THE ROLE IF INNOVATION IN ECONOMIC GROWTH – AN OVERWIEW OF THE GROWTH MODELS INCLUDING INNOVATION

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Abstract
The main purpose of this paper is to present the concept of innovation in the context of the economic growth process. First a definition of the concept is offered together with its typology. The Schumpeterian perspective on innovation is brought in discussion, as the Austrian economist is the first notable scholar to have addressed this issue with connection to the economic growth process. The paper uses secondary data to argue the liaisons between innovation and economic growth. As the "creative destruction" comes from inside the system, being an internal factor, two endogenous growth models are analysed. The result of the study is that innovation is correlated with economic growth, the volume of research activities and their results influencing the level of economical advancement.
Key words: innovation, economic growth, Schumpeter, endogenous growth model
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1. Introduction

"…not to innovate is to die" – this statement belongs to Christopher Freeman (1982, p.169) and its essence is indeed reflected in the real world since companies who achieved to become technical and market leaders have demonstrated an outstanding capability to successfully develop new products. Scanning the economic history, one can notice that industrial technological innovation is directly correlated with important economic advantages for the company which is innovating but, what is especially relevant for this project, it also leads to economic benefits for the innovating country. "Technological innovations have also been an important component in the progress of human societies" (Trott, 2005, p.5).

As Dobni (2008, p.43) states, innovation can lead to long-term benefits and ensure a powerful position toward the rest of the competitors. This is an important reason organisations need to innovate: in order to maintain their competitiveness. Innovation is the key both to survival and growth. But again it has to be said that this is not only valid at the level of the firm but as Baumol (2002) posits "virtually all of the economic growth that has occurred since the 18th century is ultimately attributable to innovation" (Francis & Bessant, 2005, p.171).

An interesting thing to notice is that unlike in the past when scientific developments and important discoveries were the result of a single individual's effort and work (for example James Watt – steam engine in 1770-80 or Michael Faraday – electromagnetic induction dynamo 1830-40), nowadays innovations are linked to organisations (for example Nokia – cell phones) and to team work. The explanation for this fact is the huge amount of money demanded in these days and the vast number of versed scientist whose implications are of overriding need (Trott, 2005, p.11).

2. Literature review

2.1. Definitions

Further on four definitions of the innovation concept are presented:

- "Innovation is defined as the creation and implementation of new knowledge into a product or service that yields profit" (Darsø, 2001, p.28)
- "Innovation is the management of all the activities involved in the process of idea generation, technological development, manufacturing and marketing of a new (or improved) product or manufacturing process or equipment" (Trott, 2005, p.15)
- Baumol (2002) defines innovation as being "the recognition of opportunities for profitable change and the pursuit of those opportunities all the way through to their adaptation in practice" (Francis & Bessant, 2005, p.171)
- "Innovation consists of the generation of a new idea and its implementation into a new product, process, or service, leading to the dynamic growth of the national economy and the increase of employment as well as the creation of pure profit for the innovative business enterprise" (Urabe, 1988 in Cumming, 1998, p.21, 22).

Authors share different opinions when it comes to whether the term innovation automatically implies also the success of the particular product/ service or not. Trott for instance holds that innovations can be also unsuccessful and gives as an example the Kodac Disc Camera or the Sinclair C5 – a small electrically driven tricycle or car. Neither of these two products has encountered commercial success. Still, according to Trott, an innovation despite its unsuccessful commercialization does not downgrade to an invention. Trott believes that the fact that the products advanced "from the drawing board to the marketplace" is enough to entitle them as innovations (Trott, 2005, p.16). However, other authors consider that through innovation one shall understand "the successful creation, development and introduction of new products, processes or services (Udwadia, 1990 in Cumming, 1998, p.22). Twiss (1995) is another supporter of this idea: "for an invention to become an innovation it must succeed in the marketplace" as well as Cumming himself sustaining that innovation could be defined as "The first successful application of a product or process" (Cumming, 1998, p.22).

