

The challenge of measuring innovation in emerging economies' firms: a proposal of a new set of indicators on innovation

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**THE CHALLENGE OF MEASURING INNOVATION IN EMERGING
ECONOMIES' FIRMS: A PROPOSAL OF A NEW SET OF
INDICATORS ON INNOVATION**

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**THE CHALLENGE OF MEASURING INNOVATION IN EMERGING ECONOMIES'
FIRMS: A PROPOSAL OF A NEW SET OF INDICATORS ON INNOVATION**

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Abstract

The traditional indicators on innovation rely on the linear assumption that research leads to development, centring on the measurement of inputs and outputs. Based on the traditional innovation indicators, recent studies focused on the industrial innovation process at Latin America state that nowadays Latin American firms display a passive role at world's innovative activities, characterised by the lack of firms' innovative skills. However, these indicators do not seem to be the most appropriate for measuring innovation, especially in emerging economies' firms. The focus of this paper is to theoretically propose a set of new indicators on innovation that might be more adequate to the reality of firms located in emerging economies, centring on the way innovation activities process takes place within the firms. In order to do so, the paper searches for support from five approaches of the economic theory. The validation of the suggested set of new indicators could shed some light on the understanding of the innovative performance of emerging economies' firms.

Keywords: innovation process, indicators, economic theory, emerging economies' firms.

JEL Classification: L20, M10, M21, O30.

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1. Introduction

Since ever, searching for novelties and exploring the unknown seem to be characteristics intrinsic to the human kind. This impetus for the new has been nurturing the human history of economic progress and development extensively. In this scenario, innovation comes into view as the force which uninterruptedly propels evolution. However, despite the fact that innovation has been a key-factor in fomenting the process of economic development, the innovative activity itself has not always been understood in a planned way.

In terms of business and management, initially, the prevailing idea was that technology represented a static variable available for firms in the market. In this context, the innovation process represented a mere activity of optimal resources allocation (Tigre, 2005; Zawislak and Marins, 2007). However, the path of technological and economic development impinges the need for firms to organise formal internal structures to foster innovation activity.

The first firms to adopt formal structures focused on innovation activity were firms located at industrialised economies, like, for instance, Europe and the United States. These structures were based on the logic of the Linear Model of Innovation, an input-output model in which research leads to technology (Kline and Rosenberg, 1986). This linear logic was the base for the creation of the first innovation indicators, which, consequently, focus only on the inputs and outputs of innovation activity (Godin, 2002). Overall, these indicators refer to R&D expenditures, human resources qualification, and patents. They represent the traditional innovation indicators.

Based on the traditional innovation indicators, recent studies focused on the industrial innovation process at Latin America - especially at Brazil - argue that during the 1990s, following the process of economic liberalisation, there was the weakening of the innovative technological capabilities that were built up in the former decade. These studies state that nowadays Latin American firms are characterised by a lack of innovative capabilities and the complex R&D activities are concentrated in industrialised economies (Cassiolato and Lastres, 2000; Viotti, 2000; Cassiolato et al., 2001; Cimoli e Katz, 2003; Katz, 2004).

The problem, though, is that the traditional indicators on innovation, employed by these studies, capture only the highest piece of the innovative activity and, hence, are incapable of understanding how the innovation process occurs inside firms. The fact that the deliberated commitment to innovation is relatively low in firms of emerging economies does not necessarily mean the absence of innovative capabilities in these firms (Figueiredo, 2001; Arocena and Sutz, 2006; Vedovello and Figueiredo, 2006; Zawislak and Marins, 2007).

Therefore, in emerging economies' firms the innovation activity presents a different form. As highlighted by Arocena and Sutz (2006), when the object under investigation is the existing innovation

activities in emerging economies' firms, it is necessary to bear in mind the impact of their informal character. Consequently, the application of instruments - in this case, indicators - designed for industrialised firms in emerging economies can be misleading, leading to the common generalisation that innovative activities are not developed by the firms which are not located on the technological frontier.

Therefore, there is a lack of indicators focused on the way innovation takes place inside emerging economies' firms. That is to say, it seems crucial to design new innovation indicators which allow the assessment of the innovative process inside these firms, going beyond the traditional input and output measures. This paper seeks to contribute with the filling of this existing gap. In this sense, it proposes a set of new innovation indicators that might be more adequate to the reality of firms located in emerging economies.

