution reflects the key characteristics of the American innovation system based on the corporation as a portfolio of activities that enables systematic introduction of new

activities enabled by the resources available to funding for research and development provided by the extra profits stemming from the introduction of previous vintages of innovations.

According to Freeman, Clark and Soete (1982) the articulation between the 'first' and 'second' Schumpeter could be regarded as a form of complementarity rather than a historical sequence. The 1911 contribution, i.e. Schumpeter Mark One, applies to science-based industries where scientific entrepreneurs play a central role. Schumpeter Mark Two –derived from the 1942 book- would apply to oligopolistic product markets where rivalry among large corporations is based on product innovation. This interpretation has been much implemented with the notion of two different Schumpeterian regimes and inspired many empirical investigations (Malerba and Orsenigo, 1994, 1996).

In our view, the notion of innovation as a creative reaction makes it clear that Schumpeter had already reconciled the divide. With his 1947 contribution, Schumpeter finally elaborates a single framework in which innovation is considered the endogenous result of the efforts of entrepreneurs, including entrepreneurs at the head of incumbent corporations, and made possible and successful by the characteristics of the system. Careful reading of the 1947 contribution suggests that there is but a single Schumpeter who praises both the entrepreneurial action of firms able of creative reactions and the central role of the characteristics of the system in which firms are embedded, as complementary and indispensable elements to provide an integrated understanding of the innovation process (Langlois, 2007).

The dynamic process established by Schumpeter in the 1947 essay can be regarded as a major progress and a generalization of the Schumpeterian analysis elaborated in *Business Cycles*. Here Schumpeter makes clear that innovation is endogenous to the economic system: "Those acts, the formation of companies for the exploitation of the new opportunities, the setting of the new countries, the exports into and the imports from them, are part of the economic process, as they are part of economic history, and not outside of it. Again, the invention of, say, the Montgolfier balloon was not an external factor of the business situation of its time; it was, indeed, no factor at all. The same is true of all inventions as such, witness the inventions

of the antique world and the middle ages which for centuries failed to affect the current of life. As soon, however, as an invention is put into business practice, we have a process which arises from, and is an element of, the economic life of its time, and not something that acts on it from without. In no case, therefore, is invention an external factor." (Schumpeter, 1939, 15).

In the following step Schumpeter makes clear that innovation is indispensable to understand the working of economic systems: "But what dominates the picture of capitalistic life and is more than anything else responsible for our impression of a prevalence of decreasing cost, causing disequilibria, cutthroat competition and so on, is innovation, the intrusion into the system of new production functions which incessantly shift existing cost curves." (Schumpeter, 1939, 88).

In *Business Cycles* Schumpeter updates and elaborates the foundations of his approach with respect to the Walrasian approach now enriched by a new appreciation of the Marshallian contributions: "What we are doing amounts to this: we do not attack traditional theory, Walrasian or Marshallian, on its own ground. In particular, we do not take offense at its fundamental assumptions about business behavior—at the picture of prompt recognition of the data of a situation and of rational action in response to them. We know, of course, that these assumptions are very far from reality but we hold that the logical schema of that theory is yet right "in principle" and that deviations from it can be adequately taken care of by introducing friction, lags, and so on, and that they are, in fact, being taken care of, with increasing success, by recent work developing from the traditional bases. We also hold, however, that this model covers less ground than is commonly supposed and that the whole economic process cannot be adequately described by it or in terms of (secondary) deviations from it. This is satisfactory only if the process to be analyzed is cither stationary or "steadily growing" in the sense of our definition of the term Growth: any external disturbances may enter, of course, provided adaptation to them is passive. And this is equivalent to saying that the assumption that business behavior is ideally rational and prompt, and also that in principle it is the same with all firms, works tolerably well only within the precincts of tried experience and familiar motive. It breaks down as soon as we leave those precincts and allow the business community under study to be faced by new possibilities of business action which are as yet untried and about which the most complete

