SESIÓN 29

Ciencia, tecnología e innovación en la Historia del pensamiento económico

Smith, Schumpeter and the so-called innovation systems: two common errors and their consequences on innovation policies

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1. Introduction

The economics of innovation has deserved throughout the last decades the preferential attention of both academics and policy makers, derived from the broad consensus about the crucial role that innovation plays as a driver of economic growth, especially in the most advanced economies.1 As a result, we find that most economic leaders —be it on the national, regional or municipal scale— bet on their speeches on innovation; that most companies define themselves as innovators and, while the term innovation has also penetrated the consumer base, that a significant number of advertisements use this word as catch—word to promote their products: and not already in sectors such as automotive, where its use may seem appropriate, but even in as mature ones as cosmetics or men's underwear.

And yet, to the extent that we advance in the study of the sources of innovation, the belief that big business ideas come from scientists or researchers who carry out systematized work in their laboratories or university departments, which are then implemented by companies thanks to public and private cooperation between universities and companies coordinated by governments seems to be obsolete (Sala—i—Martín, 2016: 94). Thus, already the study of Bhide (2000) came to show that 72 percent of the ideas that lead to an innovation came from workers not dedicated to R&D; 20 percent of the ideas derive from people (non—scientists) outside the firm; and only 8 percent of the ideas were due to formal researchers. Logically, in sectors such as robotics, ICT, automotive or biochemistry, etc. the relevance of R&D remains predominant. But it should not be forgotten that these represent, in most nations, only a relatively small part of the economy. In addition, innovations —both the product and the process— will only affect growth if they positively induce productivity, something that is not always guaranteed with the current definition of innovation that allows to include as such, for example, the implementation of a new version of software by the companies (see for a critique of innovation and R&D indicators, see Mullan, 2017).

[1] Classified by organizations such as the World Economic Forum as 'innovation driven.'

In this sense, examples such as those of Israel or Japan are paradigmatic: both are among those with the highest spending on R&D win terms of their GDP; they reach the first world positions in terms of the number of patents per capita, academic quotes, number of scientists and, in the case of Israel, of Nobel Laureates; but, nevertheless, this effort only partially translates into economic growth (see Sala—i—Martín, 2016: 95). Thus, both the Hebrew and the Japanese countries occupy positions lower than 20 in their GDP pc (ppp) in the international rankings.23
The central thesis that we expose in the present study is that the cause of this disarticulation between the R&D, innovation and economic growth, lies in a wrong design of the policies of impulse to the innovation, which is the result of a misconception of innovation —instead of R&D— as a systemic process based on a division of labor in a Smithian sense.4 As a more efficient alternative, we propose a model based on purely Schumpeterian postulates, which will turn innovation into the center of the productive process.5 For this it is crucial to understand that although R&D is systemic —and, therefore, it makes sense to speak of a national or regional R&D system— innovation is, in general, a spontaneous process, that is, fruit largely due to chance and, consequently, not systematic. Accordingly, the use of the confusing term "innovation system" should be discarded.

“Radical” innovations are only rarely the result of a systematic R&D activity. Observed since the beginning of the industrial revolution and coinciding with the beginning of economic science set at the publication of Adam Smith's Wealth of Nations (1776). Let us take as an example the own inventions and innovations that set in motion the industrial revolution:6 Henry Cort (1740—1800), who in 1783—4 patented the system of puddling and running in —which allowed steel to work industrially— was marine. James Watt (1736—1819), manufacturer of devices for mathematical calculation, discovered the possibility of using steam power when he was called to the University of Glasgow to repair the model of a "latent heat" machine that Professor Joseph Black (1728—1799) used in his classes. It is well known that Watt continued many conversations with Black and with two other professors (John Anderson and John Robinson), without them coming up with the solution to the key problem of a steam engine: how to maintain a cold condenser even when the cylinder is hot. The solution —the true beginning of the industrial revolution— came with Watt in 1765: the only one in the group who did not belong to the university's teaching staff. Similarly, another of the emblematic machines of the industrial revolution, the mechanical weaver, was designed and brought to the market by Richard Arkwright (1732—1792),7 a barber and wig