This paper is structured as follows. Section 2 deepens the discussion on the traditional innovation indicators and their limitations. Section 3 briefly reviews five economic approaches which provide the building blocks for the creation of new indicators on innovation. Section 4 presents the proposal of the new set of indicators on innovation. Finally, Section 5 presents the concluding remarks of the paper.

2. The Traditional Innovation Indicators

The first innovation indicators were developed based on the logic of the Linear Model of Innovation¹ that research leads to technology (Kline and Rosenberg, 1986). Overall, these indicators refer to R&D expenditures, human resources qualification, and patents. They represent the traditional innovation indicators. This section briefly discusses the diffusion of the traditional indicators, pointing some limitations of their transposition to firms operating in emerging economies.

2.1. A brief overview on the traditional innovation indicators

According to Godin (2002, 2004), the first recognised formal efforts for measuring innovation took place in the United States, during the 1930s. Specifically, it was in 1933 that the National Research Council (NRC), USA, based on the linear approach of innovation, created the first innovation statistics. These statistics - for instance, the relation of R&D expenditures to changes in volumes of sales, and the relative effectiveness of industrial laboratories in leading commercial development - were directly linked with research and development activities (Godin, 2002).

¹ The linear model was created to deal with a preestablished set of firms' planning, management, and operation skills at a specific historical moment. Once it could reach this purpose, the linear model became the standard model of innovation.

It seems, however, that the effective consolidation of these innovation indicators only took place 30 years later, during the 1960s. This was when the Organisation for Economic Co-operation and Development (OECD) developed a set of indicators to measure innovation at its member countries. This set of indicators gave rise to the Frascati Manual (OECD, 2002), a document which established the standard practices for the assessment of R&D activities. The Frascati Manual proposes a set of indicators to examine technological-scientific development via research and development activities, such as R&D expenditures and human resources devoted to R&D activities.

The Frascati Manual led to the creation of the “Frascati Family” manuals (OECD, 2002), which is composed by three more documents. The first one is the Oslo Manual, focused on innovation activities. The second one is the Canberra Manual, centred on human resources. The last one is the Technological Balance of Payments and Patents as Science and Technology Indicators.

The set of innovation indicators consolidated via the Frascati Manual became the standard instrument for measuring innovation. They are known as the traditional indicators on innovation. Figure 1, below, illustrates some of the traditional innovation indicators, amongst which it is worth stressing R&D and patents statistics (Becheikh, Landry, and Amara, 2006).

Figure 1: The traditional innovation indicators

- § *Intramural and extramural R&D expenditures*
- § *Operational R&D expenditures (e.g., acquisition of machinery and equipment)*
- § *Technology improvements expenditures*
- § *Training expenditures related to innovation activities*
- § *Number of collaborators devoted to R&D activities*
- § *Degree of collaborator’s qualification (e.g., number of PhDs)*
- § *Turnover from innovation*
- § *Bibliometrics*
- § *Patents*

Nowadays, the traditional indicators frequently serve as a guide for researchers, policy-makers, and managers. However, as the traditional indicators rely on the neoclassic logic of the linear model of innovation, they tend to focus only on the inputs and outputs of innovation activity (Godin, 2002).

Therefore, one important component of the innovative activity is not regarded by these indicators - that is, the intra-organisational perspective -, as they do not pay attention to what happens in-between the inputs and outputs of innovation activity. In other words, these indicators do not assess how the process of innovation takes place inside the firms. In this sense, the use of the traditional indicators can

provide a partial view of innovation, misleading the actions of academics, managers, and policy-makers. This can be especially prejudicial for firms located in emerging economies, such as Brazil.

2.2. The limitations of the traditional innovation indicators: why emerging economies' firms should not rely on them

Recent studies focused on the industrial innovation process in Latin America - especially in Brazil - argue that during the 1990s, following the process of economic liberalisation, there was the weakening of the innovative technological capabilities that were built up in the former decade. These studies state that nowadays Latin American firms are characterised by a lack of innovative capabilities and the complex R&D activities are concentrated in industrialised economies (Cassiolato and Lastres, 2000; Viotti, 2000; Cassiolato et al., 2001; Cimoli e Katz, 2003; Katz, 2004). According to this approach, the Latin American economies tend to specialise in commodities production and industrial routine activities.