command of routine teaches nothing. Those differences in the behavior of different people which within those precincts account for secondary phenomena only, become essential in the sense that they now account for the outstanding features of reality and that a picture drawn on the Walras-Marshallian lines ceases to be true—even in the qualified sense in which it is true of stationary and growing processes: it misses those features, and becomes wrong in the endeavor to account by means of its own analysis for phenomena which the assumptions of that analysis exclude. The reasonable thing for us to do, therefore, seems to be to confine the traditional analysis to the ground on which we find it useful, and to adopt other assumptions—the above three—for the purpose of describing a class of facts which lies beyond that ground. In the analysis of the process dominated by these facts traditional theory, of course, still retains its place: it will describe the responses to innovation by those firms which are not innovating themselves (Schumpeter, 1939, 96).

The notion of entrepreneurship is finally clarified: it does not identify exclusively newcomers and young firms that enter the market place, but rather the specific function of introducing innovations: “For actions which consist in carrying out innovations we reserve the term Enterprise; the individuals who carry them out we call Entrepreneurs. This terminological decision is based on a historical fact and a theoretical proposition, namely, that earning out innovations is the only function which is fundamental in history and essential in theory to the type usually designated by that term. The distinction between the entrepreneur and the mere head or manager of a firm who runs it on established lines or, as both functions will often coincide in one and the same person, be-tween the entrepreneurial and the managerial function, is no more difficult than the distinction between a workman and a landowner, who may also happen to form a composite economic personality called a farmer. And surely it is but common sense to recognize that the economic function of deciding how much wool to buy for one's process of production and the function of introducing a new process of production do not stand on the same footing, either in practice or logic.” (Schumpeter, 1939, 100). The foundations of the alternative Schumpeterian regimes are deprived of a solid Schumpeterian reference: entrepreneurs can be both small, young firms and corporations.

And finally Schumpeter lays down the ‘skeleton’ of his analysis where the

search for profit is assumed to be the basic incentive to innovate: “These new commodities intrude into the economic world that existed before at a rate which will, for reasons given in the preceding chapter, be too great for smooth absorption. They intrude, nevertheless, gradually: the first entrepreneur's supply will not, in general, cause visible disturbance or be sufficient to alter the complexion of the business situation as a whole, although those firms may be immediately affected with the products of which the new commodities or the commodities produced by new methods are directly competitive. *But, as the process gathers momentum, these effects steadily gain in importance, and disequilibrium, enforcing a process of adaptation, begins to show.*[4] The nature of the effects on the "old" firms is easy to understand. It superimposes itself on the disequilibrium caused by the setting up of the new plant and equipment and the expenditure incident thereto. But while the effects of this were, even in those cases in which they spelled net losses, softened by the flow of that expenditure, the new disequilibrium enforces much more obviously difficult adaptations. They proceed not exclusively under the stimulus of loss. For some of the "old" firms new opportunities for expansion open up: the new methods or commodities create New Economic Space. But for others the emergence of the new methods means economic death; for still others, contraction and drifting into the background. Finally, there are firms and industries which are forced to undergo a difficult and painful process of modernization, rationalization and reconstruction……Profits will be eliminated, the impulse of innovation will, for the time being, have spent itself. But second, since entrepreneurial activity upsets the equilibrium of the system and since the release of the new products brings disequilibration to a head, a revision of values of all the dements of the system becomes necessary and this, for a period of time, means fluctuations and successive attempts at adaptation to changing temporary situations. This, in turn, means the impossibility of calculating costs and receipts in a satisfactory way, even if necessary margins are not altogether absent while that goes on. Hence, the difficulty of planning new things and the risk of failure are greatly increased. In order to carry out; additional innovations, it is necessary to wait until things settle down as it was in the beginning to wait for an equilibrium to be established before embarking upon the innovations the effects of which we are now discussing.” (Schumpeter, 1939, 139).