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[2] This is in addition to the fact that, even in the most advanced economies, the productivity has nearly not been growing for years, given that, in global terms, innovation has stagnated, although this fact is not perceived by the still buoyant growth of innovation in the sector of ICT, etc. (compared to the almost non—existent advances in other crucial sectors such as energy, transport and others, see Mullan, 2017: 61-79). For the case of artificial intelligence and the "paradox of modern productivity" see Brynjolfsson et al. (2017).
[3] We understand that this is simple correlation without considering other variables such as institutional frameworks, cultural differences, etc., but this reinforces our idea that the only R&D effort doesn’t imply either economic growth or improvements in productivity and are currently working on an extended version of this paper which supports our hypothesis with a wide empirical analysis.
[4] We do not enter here into the detail about the apparent contradictions between the different models of division of labor exposed by Smith in *The Wealth of Nations*, exposed e. g. by West (1964).
[5] A proposal of this kind requires a much more extensive historical exposition and a more extensive analysis of economic doctrines than an article can cover. We kindly ask the reader to excuse in this first phase of our project having reduced to the maximum the referential apparatus, as well as any type of empirical analysis that supports our thesis, although those familiar with the subject will have no difficulty in following the line of argument.
[6] See in this regard Ashton (1948), singularly chapter III entitled "The technical innovations".
[7] Which Schumpeter himself cites as an example of an innovative entrepreneur (Schumpeter, 1947, I: 272).

maker and John Kay, a watchmaker. Later, Edmund Cartwright, an Anglican priest and poet, developed the first loom that could be handled entirely without human force. And it is worth noting that even the last of the great challenges of the textile sector —the infinite coil that did not require stopping the machine to replace the empty bobbins of thread— was resolved two centuries later by Julius Meimberg (1917—2012), had been a famous fighter pilot during the Second World War, awarded with the highest military honors, and who, at the time of this invention, was the owner of a travel agency (Holtz-Honig, 1997).

2. From the 'Schumpeterian' vision of innovation to the concept of "Innovation System"

The economics of innovation includes the study of the relationships that arise between innovation and technological change with the various economic variables, and has a broad theoretical framework that arises through the interaction of different disciplines, among which stands out the neoclassical economics, the organizational economics, the economic geography as well as the so-called evolutionary economics stand out. In the specific case of the Innovation Systems (IS), their development can be summarized through three common sources and that have basically marked its path of development: the current of the evolutionist economics, its neo-Schumpeterian sub-current, and the theories concerning of the technological change.

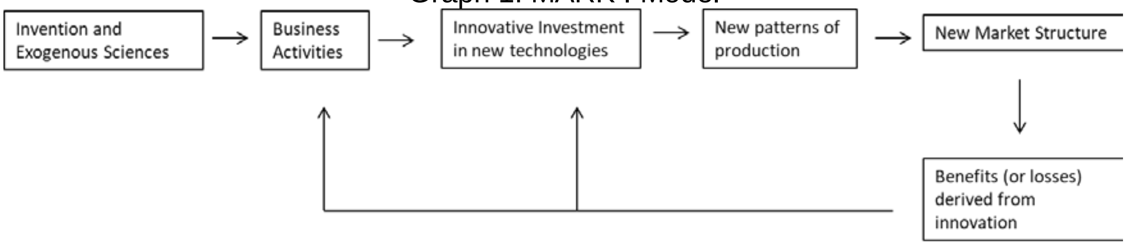
The current of the evolutionary economics has its roots in the development of the same concept within the framework of the natural sciences initiated by Darwin.8 Dosi and Nelson (1994) point out that the evolutionary economics approach studies temporal trajectories from three fundamental components: i) the selection units, ii) the mechanisms and criteria of that selection, iii) the adaptation and variation that derives. In the economic and social contexts, these elements are part of the diverse actors that converge in the economic systems. In this sense Nelson (1995) and Ziman (2000) explain that the evolutionary approach seeks in the natural sciences a set of valid similarities to explain the processes of transformation and economic development.