2.2 Innovation typology

Over the years, many authors have tried to present a classification of the concept of innovation. Among them, Tidd et al. (2005, p.10) has divided innovation in four broad categories:

- Product innovation – refers to modifications in the products or services which a company offers. Examples for this type of innovation could be a new design of a car or a new insurance package. Besides improving the existing products, Trott (2005, p.17) argues that this category also includes the development of new products.
- Process innovation – refers to alterations in the ways in which products or services are created and delivered. This type of innovation could consist of changes in the manufacturing methods or processes.
- Position innovation – this sort of innovation refers to changes in the context in which the products or services are presented to the consumer. A good example here would be an American product called Lucozade which initially was promoted on the market as a glucose-based drink for children and invalids in convalescence while later its image and purpose have been changed by the company which was producing it towards a sport drink dedicated to the fitness market.
- Paradigm innovation – refers to changes in the most important mental models which characterize how the enterprise generally acts - In order to have a good understanding of this last type of innovation it is necessary that a definition of mental models to be given; therefore, mental models refer to "beliefs, ideas, images, and verbal descriptions that we consciously or unconsciously form from our experiences and which (when formed) guide our thoughts and actions within narrow channels. These representations of perceived reality explain cause and effect to us, and lead us to expect certain results, give meaning to events, and predispose us to behave in certain ways." (The Business Dictionary, 2010).

Another classification of innovation was offered by Sundbo (1998, as cited in Darsø, 2001, p.28):

- *Incremental innovation* – small linear improvements of products or services, including second generation products and services, new applications or markets for the existing products or services
- *Radical innovation* – novel, fundamental improvement that implies a high risk for the business and need a longer time for implementation
- *Social innovation* – this type of innovation is a result of new social needs and is related with new ways of social interaction

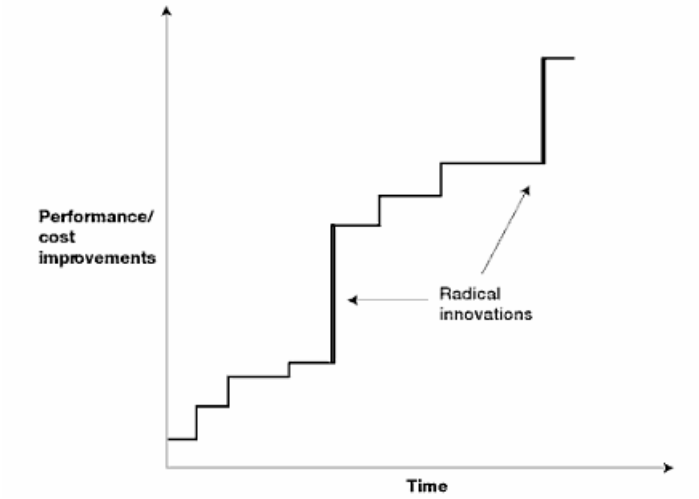
The majority of innovations occur in an incremental manner. This means that very rarely new products are indeed 'new to world' and "process innovation is mainly about optimization and getting the bugs out of the system" (Tidd et al., 2005, p.13). It has been stressed that innovations representing totally new or disruptive products are only 6%-10% of all the projects focused on innovation (Ettli, 1999 in Tidd et al., 2005, p.13).

Incremental innovations are mainly regarded as market-pull innovations and are especially arising from market oriented enterprises (Kohli and Jaworski, 1990 in Darroch and McNaughton, 2002, p.212). Because incremental innovation does not imply the abandonment of the existing business practices, it is very probable that this type of innovation will lead to improvements, completeness and to an upgrade of the present abilities within the firm, or in other words: incremental innovation offers "the opportunity for those within the organisation to build on existing know-how" (Tushman & Anderson, 1986 in Darroch & McNaughton, 2002, p.213).

On the other hand, radical innovations are going to imply new knowledge and are going to modify the current business processes (Tushman and Anderson, 1986, p.442). Usually they derive from scientific research and are characterized as technological-push innovations. Radical innovations can be either new to the enterprise or new to the world, the last case being mostly illustrated by important breakthroughs (Green et al., 1995 as cited in Darroch and McNaughton, 2002, p.213).