[4] Italics added

In *Business Cycles* Schumpeter argues that innovation takes place only in the proximity of equilibrium where there are no profits and the risks are too high. According to Schumpeter (1939, 169) it is clear "…. not only that the entrepreneurial impulse impinges upon an imperfectly competitive world but also that entrepreneurs and their satellites almost always find themselves in imperfectly competitive short-time situations even in an otherwise perfectly competitive world. In fact, evolution in our sense is the most powerful influence in creating such imperfections all around. Hence we now drop the assumption of perfect competition altogether, as well as the assumption, made at the threshold of this chapter, that there is perfect equilibrium at the start. We can assume, instead, that both competition and equilibrium are, independently of the effects of our process, imperfect from the start, or even that the system is inactive in the sense defined in the second chapter."

The notion of gale of innovations, introduced in *Capitalism Socialism and Democracy* is clearly based upon the analysis elaborated in *Business Cycles*. According to Schumpeter (1942 (1950, 83): "The opening up of new markets and the organizational development from the craft shop and factory to such concerns as US Steel illustrate the process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one ... [The process] must be seen in its role in the perennial gale of creative destruction; it cannot be understood on the hypothesis that there is a perennial lull". *Business Cycles* had laid down the foundations of the gales of innovations highlighting the complementarity of the efforts of myriad firms that try to react to a generalized downturn of profitability. Specifically, Schumpeter gathers historical evidence to support the hypothesis that the gales of radical innovations are introduced in downturns of long-term business cycles when investment opportunities, due to previous gales, decline. The new gales of radical innovations are the result of the collective reaction of multiple firms to the lack of profits.

In this context, the 1947 approach seems to solve the apparent contradiction of the *Theory of Economic Development* (1911/1934) whose first part is devoted to praising Walras and the general equilibrium approach, and the second part stresses the crucial role of the entrepreneur as an exogenous factor in the introduction of innovations and wreaking of creative

destruction. According to the 1947 contribution, equilibrium is possible. However, it is one of the possible outcomes that take place when the reaction of firms is adaptive as opposed to creative.

Consistently, with the 1947 contribution, Schumpeter substitutes the Walrasian framework with the Marshallian framework where production and variety precede exchange, to confirm but delimit the relevance of equilibrium (Schumpeter, 1941).

The mismatch between expectations and consequent plans, and actual market conditions is very much rooted in Marshallian analysis of the temporary partial equilibrium that emerges after production, and is far removed from the Walrasian world where production takes place after equilibrium has been identified. Marshall provides the platform for the introduction of innovation as part of the competitive and selective process that sorts out the original variety identifying the most efficient firms and technologies. A quote from his essay on Marshall seems useful here: "Marshall was one of the first economists to realize that economics is an evolutionary science (although his critics not only overlooked this element of his thought but in some instances actually indicted his economics on the very ground that it neglected the evolutionary aspect), and in particular that the human nature he professed to deal with is malleable and changing in function of changing environments." (Schumpeter, 1941, 237)

The Marshallian analysis of the competition process assumes an exogenous variety of firms and a selection process characterized by the exit of least performing firms, the growth of most efficient ones and the entry of new firms. The entry of new firms takes place because of the knowledge externalities that consist in the access to the competence of the most efficient ones. At the end of the Marshallian competition, the initial heterogeneous variety disappears and it is gradually reduced to homogeneity where only the most efficient firms survive. The representative agent is the result of the process. At a closer analysis it is clear that the Marshallian competition process yields the selection of the most performing firms because of the knowledge externalities that enables the less performing firms to imitate the most performing ones. When the selection process comes to an end, however, and the market has been able to reach equilibrium, knowledge externalities are no longer available. In Marshall knowledge externalities

are endogenous only in so far out-of-equilibrium conditions prevail. When the system reaches equilibrium conditions, no more knowledge externalities are being generated. The Schumpeterian analysis impinges directly upon the Marshallian legacy, yet it makes a key change[5]. In the Schumpeterian approach, in fact, both variety and externalities are fully endogenous. Both are constantly reproduced within the dynamics of the creative reaction. Firms that are able to react creatively generate new variety as well as new technological knowledge. The latter in turn becomes the source of new knowledge externalities (Metcalfe, 2010).