Although the previously cited authors made extensive contributions to the study of the economics of innovation, it is important to mention the author whose singular contributions to the theory of innovation have been more emblematic: J. A. Schumpeter. His contributions inspired the so-called neo-Schumpeterian theory.9 Thus, Nelson and Winter (1982), point out that the evolutionary theory has different intellectual debts with this current. Schumpeter (1939) made a profound critique of neoclassical economics and its definition of innovation, understanding evolution as a change in the economic process whose driving cause would be innovation. The authors usually distinguish two major complementary stages in the Schumpeterian theory. In his first works he treats the technical change as something exogenous to the firm, and the nucleus of his approach is based on distinguishing the economic agents—entrepreneurs between creators and imitators. In his later works, however, he will also recognize the importance of R&D activities performed inside large companies (Malerba and Orsenigo, 1995; Muller, 2001).
According to Schumpeter,10 it is the process of 'creative destruction' that governs the historical evolution of capitalism, being able to differentiate between five types of innovations: the introduction of a new good, the introduction of a new method of production, the opening of a new market, the conquest of a new source of provision of raw materials or semi—manufactured goods and the creation of a new organization of any industry. However, the Schumpeterian approach

[8] Darwin (1859), *The Origin of the Species*.
[9] The often used term neo-Schumpeterian school lacks any sense, as there was no previous "Schumpeterian-School":
[10] For a broad view on the "Schumpeterian inflection", see Vence (1995), pp. 106—143 and, for post—Schumpeterianism, pp. 144—178. See also the different articles collected in Scherer (1984).

is not monolithic, but presents an evolution, so we can distinguish between two types of basic models, which are complementary to each other: the model called MARK I (figure 1) corresponds to a vision of the innovation as a process that takes place in a competitive environment of capitalist entrepreneurs, characterized by —economically not yet measurable— inventions and exogenous scientific discoveries. The innovative activity of the entrepreneur consists in identifying, among the inventions and new available knowledge, those that entail an economic potential, implementing and transforming them into innovations. By acting in this way, the old technologies become obsolete, a process that Schumpeter calls 'creative destruction'.

Graph 1: MARK I Model

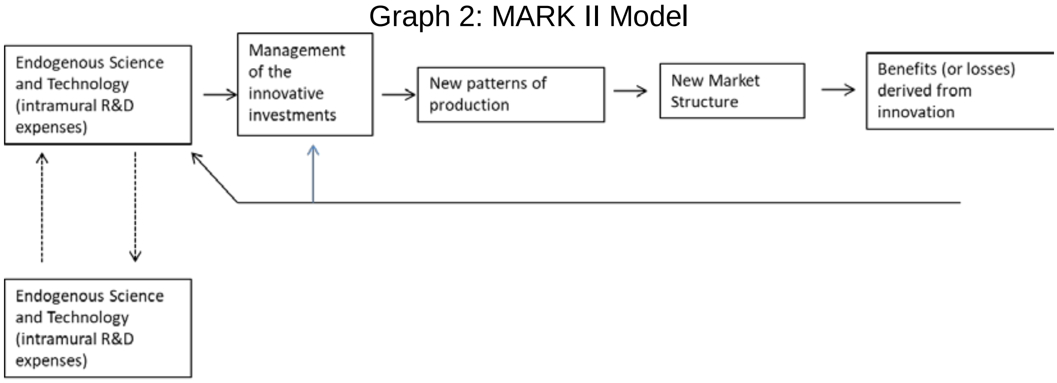


Source: Muller (2001)

This initial vision of Schumpeter is complemented by the later model called MARK II (graph 2) which is characterized by the fact that innovations are endogenous and because in it research and development is carried out mainly in the R&D departments of large companies, in a process called 'creative accumulation'.

This model would imply, then, the passage of an initial conception focused on the role of the individual entrepreneur, towards a vision that highlights the importance of collective innovation performed within the (large) companies. In the words of Heijs (2001: 29), "Schumpeter recognized both the importance of small businesses and individual inventors and the important role of the concentration level for innovative development". In short, Schumpeter paved the way for the development of the evolutionary approach to innovation —thus overcoming neoclassical theory— highlighting the importance of creative destruction and accumulation, and, at the same time, stressing the role of the entrepreneur.

Graph 2: MARK II Model



Source: Muller (2001)

However, it should be noted that neither of the two models were explicitly formulated by Schumpeter, nor is the name of MARK I and MARK II. The first model derives from Schumpeter's book Theorie der wirtschaftlichen Entwicklung, originally published in 1911, while the second model reflects the vision of the innovation process contained in his work Capitalism, Socialism and Democracy, published first in 1942. In the latter work, Schumpeter also ensures that the socialist system can be (in the best case) as efficient as the free market capitalist system,11 because —simplifying its argument— the tendency to the concentration of capitalism leads to large corporations bureaucratic, 'strangulating' any innovative and entrepreneurial spirit that made them grow in a moment, leading them to a situation of stagnation. In this sense, the concession made by Schumpeter to the R&D departments of large corporations as advantageous for innovation in the so—called MARK II model, must be taken cum grano salis. Instead, it has served to give a Schumpeterian veneer to the concept of innovation system, when in reality it should not be so. Let's briefly see what has been the genesis and development of this concept (keeping in mind how much more accurate it would be to speak of 'R&D system').