Tushman & Anderson (1986 in Darroch & McNaughton, 2002, p.213) consider that in comparison to incremental innovation, radical innovation would have damaging influences on the acquired competencies, "often making existing skills and knowledge redundant". Moreover radical innovations involve a high risk because it is more difficult to turn them into a success on the market (Darroch & McNaughton, 2002, p.213). However, in the long term radical innovations seem to be pretty important since they are based on "development and application of new technology" (Veryzer 1998 in Darroch & McNaughton, 2002, p.213).

Figure 1. Graphical representation of incremental and radical innovation



Source: The innovator's toolkit, 2009, p.6

It is interesting to observe that while Sundbo describes radical innovation as something "new to the world" or a so-called breakthrough, there are other researchers like Barczak (1991), Green et al. (1995) or Hage (1980) who posit that products or services that are not necessarily new to the outer world but new for the company itself are also recognized as radical innovations (Darroch & McNaughton, 2002, p.213).

The graph above tries to make the comprehension of the distinction between incremental and radical innovation more explicit. It can be seen that incremental innovation happens in a more uniform manner and in many but small steps and implies tiny improvements over a longer period of time, whereas radical innovation refers to more intense alteration taking place faster. The focus of this graphic is on the pace at which innovation occurs.

3. Data and research methodology

Further on, the paper is constructed on the basis of secondary data available on its subject of research. Schumpeter's view on innovation will be the first to be analysed and his findings will be considerate. As he is the first notable scholar to address the issue of innovation as an endogenous factor capable of disrupting the equilibrium of the economic system, his ideas represent the basis for the following construction of the hypothesis that innovation influences economic growth. As a premise of this research, innovation is considered endogenous for economy. The paper will verify the position adopted by two endogenous growth models in what regards innovation. Therefore Romer's and Caballero and Jaffe's models of endogenous growth are presented and their findings are taken into consideration in testing the paper's hypothesis.

3.1 Schumpeter's "creative destruction"

The research on innovation has not always represented an attraction for the academic or business world. That is because, for a relative long period of time, innovation was considered to be exogenous to the economic system (Abernathy & Clark, 1985, p.3).

One of the pioneers and at the same time a leading figure in the research on innovation is Joseph Schumpeter. His studies offer a whole new perspective over the process of innovation and over the influence of this process on economy. In his original work from 1911, namely "The Theory of Economic Development", Schumpeter underlines the fact that the economy as a system reacts also to internal impulses beside the external ones, which were previously argued by the classic theory of economics. Therefore, in his theory of economic development, Schumpeter credits the entrepreneur, who he defines as a person who produce innovations (Swedberg, 2002, p. 15), with the quality of a change agent. This change agent, throughout its innovative actions, generates the impulse needed to disrupt the economic equilibrium and hence drives the beginning of a new economic cycle (Swedberg, 2002, p.14). By innovations, Schumpeter understands "the setting up of a new production function" (1939 as cited in Swedberg, 2002,

p.15) which constitutes the result of a new combination of the economy's existing resources (Schumpeter, 1961, p.68).

Schumpeter (1939) perceives the innovation process as autonomous and mainly independent of market demand. Consequently, he argues that innovators create markets rather than to adapt to the existing ones (Shleifer, 1986, p.1164).

The central concept of Schumpeter's work, from a neoclassical tradition point of view over the economic theory of growth, is thus represented by the "creative destruction" (Verspagen in Malerba & Brusoni, 2007, p.42) process, which has the role of a growth vehicle inside Schumpeter's theory of innovation and economic development. By creating innovations, one will create new knowledge which will represent in fact a competitive advantage. Because of this, the new knowledge will arouse the interest of the market and will force the destruction of the existing knowledge, which in time may become obsolete. As a result, in Schumpeter's opinion, the radical change brought on by innovation is able to determine economic growth (Abernathy & Clark, 1985, p.6).