In the 1947 essay variety is no longer an exogenous attribute defined at the onset of the process, as in Marshall, but an endogenous product. Schumpeterian firms, as opposed to Marshallian firms, are expected to try to change their technology as a consequence of mismatch experienced in the marketplace. In so doing they re-create variety that is at the same time a determinant and a consequence of the process.

[5] The first attempt to integrate the Marshallian externalities into the analysis of innovation as an out-of-equilibrium process dates from the 1928 essay "*The Instability of Capitalism*" where the role of externalities in the innovation process is clearly identified: "What matters for the subject of this study is merely the essentially discontinuous character of this process, which does not lend itself to description in terms of a theory of equilibrium. But we may conveniently lead up to this by insisting for the moment on the importance of the difference between this view and what I have called the received one. Innovation, unless it consists in producing, and forcing upon the public, a new commodity, means producing at smaller cost per unit, breaking off the old "supply schedule" and starting on a new one. It is quite immaterial whether this is done by making use of a new invention or not for, on the one hand, there never has been any time when the store of scientific knowledge had yielded all it could in the way of industrial improvement, and, on the other hand, it is not the knowledge that matters, but the successful solution of the task sui generis of putting an untried method into practice-there may be, and often is, no scientific novelty involved at all, and even if it be involved, this does not make any difference to the nature of the process. And we should not only, by insisting on invention, emphasize an irrelevant point irrelevant to our set of problems, although otherwise, of course, just as relevant as, say, climate-and be thereby led away from the relevant one, but we should also be forced-to consider inventions as a case of external economies. Now this hides part of the very essence of the capitalist process. *This kind of external economies -and, in fact, nearly every kind, even the trade journal must, unless the product of collective action, be somebody's business- characteristically comes about by first being taken up by one firm or a few-by acting, that is, as an internal economy. This firm begins to undersell the others, part of which are thereby definitely pushed into the background to linger there on accumulated reserves and quasi-rents, whilst another part copies the methods of the disturber of the peace.* That this is so, we can see every day by looking at industrial life; it is precisely what goes on, what is missing in the static apparatus and what accounts both for dissatisfaction with it and for the attempts to force such phenomena into its cracking frame instead of, as we think it natural to do, recognising and explaining this as a distinct process going on along with the one handled by the static theory." (Italics added) (Schumpeter, 1928, 378-79).

Finally, Schumpeter (1939) retains the Marshallian notion of endogenous externalities. In *Business Cycles* externalities are the endogenous result of the concentration of innovative efforts that in turn stem from the exhaustion of investment opportunities and the decline of profitability based upon the previous gales of innovation. The concentration of innovative efforts engenders knowledge spillovers that support the innovation process. Once the gales have been introduced, the density of innovation efforts declines and together with them the amount knowledge of externalities shrinks. In *Business Cycles* knowledge externalities are generated within the system and do stay at given levels: they fluctuate across time and space as they are at the same time the cause and the consequence of creative reactions.

Schumpeter (1941) actually implements the Marshallian notion of endogenous externalities. In Marshall, in fact, externalities are endogenous but cannot increase beyond long-term equilibrium levels. Once the Marshallian selection process has made possible to reduce (exogenous) variety and identify the best practice, the system has reached the maximum possible output and the endogenous provision of externalities stops (Cassata and Marchionatti, 2011). The Schumpeterian process of endogenous creation of knowledge externalities is cyclical but endless as it is associated to long-term disequilibrium.[6]

The new characterization of the relationship between the Schumpeterian homo oeconomicus and innovation is substantial with respect to his previous contributions. The 1911 entrepreneur is an outsider who enters the economic system guided by animal spirit, and is possessed by the prospect of concretizing his innovative aims. In *Capitalism Society and Democracy*, innovation is the result of the strategies of incumbent corporations in