The term 'System of Innovation' appears for the first time in Freeman (1987). Other authors who made major contributions to the Innovation Systems approach are Nelson (1993) and Lundvall (1992). The IS are also initially related to the concepts of industrial district (Marshall, 1919), growth poles (Perroux, 1955) and Porter's clusters theory (1990), whose works were crucial in the definitions of competitiveness and advantages competitive of the nations. These approaches have in common, on the one hand, the importance they attribute to spatial proximity, externalities, regional culture and identity and the collective or regional learning process (Koschatzky, 2000) and, on the other, to the results of the growth theory that underline the importance of innovation for such geographical areas.

In this context, we can try to define the concept of a national (or regional)12 innovation system, analyzing each of its elements separately. Thus, we can confirm that regardless of whether the national or regional system is being defined, both concepts start from a certain 'geographical focus', implicitly coinciding with an outstanding relationship with the economic, political and sociocultural environment. In the same way, innovation in this process results in a mixture of ends and means, since we can define it as a 'process' that is characterized as interactive, specific and institutionalized internally and externally of companies (Muller, 2001), where the maximization of profits is one of the arguments in decision making but not the only one.
However, beyond the strict definitions of the Innovation Systems, for the purposes of the present paper it is relevant to analyze those elements that the various authors have pointed out as fundamental and determinant in the generation of these systems and that have been considered in the design of models and empirical applications. For example, Lundvall (1992a) identifies five differentiating elements between the systems: business organization, relationships between companies, R&D expenditures of the public sector, the structure of the financial sector and the

[11] This point would merit a more detailed exposition, which would also take into account the irony employed by Schumpeter in some of the pages of this work, an aspect that is usually ignored and which tends to distort some of his statements. This is the case, for example, when he talks about the possible alternatives to reward more outstanding workers in a Socialist system, to make them stand out of the "collectivity" (Schumpeter, 1947: 208).

[12] The innovation systems approach is established as such, starting in the first half of the nineties, what we know as the Regional Innovation Systems approach (terms coined by Freeman in 1997) emerges a little later with an emphasis on the need to develop analyzes at local and regional level. In this context, according to various sources, a system can have different scales of agglomeration both internally and externally in countries, where the regional approach has an important role. The regional approach is important because, just as innovation activities present a very heterogeneous distribution among countries, it also happens internally, which implies that the intensity and effectiveness of innovative activities differs from one region to another inside the same country (DeBresson, 1996). However, it is important to point out that the fundamental difference between the approach of the National and Regional Innovation Systems is that the former emphasize more the cultural proximity, while the latter emphasize above all the institutional and geographic proximity as a catalyst for the accumulation and transmission of specific knowledge (Lundvall, 1992b)

organization and intensity of business R&D. In this context, Nelson (1993: 517—520) highlights as relevant elements the national structures, the incentives to innovation, the creative capacity of economic agents and cultural singularities. In the same way, Patel and Pavitt (1994) list four elements that they identify as central to innovation: companies, higher education and applied research centers, and public administration. In turn, Edquist and Jhonson (1997) identify the private sector, specifically firms, and the public sector as whole as relevant components of an innovation system (Edquist, 2005). According to Edquist (2005), these organizations would be formal structures with an explicit objective, which have been created consciously, that is, they have been established with a purpose determined by the agents or actors of the system. Finally, we can conclude that the concept of innovation system can be analyzed from two perspectives: a more specific and a broader one (Asheim and Gertler, 2005). A strictly theoretical definition would include the R&D of firms, universities and public administration and would reflect a linear ‘top—down’ model similar to the ‘triple—helix’ approach (Etzkowitz and Leydesdorff, 2000). A broader definition of the term would include all elements and aspects of the economic structure and institutional networks that affect both learning and research and exploration. This approach is more interactive and would reflect a ‘bottom—up’ model (Baumert, 2006).