Another important aspect for the understanding of the connection between innovation and economic growth is Schumpeter's argument about the temporal clustering of innovations. As he posits, innovations "are not evenly distributed in time, but that on the contrary they tend to cluster, to come about in bunches, simply because first some, and then most firms follow in the wake of successful innovation" (Schumpeter, 1939 as cited in Verspagen in Malerba & Brusoni, 2007, p.49). This view can be interpreted in two senses, both of them being significant for the above stated purpose. First, radical innovations are generally followed by an increased number of incremental innovations which tend to improve the original breakthrough. This type of innovation can be also perceived as a conservative innovation and can have both positive and negative effects over market competition like raising entrance obstacles, lowering the risks of substitute products or making rival technologies less attractive (Abernathy & Clark, 1985, p.6).

Secondly, there are authors who interpret Schumpeter's statement in the sense that large, radical innovation tend to cluster in time (Mensch, 1979 & Kleinknecht, 1987 as argued by Verspagen in Malerba & Brusoni, 2007, p.49) and as a result one can observe during the history periods with different levels of radical innovations (Verspagen in Malerba & Brusoni, 2007, p.50). Following both these interpretations of Schumpeter's argument about temporal clustering of innovations, one can comprehend the stages of a business cycle. Therefore, the growth and the peak of a business are achieved after the implementation of the basic innovation and its further improvement throughout incremental innovations. Then, at the point when these incremental innovations are not able to improve any more the already implemented new technology, the business slows down until a new cluster of new major innovations will appear on the market (Scherer, 1984, p.263).

An interesting observation regarding Schumpeter's work is that in his book entitled "Business Cycles" he has stated that the standard example of his analysis on capitalist evolution is represented by the railroad and its consequences for the

economic system. In order to refer to the economic development brought about by the innovation in the railroad transport, Schumpeter has employed the term of "railroadization" (Andersen, 2002, p.41). Besides writing an entire section with historical and statistical data about the process of railroadization, in "Business Cycles" Schumpeter makes numerous references to this part and reflects upon different aspects of the above mentioned process, considering it of paramount importance for the understanding of its model of evolution (Andersen, 2002, p.42).
According to Andersen (2002, p.48), it can be concluded that in "Business Cycles" Schumpeter's theory of the distinct innovation-driven cycles of an economy and its implicit model of capitalist evolution have been designed to account the aggregate implications of the railroadization process. Therefore, Andersen has tried to present an adaptation of Schumpeter's initial schema of capitalist evolution to the steps of the railroadization process (Andersen, 2002, p.48):

1. The system of economic applications of routines is not fully equilibrated at the beginning of a new wave. On the contrary, the railroad innovation, which will carry the new wave has already been progressing at micro level and is evolved enough to influence macroeconomic actions
2. It is the clusters of innovative railroad projects that determine macroeconomic effects. Some cycles of railroad investments will take place until the innovative character of these activities will be removed
3. The installation of a new and relatively equilibrated system of economic applications will also imply several cycles of rather routine railroad related investments. During this stage incremental innovations take place and therefore many economic activities are improved. In the same time, some new radical innovations happen, but they do not have immediate macroeconomic effect – instead they are preparing the emergence of a new wave
4. A new wave will arise when new innovations have developed at a level from where they are able to have macroeconomic effects (Andersen, 1992, p.48).

Studying the arguments brought by Andersen and at the same time exploring the work of Schumpeter on innovation and economic development, one can acknowledge the feature of the process of railroadization as a driver of change in the economic cycles presented above. Therefore, the most significant impulse that maintains the economy's engine running is generated by innovations like the ones stated above (Schumpeter, 1974. p.83).

3.2 Endogenous growth models based on innovation

The process of innovation has started to receive the attention which it deserves from academia quite recently, more precisely after almost forty years since Joseph Schumpeter has stressed its special place in economy throughout his work. As a result, authors like Romer or Aghiot and Howitt have developed models of economic growth which are based on industrial innovations as engines of growth (Grossman and Helpman, 1994, p.24). These authors pertain to the current of new economic growth models, also called endogenous growth models, which has a

different perspective over knowledge and technology than the early neoclassical economic growth models did (Howells, 2005, p.1221).