Cimoli and Katz (2003), for example, state that Latin American countries display a passive role at world's innovative activities, characterised by the lack of firms' innovative skills. According to Katz (2004), with the destruction of the innovative capabilities built up in the 1980s, the innovative performance of Latin American firms became irrelevant, especially when compared to industrialised economies firms.

These studies, however, are exclusively based on the employment of the traditional indicators on innovation, which, as previously stated, do not seem to be the most adequate to measure innovation at emerging economies' firms. Naturally, the deliberated managerial commitment to innovation activity is relatively lower in firms located at emerging economies. Yet, this lower formal commitment does not necessarily mean the absence of innovative activities (Figueiredo, 2001; Arocena and Sutz, 2006; Vedovello and Figueiredo, 2006; Zawislak and Marins, 2007).

Measuring the innovative performance of a firm is a question much more complicated than measuring social and economic indicators (Archibugi and Coco, 2005). Therefore, macroeconomic statistics and indicators, such as the number of applied patents, the number of scientists and engineers devoted to R&D, and the amount of R&D expenditures, seem to be incapable of assessing the process of innovation and the way it happens inside firms.

Regarding R&D, the assessment of the amount of expenditures on research and development do not allow the evaluation of the purpose of the R&D activities neither of other activities undertaken out of the boundaries of R&D labs. Besides, it is worth stressing that the indicators on research and development activities are only prevalent at certain industrial sectors of industrialised economies - as

the USA, Germany, UK, and Japan - where firms comprise deep levels of formal R&D (Figueiredo, 2001).

For instance, in Brazil formal R&D expenditures are conversely derisory. According to the OAS (2007), in 2000, Brazil invested 1.05% of the country gross domestic product (GDP) in research and development activities. Firms were responsible for only 38.2% of this total, and government responded for around 60.2% of it. On the other hand, in the United States, the numbers were very different: 68.4% of R&D expenditures (which represented 2.68% of the American GDP) were made by firms and 27.1% by government entities.

Besides the unbalanced distribution between public and private expenditures in R&D, the total amount of R&D expenditure made in Brazil is much lower than in developed countries. Excluding the case of the global corporations, formal investments in R&D are not a deliberated component of the strategic decisions of the Brazilian managers. This is a reflection not only of the high cost of R&D activities but also of the lack of legal incentives.

In this context, the low amount of R&D expenditure also limits the employment of the number of human resources - for instance, engineers - devoted to R&D activities as an innovation indicator. Once there are low investments in formal R&D, it is not expected to find a high number of collaborators working on formal R&D activities. According to the Brazilian Ministry of Science and Technology (MCT, 2007), while in Brazil only 11% of the scientists and engineers were working at private firms, in the United States this proportion was of around 68%. This difference seems to be consistent with the low formal Brazilian R&D efforts.

As already mentioned, patents are another traditional indicator frequently acknowledged as a high measure of innovative capacity. However, it does not seem truthful expecting emerging economies to present the same bulk of patents as the USA economy, bearing in mind the high costs for patent registration and maintenance. In Brazil, the situation is worsened by the operational difficulties faced by the Brazilian authority for patenting, that is, the Brazilian National Patent Office (*Instituto Nacional de Propriedade Industrial* - INPI). Moreover, the validity of patents as an innovation indicator has been questioned even when regarding firms located in industrialised countries (Adams, Bessant, and Phelps, 2006).

Therefore, in spite of the merits and the relevance of the traditional indicators, their scope of analysis appears to be limited, especially in emerging economies' firms. Once innovation activity presents a different form in emerging economies' firms, the mere transposition of these indicators to a context where there are less (financial) resources available and where innovation activity is not always deliberated and structured seems to underestimate the innovative performance of the firms operating under these conditions.

As highlighted by Arocena and Sutz (2006), when the object under investigation is the existing innovation activities in emerging economies' firms, it is necessary to bear in mind the great impact of their informal character. Consequently, the application of instruments - in this case, indicators - designed for industrialised environments in emerging economies' firms can be misleading, bringing about the common generalisation that innovative activities are not developed by the firms which are not located at the technological frontier. In this context, it is possible to state that, before establishing any kind of comparison between firms of emerging and industrialised economies in terms of innovative performance, it is important to pay attention to the instruments guiding the assessment.