[6] See Schumpeter (1941, 242-243): "A still more significant point comes into view if we pass from the distinction static-dynamic to the distinction stationary-evolutionary. Marshall put up, somewhat regretfully as it seems, with the static nature of his apparatus but he disliked the stationary hypothesis to the point of overlooking its usefulness for some purposes. His thought ran in terms of evolutionary change—in terms of an organic, irreversible process. And something of the flavor of it he imparted to his theorems and concepts and still more to the factual observations with which he presented them. I do not think that the theory of evolution at the back of them was satisfactory. No schema can be that does not go beyond an automatic expansion of markets—an expansion not otherwise motivated than by increase of population and by saving—which then induces internal and external economies that in turn are to account for further expansion. But still it was a theory of evolution, an important development of Adam Smith's suggestions, and greatly superior to what Ricardo and Mill had to offer on the subject."

product markets. The introduction of innovation becomes a standard process that is part of the strategic management in the context of rivalry into oligopolistic product markets. The 1942 corporation is doomed to transform innovation into a routine. No surprise that the demise of capitalism and the final victory of socialism are the final consequences.

The 1947 Schumpeterian agents are not capable of long-range planning and are not able to foresee all possible future events. Entrepreneurial forces are necessary to cope with surprises and to implement creative reactions. Such entrepreneurial forces are also necessary for incumbents. Yet entrepreneurial action succeed only if and when knowledge externalities are available within the system. Close reading of the 1947 contribution suggests that the strong emphasis in the literature on the individualistic foundations of Schumpeter's analysis and the central role of entrepreneurs, should be reassessed to accommodate the new understanding of the central role of the system. The late Schumpeter is much closer to the notion of innovation as an emerging property of a system, than the scholars of the entrepreneurial animal spirit would suggest.

The 1947 contribution seems to complete the analysis of the new capitalism, opened in 1942 with the identification of the crucial loop between the creative destruction and the creative reaction. Creative destruction is the cause and the consequence of creative reaction. Creative destruction causes creative reaction because it is at the origin of the mismatches between plans and actual factor and product market conditions. Creative destruction is a consequence of creative reaction because the mismatch between planned and expected market conditions and actual ones is the direct consequence of the introduction of innovations.

The notion of innovation as the result of a creative response that is contingent upon the characteristics of the system, can be regarded as the main outcome to go beyond the limits of his previous contributions from three viewpoints.

First, innovation is not planned and is not the result of a routine. Innovation takes place as a special form of reaction to unexpected events. From this viewpoint Schumpeter was able to generalize and synthetize the analyses elaborated in *Business Cycles*: innovation is not only determined by rivalry

in monopolistic competition and profit-seeking strategies in economic systems that are close to equilibrium levels and hence zero profits, but more generally by the mismatches between expectations and actual factor and product market conditions.

Second, innovation is the result of positive feedbacks occurring in the interaction among and between firms, and the structure, organization and composition of the system. The response of firms cannot be creative in contexts that do not provide sufficient access to skills and competence. Innovation is possible only if the system is able to support the entrepreneurial efforts of the agents caught in out-of-equilibrium conditions due to unforeseeable events, through the provision of knowledge externalities. Here the analysis about the self-reinforcing mechanisms that take place in the phases of introduction of radical innovations laid down in *Business Cycles* are generalized beyond the cycle so as to characterize the general innovation process. As the *Instability of Capitalism* had already made clear, externalities are both crucial and endogenous.

Third, with *Alfred Marshall's Principles* innovation becomes part of an organic selection mechanism of endogenous variety that enables to identify the innovations that fit better in the economic system. The Schumpeterian creative response is the origin of endogenous variety, only a few innovations, out of the many introduced, are actually successful.

Fourth, technological and structural changes are intertwined and inseparable within a historical process where the past - stochastically as opposed to deterministically – affects the future path of the dynamics. The gale of innovations, introduced in *Capitalism Socialism and Democracy*, becomes a general attribute of the system dynamics.