The expression endogenous growth comprises a body of empirical and theoretical work which has started in 1980s and is distinguishing itself from the earlier neoclassical growth by outlining that economic growth is an endogenous result of an economic system. The main target of the endogenous models of growth is represented by the general behaviour of an economy (Romer, 1994, p.3).

The literature on endogenous growth models developed fast after Romer's publication from 1986 and authors like Aghion and Howitt (1992), Grossman and Helpman (1991), Caballero and Jaffe (1993), Segerstrom (1991), and again Romer (1990) tried to provide models of economic growth which take into consideration as much as possible the realities of the economic system (Verspagen in Malerba & Brusoni, 2007, p52; Caballero & Jaffe, 1993, p.15).

Even though the economic growth models accepted by scientists in present time are endogenous models, the early neoclassical models have had an important role in the economists' thinking over the years. The most relevant name for the early neoclassical economists is Solow, whose model of economic growth is exogenous and considers knowledge and technology as being exogenous factors (Howells, 2005, p.1221). This view is different from Schumpeter's argument, namely that growth is determined by endogenous drivers, but agrees with the classic economists like Walras, who also considered that the economic equilibrium can only be disturbed from outside the system (Swedberg, 2002, p.14; Fagerberg in Malerba & Brusoni, 2007, p.64).

The early neoclassical growth theory, in the form proposed by Solow in 1956, has directed the economists' ideas in what regards the long run dynamics of per capita income for more than thirty years (Grossman and Helpman, 1994, p.25). The main premises of Solow's theory of growth are the existence of perfect competition (Romer, 1994, p.13), therefore the economic agents are perfectly informed (Fagerberg in Malerba & Brusoni, 2007, p.65) and act as price-takers, the categorization of knowledge and technology as public goods, therefore they are non-rival and non-excludable (Howells, 2005, p.1221) and knowledge spillovers do not exist and the fact that in the long run the level of per capita income and the growth rate of all the countries with the same saving behaviour and technologies will converge (Grossman and Helpman, 1994, p.27). Hence, this model disregards the importance of innovation for growth, as it considers that all the countries have the same access to knowledge and technology and in consequence the advances in science and technology can only be exogenous (Fagerberg in Malerba & Brusoni, 2007, p.65).

In these conditions it was clear that a different perspective had to be taken into consideration, because the real world was and still is confronting on a large scale with totally different issues like imperfect competition, for example monopolization and bounded rationality, knowledge spillovers or distinct rates of growth and levels of per capita income (Romer, 1994, p.10). In consequence, this different perspective came along with the work of the evolutionary economists,

also named neo-Schumpeterian economists, and that of the authors of the endogenous models of growth (Verspagen in Malerba & Brusoni, 2007, p.57-58).

Evolutionary economics, like for example Nelson, Winter, Fagerberg, Dosi, Freeman have presented in their models of growth ideas as the one that technology is a driver for growth, introducing in the modern literature of economics concepts that have initially been stated by Schumpeter: "Innovation will therefore be a strong disequilibrium factor in the processes of economic growth, giving rise to the pervasive differential growth rates between geographical areas" (Verspagen in Howells, 2005, p.1222). The major difference between the evolutionary models of growth and the endogenous models of growth is connected with the idea of bounded rationality. While the first ones accept it and construct their arguments upon it, the last ones neglect it and instead point out that the economic agents act in conditions of full rationality. Nonetheless, the endogenous models of growth have adopted the belief that innovation represents a fundamental factor for economic growth (Verspagen in Malerba & Brusoni, 2007, p.58).