Taking Brazil once more as an example, it is possible to observe in the country the emergence of a set of studies which aimed to adapt the stressed traditional innovation indicators to the national reality. It is worth highlighting three of them, namely: (i) the research conducted by the National Association of Research, Development and Innovation of Innovative Enterprises, (ANPEI, 2001); (ii) the Industrial Survey of Technological Innovation (PINTEC), conducted by the Brazilian Bureau of Statistics (IBGE, 2005); and (iii) the study of the National Institute of Applied Economic Research (IPEA, 2005). In spite of their merits, these studies still rely on the traditional innovation indicators. Thus, even when they intend to examine the innovative process, they fail to capture important intra-organisational aspects (Figueiredo, 2006).

According to Salazar and Holbrook (2004), even when it is recognised that innovation activity goes beyond research and development, there are minor changes in the (linear) logic underlying the traditional innovation indicators, which still focus on inputs and outputs. Therefore, there is an urge to develop indicators on innovation capable of evaluating innovation as a whole process (Arundel, 2006; Godinho, 2007; Zawislak and Marins, 2007). And this process is not always a deliberated and clearly structured one - particularly when regarding firms located in emerging economies.

3. The Economic Theory as Support for the Creation of New Indicators on Innovation

It seems proper to state that in order to guarantee effectiveness to new indicators on innovation, their creation should be theoretically supported. According to Bloch (2008) and Schibany and Streicher (2008), new indicators on innovation should rely on theory in order to allow accurate application and interpretation. Therefore, with the purpose of developing new indicators on innovation, this paper searches for help from five approaches of the economic theory, namely: the Classic Theory, the Neoclassic Theory, the Schumpeterian Theory, the Theory of the Firm, and The Evolutionary Theory. These approaches, especially when taken together, are here considered valuable to broaden the understanding of the way the innovation process takes places inside firms and, thus, guide the creation of a new set of indicators.

3.1. The classic theory

Despite the fact that firms only recognised the importance of innovation as a strategic factor for competitiveness in the last decades, the concept of innovation and its relevance for economic development has been extensively stressed by the economic approach. This is so that the role displayed by technological and scientific development in pushing the economic prosperity of nations is part of the discussions found at the Classic Economic Theory.

The constitution of this approach is marked by the publication of the publication of the *Wealth of Nations* by Adam Smith (1776) which took place in England in the middle of the industrial revolution context. It is possible to state that this publication represents the study of the appropriate ways to keep economic order through the liberalism and the incorporation of technological innovations stemming from the revolution.

Smith (1776), by questioning the commercial regulation of the mercantilist system, states that the invisible hand of the market, that is, an environment of free competition, results in economic development. Besides, the author, in his labour theory of value, establishes the principles to analyse value. Briefly, the value of a good is determined by the amount of labour required to its production. The formation, accumulation, distribution, and consumption of the wealth (goods) constitute the pillar of the classic theory. This represents, in other words, the process of value generation.

Marx (1863) argues that the value is exactly what allows the transformation of labour's product into good. The author believes that goods represent an object capable of satisfying human needs directly - subsistence or consumption - and indirectly - means of production. Goods can be the by-product of a new sort of labour intended to satisfy the emerging material requirements of life or even to create unknown requirements.

According to Marx (1863), the wealth of the capitalist society relies on goods accumulation. The realisation of the price (ideal form of value) of a good is the realisation of the ideal value to use the money. The transformation of goods into money also represents the transformation of money into goods. Therefore, a single process ends two operations: sale, for the owner of the goods, and purchase, for the owner of the money. This represents the basic form of circulation of goods: transforming goods into money and then "re-transforming" money into goods; in other words, selling to then buy.

Marx (1863), however, highlights that actually it is another cycle that sustains the capitalist system: the transformation of money into goods and "re-transformation" of goods into money; that is, buying to sell. In this cycle, the buyer receives the good and, positioning himself as a seller, he transfers the good to another buyer. By doing so, he more than regains the money he had put into circulation, obtaining a greater amount than he previously had. In this context, money represents capital; and the circulation of

money as capital is the movement that allows value extension. The buyer, who owns the money and consciously feeds this movement, becomes, thus, the capitalist.