4. TOWARDS INNOVATION AS A SYSTEM EMERGENT PROPERTY

The framework elaborated by the 1947 essay can be regarded as a platform that is able to accommodate the new developments of evolutionary complexity. In order to identify these complementarities it is necessary to make explicit a number of important assumptions that Schumpeter (1947) has made tacitly. Let us consider them in turn.

First, firms are characterized by bounded rationality that impedes the perfect forecast on the future conditions of product and factor market conditions. Firms rely upon procedural rationality that makes it possible to try and react to the evolving conditions of product and factor markets, assuming the actual consequences of the choices that have been made until that time. Procedural rationality implies, as a consequence, that weak irreversibility qualifies the decision making of firms. They can change their assets and their market conduct only within a limited range of alternatives.

Second, the reaction can be creative only if and when appropriate knowledge externalities are accessible. Innovation requires two strictly complementary conditions: the entrepreneurial vision of firms exposed to unexpected mismatches as much as the appropriate characteristics of the system into which the reaction takes place. From this viewpoint innovation is a participated activity that can succeed only when the tacit competence of a variety of agents is able to complement each other in a collective effort, integrate the economics of innovation. The new understanding of the unique features of the activities that enable the generation and use of technological knowledge for the introduction of innovations contributes to an appreciation of the crucial role of the system in which agents are embedded, in their efforts to try to react to unexpected events by innovating. The characteristics of the system can support or contrast their efforts (Antonelli and David, 2015).

Third and consequently, it is clear that the characteristics of the system are endogenous and dynamic. This in turn makes it clear that history matters for explaining the intertwining relations between the outcome of innovative efforts and the characteristics of the system but not in a deterministic way. The dynamics is non-ergodic and path dependent as opposed to past dependent.

The appreciation of these ‘tacit’ assumptions embedded in the notion of creative reaction contingent upon endogenous externalities paves the way to a new understanding of innovation as an endogenous and systemic process that can be usefully analyzed with the notion of emergent system property. The correct appreciation of the Schumpeterian legacy, and specifically the correct understanding of the evolution of his analysis, provides a major contribution to the economics of innovation as an emergent system property

articulating in an integrated frame the key notions of: i) procedural rationality based upon the notion of reaction, ii) feedback based upon knowledge interactions, iii) endogenous externalities; iv) innovation as the product of an emergent, systemic process rather than individual action, and v) non ergodic path dependent dynamics (Lane and Maxfield, 2005; Lane, Pumain, van der Leeuw, and West, 2009; Louçã, 2010; Fontana, 2010).

The prospects for important progress in the economics of innovation along these lines of enquiry are most promising: the Schumpeterian notion of creative reaction paves the way to implementing a complex evolutionary approach that can overcome the limits of both biological evolutionary approaches and new growth theory (Anderson, Arrow, Pines, 1988; Arthur, Durlauf, Lane, 1997; Arthur, 2010; Foster and Metcalfe, 2012**)**. Let us analyze them in turn.

Evolutionary approaches built upon biological metaphors are in fact unable to explain the origin and the endogenous determinants of the introduction of innovations. The implicit assumption that variety is continuously re-generated within the system by random recombination limits the scope of the economics of innovation that is no longer able to explain why is innovation is introduced but only how and possible where (Nelson and Winter, 1973 and 1982). In standard evolutionary approaches innovation, in fact, is ultimately regarded as the product of spontaneous and automatic recombinations that have no economic intentionality. In this approach technological change does not fall like manna from heaven, but share the intrinsic economic exogeneity of standard economics. Animal spirits substitute for the manna.

Standard evolutionary approaches fail to elaborate theory of endogenous innovation but succeed in providing an endogenous theory of the selective diffusion of innovations. Here the notion of dominant design, eventually elaborated by James Utterback can be regarded shows how the selection environment is able to identify and sort the innovations that fit better, out of the array of tentative innovations generated by random recombination (Utterback and Abernathy, 1975; Utterback, 1994).