In spite on the fact that all these endogenous models of growth follow, as stated earlier, the main ideas of Schumpeter's work in the field of innovation and economic development, there are distinctions regarding the way they treat the process of "creative destruction" (Schumpeter, 1974, p.83). Therefore the endogenous growth models can be divided into models where innovations pursue a "quality ladder" (Verspagen in Malerba & Brusoni, 2007, p.53), as the monopoly offered to the innovative company by its innovation is only temporary, until a new enterprise will make a new innovation which will take the place of the existing one, and into models where innovations, although different in time, can coexist. In the last situation, even though new innovations will have a better place on the market, the old innovations will continue to exist at least for a period, depending on the degree of inter-changeability of the new innovation. The former group of models bases their innovation concept on vertical differentiation, while the latter ones approaches it in terms of horizontal differentiation (Verspagen in Malerba & Brusoni, 2007, p.53). Because of this situation, the knowledge spillover is also affected and divided into inter temporally knowledge spillover – in the case of vertical differentiated innovations – and coexisting knowledge spillover – in the case of horizontal differentiated innovations (Verspagen in Malerba & Brusoni, 2007, p.54).

3.2.1 Romer's model

In 1990 Paul Romer, one of the most representative figures of the new models of economic growth's current, has developed a model based on endogenous growth. In this model, technological progress, as the driver of growth, is seen to appear from people's intended actions and investments by which they follow economic motivators (Romer, 1990, p.72).

Technology as an input is considered to be a non-rival, partly excludable good, being therefore situated between the concepts of public and private good. As a consequence of the non-rivalry characteristic of a good, the price-taking

competition cannot be sustained and hence the model is constructed with the premise of monopolistic competition (Romer, 1990, p.71). Nonetheless, the monopoly rents over technology are considered to be ephemeral and incomplete because of the continuous development of new innovations (Howells, 2005, p.1222).

Further one, Romer's model from 1990 follows the path of horizontal differentiation of innovation, being based upon Dixit-Stiglitz's (1977) model of product variety. In this way, it is stated that even though new innovations will be rewarded with monopoly rents, these will be incomplete, allowing old innovations to continue to have a market share for a temporary period and thus not necessarily implying the concept of obsolescence (Aghion & Howitt, 1992, p.326).

Beside the notion of monopolistic competition, this model also acknowledges the idea of knowledge spillovers taking place as a consequence of innovations (Romer, 1990, p.73). Hence, innovations expand the level of knowledge accessible inside an economy determining an increased productivity of the research and development process (Verspagen in Malerba & Brusoni, 2007, p.53-54). For example, while a company develops novel technologies, it sometimes obtains breakthroughs which have a wider applicability and for which is difficult to obtain a patent or to keep them away from the public area (Grossman & Helpman, 1991, p.16). Subsequently, Romer develops his work under the premise of incomplete intellectual property rights (Romer, 1994, p.18).

The main inputs of the discussed model are capital, labour, human capital and an index of the amount of technology (Romer, 1990, p.78). By human capital the author understands the cumulative effects of education or of the on-the-job training that are specific to one person and inside the model it clearly states the difference between the rival component of knowledge, namely human capital and the non-rival, namely technical component. The model accounts an economic structure formed from three sectors: a research sector which employs human capital and the existing knowledge in order to develop new knowledge, an intermediary goods sector which uses the designs from the research sector in order to produce intermediary products and a final outputs sector which utilizes labour, human capital and intermediary goods in order to create final goods. Further, it is assumed that the population and the supply of labour are constant and that the accumulation of human capital in the overall population is fixed (Romer, 1990, p.79).

The findings of Romer's endogenous growth model are that the stock of human capital is highly significant for the research process and determines the rate of growth, that integration into the world's markets will augment the rate of growth, while having a large population will not be enough to induce growth – this is because the scale is not a function of the labour available but of the human capital level (Romer, 1990, p.71, 78).

3.2.2 Caballero and Jaffe's model

Ricardo Caballero, currently the chairman of the Department of economy at Massachusetts Institute of Technology and Adam Jaffe, currently a Fred C. Hecht

professor at Brandeis University in USA, have proposed in 1993 a model of economic growth which's task was to identify the factors determining the impact of creative destruction and knowledge spillovers on growth. The model pertains to the current of endogenous growth models and is based on the horizontal differentiation of innovations. Hence, the economy is formed from a continuum of monopolistic goods in competition, where the newest are the best and where the decline of each good, in terms of market share and profitability is a function of the degree of inter-changeability between the new and old product and of the speed with which new products are introduced in the market (Caballero & Jaffe, 1993, p.17). Therefore, as goods become more substitutable they will be extinct more rapidly (Caballero & Jaffe, 1993, p.23).