In this context, Marx (1863) believes that technology reveals the way men deal with the environment and the production process through which they sustain life and establish their social relations. Technological change, therefore, appears as a crucial condition for adding more value. According to the author, the need for development, inherent condition of the capitalist system, leads to technological progress. It is technological change that nurtures the maintenance and evolution of the dynamics of the capitalist system. Innovation takes place in the acceptance and valorisation of goods through the market.

The bourgeoisie - specifically, the capitalist - can only exist through the incessant revolution of the production means, which modifies all the production relations and, therefore, all the social relations. Therefore, there is a life-cycle for the development of new production techniques (Rosenberg, 1985). In this context, it seems adequate to state that if the capitalist wishes to keep the process of profits generation alive, he needs to innovate. Technological innovation, thus, exists to create and aggregate value, nurturing the functioning of the capitalist system. Without it, there is no value creation and, therefore, there is no economic development.

3.2. The neoclassic theory

In the end of the 19th century, with the Economics Neoclassic School, the focus of value creation debate was redirected to market and its relations (Zawislak, 2004), based on principles like equilibrium, rationality, and maximization. The neoclassic approach also relies on the principle of perfect free competition; once every supply creates its own demand, the market is able to promote the economic equilibrium (Possas, 2002).

In this context, technology is regarded as a static variable that a firm can find in the market. A firm, in turn, represents an actor with a status similar to the individual consumer; a passive agent with autonomy, responsible only for optimally transforming production factors into goods. The nature of the variables that a firm manipulates is not determined internally, but externally by the market structure surrounding it (Foss, 1998). Considering the information availability and the perfect estimation capacity (unbounded rationality), the firm behaves as an automaton, once programmed, programmed forever (Tigre, 2005).

Basically, by the neoclassical principles, firms, treated as individuals, operate with a determinate purpose; they are guided by standard objectives. Besides, they are capable of hierarchyly ordering their preferences, making optimal rational choices (Varian, 1999). In this sense, it is possible to affirm that

activities as planning and management are components of the neoclassical function of production, even if they are (wrongly) regarded as mechanical activities.

The decisions to be made by firms, however, are not regarded as a problem. In this approach, the main question is always how to allocate the existing resources in the most efficient way, that is to say, in order to guarantee firms more profits. In this context, by inference, the innovation process is simply regarded as a matter of resources allocation (Zawislak and Marins, 2007).

Therefore, even though recognizing the existence of technological innovation, the neoclassic theory does not deeply pay attention to this phenomenon. Technology is regarded as one more factor in the bulk of static production factors, when, actually, it should be understood as a dynamic element crucial for value aggregation. Once the economic orthodoxy does not focus on the examination of the processes that take place inside firms - as they are optimal resources allocation processes -, there is no concern about innovation management. The process of technological innovation is treated as a black box (Rosenberg, 1985; Fagerberg, 2003). No attention is paid to how innovation takes place within firms. Although the existence of innovation is acknowledged, it is only recognised outside the firms' scope, that is, exogenously.

3.3. The Schumpeterian theory

The emergence of the Schumpeterian approach is a result of an attempt to split with the neoclassic notion of equilibrium and maximisation. Discontented with the view of economic equilibrium and the exogenous role attributed to technology in the development process, Schumpeter (1912, 1942) argues that economic development is propelled by technical progress, that is, by technological change. The author believes that innovation is the essence of the process of economic development, as far as it represents the creation of new values. As Marx (1863), Schumpeter (1912, 1942) considers that technological development is the factor responsible for the generation of more value.

Regarding Schumpeter's work, it is worth mentioning the distinction he makes between invention and innovation. On the one hand, an invention represents an idea, a sketch or even a model to a new device, product, process or system. An invention not necessarily becomes an innovation. On the other hand, an innovation takes place when there are commercial transactions involving the new creation, that is, when it acquires market value. In this sense, it is worth mentioning that, in this study, the definition of innovation is similar to the Schumpeterian one. Here, innovation is understood as the generation and improvement of products and process, which allow firms to aggregate value (Tidd, Bessant, and Pavitt, 2005).