3. The ‘Smithian’ vision of Innovation Systems

According to what was reviewed in the previous section, there is no doubt that the concept of Innovation System reflects the process of division of labor in the field of innovation with the corresponding participation of a broad set of interrelated agents and institutions, whose activities should generate synergies or save costs, according to the central postulates exposed by Adam Smith. In fact, in this vision, the innovation is an increasingly complex and interdisciplinary activity, so, a priori, it could be assumed that its development requires the interaction of a large number of institutions, organizations and specialized firms. The activities of these agents of the Innovation System are often complementary, based on a division of labor, where large public research centers (including universities) are engaged in basic research that is often not directly economically exploitable, while firms are dedicated to developing new products or processes through applied research. In the intermediate there is a wide set of organizations and institutions that deal with the transformation of scientific knowledge to marketable products and in the transfer, diffusion and adaptation of new technologies.

The advantages of the division of labor apply to the concept of Innovation System in the same way described by Smith, understanding each single workman like an individual actor of the IS (firms, universities, public agencies, etc.): “first, to the increase of dexterity in every particular workman; secondly, to the saving of the time which is commonly lost in passing from one species of work to another; and lastly, to the invention of a great number of machines which facilitate and abridge labor, and enable one man to do the work of many” (Smith, 1776: Book I).13

[13] As is well known, other consequence of the division of labor applied to the innovation is the possibility to generate exchange by the gains in productivity obtained by the division of labor itself. In the first book of the Wealth of Nations Smith pointed this out in terms of opulence: “It is the great multiplication of the productions of all different arts, in consequence of the division of labor, which extends itself to the lowest ranks of the people. Every workman has a great quantity of his own work to dispose of beyond what he himself has occasion for; and every other workman being exactly in the same situation, he is enabled to exchange a great quantity of his own goods for a great quantity, or, what comes to the same thing, for the price of a great quantity of theirs. He supplies them abundantly with what they have occasion for, and they accommodate him as amply with what he has occasion for, and a general plenty diffuses itself through all the different ranks of the society” (Smith, 1776: Book 1).

Moreover, recognizing the difference of 'talents' among the actors of a IS (remarkable among men of different professions in Smith's words) it is possible to glimpse the same disposition which renders that difference useful, identifying the principle which gives occasion to the division of labor. "Among men […] the most dissimilar geniuses are of use to one another; the different produces of their respective talents, by the disposition to truck, barter, and exchange, being brought, as it were, into a common stock, where every man may purchase whatever part of the produce of other men's talents he has occasion for" (Smith, Idem).

This Smithian vision of the Innovation System is fundamental to understanding the innovative behavior within complex structures and systems, where not only the single actors, but also their interactions and interdependencies are interested. The 'systemic' part of the Innovation System is revealed because many different aspects in different parts of the economy and society in general seemed to behave according to the needs of other parties, as if many positive feedback loops were operating more or less synchronized. The OECD (1994b: 4) states to this regard, that "the global innovative results of an economy do not depend so much on the specific performance carried out by formal institutions (companies, research centers, universities, etc.), but rather of the way in which they interact with each other, as elements of a collective system of creation and use of knowledge, and the degree of interaction with social infrastructures (values, norms and the legal framework)". The IS is a heterogeneous, dynamic and open system, characterized by positive feedback and reproduction. As Lundvall states: "Frequently, the elements of the innovation system reinforce each other in the promotion of learning and innovation processes or, conversely, they are combined in groups, blocking these processes. Cumulative causation, and virtuous or vicious circles, are characteristics of innovation systems and subsystems." Regarding this, technology transfer and learning are important aspects of interaction processes and innovative activities require an innovative environment where important the reciprocal exchange of staff, scientific and technological knowledge, specialized services and innovative impulses (Aydalot and Keeble, 1988, Stöhr, 1987, Perrin 1986, 1988, Koschatzky, 1997).

Obviously, the division of labor applied to the innovation systems, as explained by Smith in the general case, is limited by the extent of the market, in our case an important number of actors and institutions committed with activities of science and R&D, as " [it…] is the power of exchanging that gives occasion to the division of labor, so the extent of this division must always be limited by the extent of that power, or, in other words, by the extent of the market" (Smith, Idem).

For illustrative purposes we propose to divide the IS into four subsystems (see diagram 1):

- Firms with their inter-business relationships and market structures;
- Public actions in relation to innovation and technological development (including the legal and institutional framework and technology policy);
- Public and private infrastructure to support innovation;
- The national and regional environment.