The authors have tried to calibrate this model of innovation based growth, in order to observe how well it is able to describe the trends in aggregate productivity and consumption growth in USA (Grossman & Helpman, 1994, p.31). Following the direction of previous models of endogenous growth, the model discussed here embraces the idea that change, in the sense of Schumpeter's innovation concept, is brought by profit seeking firms that try to obtain market power by creating qualitatively improved goods (Caballero & Jaffe, 1993, p.15-16). The new ideas represent the result of private research which also employs the public stock of the existing knowledge.

In what regards the concept of knowledge and more specifically the one of knowledge spillover characteristic to the endogenous growth models, the model of Caballero and Jaffe (1993) argues that the growth of the economy will depend upon the processes of knowledge diffusion and knowledge obsolescence. The former is considered by the authors to need time in order to happen and as a result they point out that very recent knowledge is, in the beginning, usefulness in developing new knowledge. The process of knowledge obsolescence is different from the obsolescence of value and is explained throughout the two side effects of the new ideas on the current accumulation of ideas. That are, on one hand the fact that new ideas render the products relying on the existing ideas less valuable – this is value obsolescence or creative destruction – and on the other hand they render the knowledge represented by existing ideas less applicable for the production of new knowledge – this is knowledge obsolescence (Caballero & Jaffe, 1993, p18). Inside the model, knowledge obsolescence is not an exogenous function of time, but rather an endogenous function of the number of ideas developed over time (Caballero & Jaffe, 1993, p.19).

One of the main findings of this model, which is relevant for the overall subject of this paper, is the connection between the rate of new goods production and the consumption or productivity growth. This finding is sustained throughout empirical data from USA, where the authors have noticed a strong relation between the productivity slowdown from the middle of 1960s and the fall of research productivity (Caballero and Jaffe, 1993, p.70). Another important contribution of the above stated model is the endogenization of the research technology, which relies upon the time distribution of past innovations (Aghion, 1993, p.74).

4.Findings

Endogenous growth models, also known as the new economic growth models, are in comparison to neoclassical economic growth models more close to reality because they rely on premises like imperfect competition, existence of knowledge spillovers and monopolization, different rates of growth registered in different economies, and what is of great importance, they do not consider knowledge and technology as pure public goods. Endogenous growth models are divided into two categories: models based on vertical differentiation and models based on horizontal differentiation. The former ones presuppose that the monopoly over an innovation is only temporarily because in time a better innovation based on the already developed one will replace its role, whereas the latter ones hold that it is possible for both innovations (the already existing one and the new developed one) to coexist, at least for a while.

Further on a table with the main findings of Romer's and Caballero and Jaffe's endogenous growth models are presented.

Table 1: Overview of endogenous growth models

Model	Key ideas
Romer's model (horizontal differentiation)	- presupposes an incomplete monopoly on new innovations since old ones continue to have a market share for a period depending on the inter-changeability of the goods - new innovations do not necessarily make the old ones obsolete - incomplete intellectual property rights (breakthroughs which have a wider applicability and their technological recipe cannot be kept secret from the public and can serve for future breakthroughs in other domains) - having a large population is not enough to determine economic growth but the level of knowledge the human capital possesses is of great importance (Romer, 1990)
Caballero & Jaffe's model (horizontal differentiation)	- the economy is "a continuum of monopolistically competitive goods" (Caballero & Jaffe, 1993, p.17), where the newest have the highest quality and the decline of the older ones depend on the degree of substitutability between the new and old products and on the rhythm in which the new products are developed - USA data show a strong relation between the productivity slowdown and the research productivity => the consumption/ productivity growth is connected to the rate of new goods production (Caballero & Jaffe, 1993)