The new growth theory suffers quite the same limitations. The generation of technological change and the introduction of innovations that make the

increase of total factor productivity possible take place because of the automatic and spontaneous spillover of technological knowledge that is characterized by non-exhaustibility and non-appropriability. Technological knowledge spills from knowledge producers to knowledge users that can access and use it with no efforts and no costs. Technological knowledge does not fall from heaven like manna, but shares the characteristics of the atmosphere (Romer, 1994).

The notion of innovation as an emergent system property stemming from the implementation of the Schumpeterian creative reaction contingent upon endogenous knowledge externalities can be much enriched including in an integrated frame the theories of endogenous innovations elaborated in the history of economic analysis and specifically the notion of induced technological change and the notion of demand pull. Building upon the reappraisal of the Schumpeterian legacy, innovation can be viewed as the result of the creative reaction, to unexpected mismatches between the plans elaborated by firms and the actual conditions of product and factor market evolving conditions, that is contingent on the quality and availability of endogenous knowledge externalities. Innovation cannot be any longer regarded as a resultant property i.e. a property valid both at the individual and the system level, but only as an emergent system property i.e. a property of the system into which the action of innovators takes place. The quality of the system in terms of structure of interactions and transactions among firms and between the business sector and the public scientific infrastructure including the supply of human capital is not set forever by external conditions. It is determined within the system and keeps changing. The direction of such change can both positive and negative. The generation and exploitation of technological knowledge that is necessary to the introduction of innovations may increase the amount of knowledge externalities as much as reduce it. The introduction of innovations changes the architecture, composition and organization of the system. The effects can be positive as well negative with respect to system's actual capability to support or contract the innovative efforts of agents (Antonelli, 2008, 2011, 2015).

5. CONCLUSION

The contribution by Schumpeter (1947) can be regarded as the synthesis of a long exploration into the economics of innovation in which the most important results are brought together in a consistent and very innovative frame that deserves to be fully appreciated and implemented. The 1947 contribution in fact provides a simple and yet powerful platform able to integrate within a systemic and dynamic framework, a variety of partial explanations, and provide a systematic understanding of the endogenous origin of innovation that impinges upon the identification of the notion of creative reaction as the product of two strictly complementary processes: individual –entrepreneurial- action and appropriate levels of endogenous knowledge externalities art the system level.

This achievement is quite remarkable since in the neoclassical world there is no way to explain why firms would not continuously increase their innovation activity to the point where its marginal product matches their costs. Standard evolutionary approaches have the same limits as neoclassical analysis: firms innovate by chance without any economic rationale. Evolutionary economics based upon biological metaphors explains the causes and consequences of selective adoption and diffusion of innovations rather than the causes of their introduction. New growth theory assumes that knowledge externalities are not endogenous and do not require the dedicated action of perspective users. New growth theory, like standard evolutionary economics is not able to go beyond the basic assumption that the generation of technological knowledge and the introduction of innovations are the spontaneous and automatic product of economic activity. The new knowledge economics fails to appreciate that the availability of knowledge externalities is *a necessary but not sufficient condition* for the actual introduction of innovations increase of total factor productivity. Innovations are introduced when two complementary conditions apply: i) the possibility to generate new technological knowledge at costs that below equilibrium levels, and ii) the effort of firms to generate and use it to introduce technological innovations. The analysis of the working of these to joint conditions can be implemented successfully with the notion of system emergent property.

The 1947 contribution by Schumpeter provides an integrated framework into which a new economics of innovation is able to recognize the crucial role of the collective and systemic processes that make it possible. The

notion of creative reaction, contingent upon the characteristics of the system into which it may take place, stresses the crucial role of the evolving structure and architecture of knowledge interactions and transactions that qualify system into which the reaction may be creative.

The Schumpeterian notion of innovation as a the result of a creative reaction contingent upon the endogenous and evolving characteristics of the system makes it possible to use the tools of the economic of complexity to overcome the limits of standard evolutionary and new growth theory implementing the notion of innovation as an emergent system property.

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