The differences between the countries in terms of the configuration of these elements are important and are decisive for the functioning of the national system as a whole. Diagram 1 indicates the main components of these four subsystems. In fact, the border between them is sometimes diffuse and there is a certain overlap between the different areas; For example, public infrastructure to support innovation is part of the technological policy. That is, it is not always easy to classify each of the factors or actors exclusively according to the four subsystems used here; however, such classification —as well as the concept of the national and regional innovation system— is very useful as an analytical scheme to study such a complex topic as the scientific policy.

It should be noted here that using the concept of innovation in a broad way implies that the system does not only include agents and factors directly linked to research and development activities, but also other agents or factors that indirectly influence innovative activities . These aspects —which are generally part of the global environment—, are among others, the financial system and risk capital, the education system or the demand.

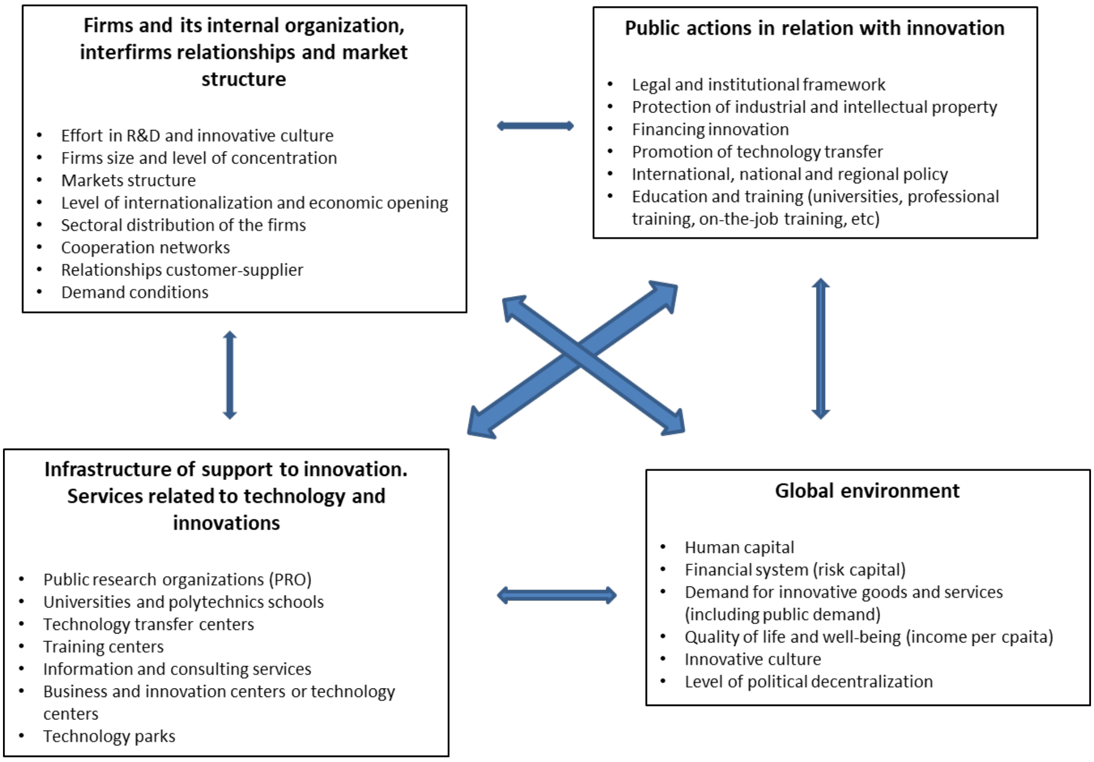
The existence of a good infrastructure to support innovation highlights the importance of the division of labor in this field, which makes it a key factor in attracting R&D investments from other countries. The division of labor allows obtaining advantages of scale with respect to certain R&D activities whose facilities are expensive (laboratories, large installations) and are little used by each of the individual companies, especially in the case of SMEs. In addition, they allow companies to have specialists in certain fields where internal technological capacity is lacking or are highly complex. Therefore, companies locate their innovative activities in those regions where they can take advantage of a range of services related to innovation that complement their own knowledge and needs.