Source: authors' view

The study hypothesis of this paper was that innovation is influencing economic growth. The main premise defined innovation as an endogenous factor for the economic system. As it was presented, given the importance of the concept, in time several definitions were constructed. Authors like Darsø and Urabe have clearly stated that the production of a new good or service is not enough to call it an innovation. Instead, they requested that the service or the good newly designed to

have success on the market and to bring profit for its producing company. This point of view sustains that innovation leads to profit and therefore to economic advancement. In the same time Schumpeter argued that entrepreneurs, who are responsible for creating innovations, act inside an economic system as agents of change. Therefore, throughout its theory, Schumpeter defines innovation creators as part of the economic system, and as a consequence innovation becomes an endogenous factor of that system. Even though he is the first scholar to adopt this position, over time his point of view was tested and enforced transforming itself into a truism nowadays.

The Austrian researcher is also the one who posits the idea that innovations, in the sense of radical innovations, are autonomous processes, capable of creating markets and implicitly economic growth. An essential case study which enforces the idea that innovation, as an endogenous factor, influences economic growth is created by Schumpeter's analysis of the railroadization process. Throughout it new markets are developed and the incremental innovations following radical ones bring added value transformed into profit and economic growth.

Even if the neoclassical school of economics represented by Sollow has disregarded the role of innovation in economic growth, by considering knowledge spillover don't exist and that knowledge is a public good, the fact that this theory is no longer considered valid by scholars in present time, is this a clear proof that its premises were not real. Romer's and Caballero and Jaffe's models follow Schumpeter's initial work and base their studies on premises like incomplete monopoly, knowledge spillover together with knowledge obsolescence, and last but not least horizontal differentiation of innovations. Both of them find a strong connection between the volume of knowledge existing inside an economy, which is the result of research processes, and the rate of economic growth. Research, as they posit has a double role, being directly correlated with new products/services development rate and with the rate of consumption inside an economy. That is, in the first case because of the knowledge spillover process and in the second case because of the innovation creation process. By their study, Caballero and Jaffe find that on the USA market from mid 1960's the slowdown on consumption rate was the consequence of the low level of research investment.

In these conditions innovation turns out to have a significant role in the economic growth of a country and even represent the factor which leads to the differentiation of growth levels between different countries. The hypothesis of this paper is tested and it turns out to be valid, based on the existing theories of endogenous growth models.

5. Conclusions

In his theory of "creative destruction" Schumpeter holds that the creation of new innovations means creation of new knowledge which in fact represents a competitive advantage. Therefore companies are interested in creating this new knowledge while the old one does not represent an attraction anymore and will be therefore destroyed.

According to Schumpeter innovations disrupt the equilibrium in the economy giving birth to a new economic cycle. He holds that innovations usually occur in clusters, beginning with one radical innovation followed by many incremental innovations on the basis of the first one, and once there is no possibility to improve the original breakthrough anymore, economic activity comes to a halt and then the whole process restarts. The most important idea from Schumpeter's theory is that the activity of the change agent (the entrepreneur) within the economy leads to economic growth.

Also Caballero and Jaffe consider in their model that both the average growth rate and the variance of the economical growth rate are increasing functions of the dimension of innovations among other factors and like Schumpeter they hold that new innovations make the existing ones obsolete in time and extinct them from the market after a period of coexistence.

In his model, Romer states that an important consequence of the simultaneity of various innovations is the appearance of knowledge spillovers which are distributed horizontally in the same period, meaning that a company can benefit for free from the research made by another one and develop a better innovation on the basis of the initial one. And based on Schumpeter's idea that creating these new improvements (new knowledge) means to have a better position towards the competitors, as well on Romer's hypothesis that innovations expand the level of knowledge accessible inside an economy, this will determine an increase in the level of research productivity and economic development.

In order to conclude, Schumpeter' work on innovation, together with the findings of the endogenous growth models and with the current definition of innovation as the creation of a new product/service/process/paradigm which is successful on the market and brings profit to its producing company show a clear and strong liaison between the process of innovation and the one of economic growth.

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