This “open and flexible” definition of the Innovation System concept has also allowed a broad interpretation of the geographical limits of application. Thus, although the initial approach developed by Lundvall and Nelson placed special emphasis on the role played by national institutions in the innovation process, the concept was soon applied to a subnational analysis scope, not only regional, but also local and sectoral. At the same time, the opposite phenomenon is beginning to occur, which points out the importance of studying supra—state systems, especially in the case of the European Union. This flexibility — or ambiguity — is evident in Lundvall's phrase, according to which "National Innovation Systems are open and heterogeneous systems. Innovation processes transcend national borders and are sometimes local rather than national” (Lundvall, 1992: 4).

Another feature of the innovation systems is that it is possible to indicate their limits. In the most recent definitions, this is one of the weak points of the innovation systems approach, given that its borders are not clearly indicated, which, on the other hand, has allowed the concept to be applied successfully to different geographical analysis plans. What we can verify is that, regardless of whether they are national, regional, local or supra—state systems, they all start from a certain “geographical focus”, thus implicitly granting a prominent role to the economic, political and socio—cultural environment.

The geographical focus of the concept of a national innovation system can be seen very well in the role of the technological infrastructure. The region and proximity prove to be fundamental factors for innovative activities. The regional concentration of innovative activities generates synergies and a collective learning process. The presence of institutions that support such activities (such as technology centers, public R&D institutions, technical consultants, technology parks, financial agents with risk capital) allows the division of labor that turns out to be an elementary condition to ensure the acceleration of the transfer technology and the interaction between the different agents of the system. All this indicates that a very important aspect of public intervention is the creation or improvement of the public technological infrastructure.

Diagram 1: Theoretical components of an Innovation System



Source: Own elaboration.

4. Discussion: A Schumpeterian critique to the Smithian vision of the IS

So far, the postulates of the generally accepted theory about systems of innovation, based on the principle of division of labor exposed by Smith. Now, the question that arises is to what extent this theory is compatible with the Schumpeterian vision of innovation. In the first place, it is necessary to observe the contradiction inherent when speaking, in a general way, of 'innovation systems'. If, according to the Austrian economist, innovation is a spontaneous phenomenon, the result of "creative genius", it seems incoherent to assume that it can be the object of, nor be the result of any systematization. It is true that Schumpeter himself was able to consider that large companies —referring to American companies— benefited from having their own R&D departments, while thereby converting innovation into part of their business routine, although in a somewhat less categorical way than what is stated in the so—called MARK II model.14 Thus, a confusion arose between two concepts that continue to this day: R&D and innovation, a disconcert especially notable in the case of Spain and Latin America, in which both terms are mixed in the erroneous but deeply rooted expression "I + D + I".

And it is amazing to contemplate the persistence with which some expressions coined by politicians are imposed, beyond any logic, in the common language. Such is the case of the so—called "R + D + i' — Research plus Development plus innovation—, a phrase that has come together not only among politicians, but in the academic and scientific field itself. What is the reason for this arbitrary use of the lowercase i as an appendix to R&D? It is interesting to note that Spain is the only developed nation —besides some Latin-American countries— in which "I"

[14] Vid supra.

of innovation is added to Research and Development,15 while in the Anglo—Saxon and German—speaking world R&D are respectively sufficient (Research and Development), or F & E (Forschung und Entwicklung) without further ado, which does not prevent these countries from being far ahead of Spain in the classification of the Global Innovation Index.

Although at first glance the treatment of innovation as another summing more to R&D, it may seem inconsequential, nevertheless it has singular relevance for the design of economic policy, since this erroneous R+D+i comes to mask one of the most alarming problems of the Spanish and Latin—American innovation system, namely, the almost absolute disengagement between R&D and innovation. In other words: the critical dismantling of the system when it comes to transforming scientific advances and technological developments into marketable products.

And it is that one of the great pending challenges of the Spanish and Latin American economies —and of many other Western economies— lies precisely in getting Research and Development to be transformed, to the greatest extent possible, in innovations. Let us abandon the expression R + D + i —whose conceptual error only confuses the reader— and replace it with the equation R + D = i, which thus comes to clearly capture what should be the ultimate objective of all technological policy: the maximum interaction between basic and applied science, or in other words, between R&D and innovation. And we must not lose sight of the fact that, according to Schumpeter himself, "the development of an invention and its transformation into an innovation are, both economically and sociologically, two completely different issues". It may be that both interact, but they are never the same, so that "the result of focusing on the former rather than the latter will always result in confusion."16 This interrelation was explained some years ago with surprising —for simple— precision by the then Finnish Prime Minister Esko Aho —whose country was then among the leading nations in terms of technological innovation—, indicating that "research is to invest money to obtain knowledge; to innovate is to invest knowledge to obtain money" (Baumert, 2013). A differentiation that unfortunately has not yet penetrated in most economies.

Thus, once inventions and innovations have been delimited and separated and, consequently, the processes that lead to one and another, namely, research versus innovation, we can conclude that, while the invention can be systematized —and, for therefore, it benefits from a division between Smithian-type agents—, this is not the case of innovation which, according to Schumpeter's postulates, would be usually spontaneous, that is, not systematic.
From the above, a series of conclusions are derived that are worth to analyze more closely. First, it should be noted that the concept of an innovation system as a regime in which different agents are divided and specialized in different tasks —in line with Smith's division of labor postulates— interacting with each other, is now obsolete. This approach, in any case, can be applied to the

[15] To explain this Spanish particularity, it is necessary to remember the genesis of the expression, due to an initiative of the Ministry of Science and Technology in the time of President Aznar, destined to increase the budget item corresponding to R&D expenditure, so that —with identical and actual disbursement—, its value will be closer to that recommended by the European Union. Basically, the accounting device consisted of adding to the R&D some items that, according to the strict OECD definitions, had no place in this concept, but in the innovation one. In this way, Spain suddenly compared its "R&D+i expenditure with respect to GDP" to "R&D expenditure with respect to GDP" of the remaining countries of the European Union, thus improving significantly its relative position in this fundamental economic indicator. Such a strategy —to treat innovation not as a result of the R&D process but as an input of it— undoubtedly fulfilled its immediate purpose; However, what is irritating, is that since then this subtle scheme has been maintained and it has been consolidated and institutionalized, as evidenced by the fact that, to date, even the corresponding Secretariat of State is called "R&D + i".
[16] Schumpeter (1939), I, 84—85 and 271—272.

field of R&D, but not to innovation. Consequently, it would be more appropriate to talk about (national or regional) R&D systems. In this way, the spontaneity and creativity of innovation is stressed.

It does not mean the previous thing that the innovation cannot sometimes result from the own R&D carried out by the big companies. But, as different empirical studies begin to show, systematic R&D will not lead to systematic radical innovation, since —except in very specific sectors— this will be spontaneous and marked by a strong component of chance. Obviously, incremental innovations, that is, improvements within existing guidelines and models, may result from a research activity and systematic development: but we must be aware that incremental innovations are not the main 'engine' of the economic growth.

From the above, it follows that policies to promote innovation —basically consisting of continuously increasing R&D expenditure with respect to GDP— are not efficient. And this for a double reason: in the first place, because they are based on the erroneous idea of linear causality between effort in R&D and innovation, masked by the evolutionary theory of "innovation systems" (to greater relative expense in R&D greater innovation); and, secondly, by assuming that the "innovation system" model reflects the Schumpeterian MARK II model, when this, in fact, would have a very nuanced validity.17

Another additional cause of inefficiency would be by omission: as indicated by the late Steve Jobs, creativity consists first of all in discovering how to "connect things" —in his specific case in knowing how to connect the first model of "computer mouse" with the "deodorant ball" to design the first "track-ball-mouse". Due to the excessive emphasis on increasing R&D expenditure with respect to GDP, other crucial issues are being marginalized, such as the promotion of entrepreneurship in society, the design of high school and university curricula that seek to cover the largest possible number of fields —since they provide the basis for interconnecting knowledge from the most diverse areas— while current training plans favor a growing specialization to the detriment of breadth; develop creative thinking, etcetera.

It would be possible to continue deepening in this line, and in later phases of our research, we will give more space to these and other aspects that, at the moment we have only been able to deal with in passing, and that result from clarifying the confusion between the R&D systems —based on the division of labor, specialization and interaction between the agents that compose it postulated by Adam Smith— and the innovation process —the fruit of creativity, "genius" and chance, according to the postulates of J. A. Schumpeter— and that require, of course, a favorable environment to be able to become successful, thus contributing to greater productivity and, thus, to greater growth and economic development.

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[17] Once again, it is worth noting the possible existence of exceptions for certain sectors or sub—sectors.

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