Until the materialization of the Schumpeterian approach, innovation was considered as originated outside of the economic system. Basically, there was no explicit explanation for it, once, following the

neoclassic view, the market was responsible to support the exchange of goods and services in their definite and finished forms. Schumpeter (1912), then, moves towards in the conceptualisation of development as an event that is not imposed from outside (by the market) to inside (the firm). The author postulates that the development process occurs inside firms, agents of economic transformation who induce consumers to desire new and different things to which they are not familiar with.

Technological innovation, therefore, helps firms to maintain a competitive position in the market, assuring extraordinary profits to entrepreneurs. The entrepreneurs, in turn, are responsible for the development of the economy, once they are the agents fomenting the dynamism of the economic system, turning it into a competitive environment which continuously generates new opportunities.

Initially, Schumpeter (1912) defines the entrepreneur as an individual agent capable of running a new business, even if not owning the capital. According to the author, the entrepreneur is that person who takes the risk of running a business and is capable of successfully generating technological innovations, creating new markets, and overcoming the competitors.

Therefore, the Schumpeterian entrepreneur is more than a simple capitalist or manager. While a manager is someone who chairs a managerial position at firms, dealing known production techniques, the Schumpeterian entrepreneur is that one who deliberately and proactively seeks for opportunities to generate differentiated profits - that is, more value -, yet not obtained by nobody else and which, he knows, he will only get innovating (Winter, 2006).

Afterwards, some differences regarding both firms and countries became more prominent. Firms achieving extraordinary profits were overcoming the others. Countries' development path was being based on much more than comparative advantage. Schumpeter (1942), then, described it a consequence of the creative destruction process. Through the creative destruction process Schumpeter (1942) states that technologies, by the same time they are creative, are destructive. The emergence of a new technology supplants old technologies. Thus, new products steal the place of old products, and new productive structures knock down structures in use. And this is the process that stimulates economic development and progress.

Therefore, the process of creative destruction acclaims the innovative firms, which prevail over firms incapable of following this deliberated continuous process of change. The real economic competition takes place among the innovative enterprises that generate new products and remove old products from the market. The capitalist dynamic promotes a permanent state of innovation, change, discontinuity, replacement, and creation of new consumption habits, marked by value aggregation - as in Marx (1863). Briefly, the creative destruction is responsible for the economic growth of a country and technological progress is crucial for understanding the competitive process, as well as the capitalist system itself.

In this context, Schumpeter (1942) transposes the definition of entrepreneur from the individual to the organisational sphere, where it takes place into firms' research and development laboratories. Hence, the fact that innovation activity happens inside firms and, therefore, must be structured and conducted by them is finally recognised - even though without opening the black box.

When regarding terms as structure, coordination - going beyond allocation - and market - going beyond equilibrium - it seems to be of help to discuss some principles of the Coasean (1937) view of the nature of the firm.

3.4. The Coasean theory - the theory of the firm

It is possible to state that Coase (1937) is among the authors who question the neoclassic view that firm behave as an individual agent. The author specifically criticises the lack of realism and the emphasis on individual agents in detriment of the organisational sphere (Winter, 1993). The discontentment with the notions of equilibrium and automatic market adjustment - that is, the intrinsic capacity of the market to effectively conduct the economic transactions - leads the author to examine the nature of the firm, attempting to explain why there is not only one big firm in the economy.

The key-question put by Coase (1937) is: why do organisations (firms) exist? The author argues that, if the market by itself was enough to coordinate economic transactions, it would respond for the coordination of all these transaction; that is to say, there would not be transactions coordinated by firms. According to him, firms exist because of the inherent costs of undertaking certain activities in the market.

In many cases, the costs of pursuing a good in the market are higher than its real price. This occurs because the acquisition of the good in the market also involves other costs, such as searching, bargaining, and maintenance of industrial secrecy. This situation suggests firms appear when they can internally organise the production of what they require without being necessary to go to the market, thus, avoiding the transaction costs².

Therefore, Coase (1937) argues that there is a series of transaction which can (and must) be developed internally, i.e., within firms, saving them from facing the troubles of doing these transactions in the market. In other words, in many cases, it is cheaper for a firm to internally undertake its activities - among which innovation can be included - than to go to the market to execute them, once going to the market could imply higher transaction costs. Basically, that is the reason why firms exist.

² In fact, in his paper, Coase (1937) employs the term marketing costs. The term transaction costs is explicitly employed years later, by the Transaction Cost Economics (TCE). Transaction costs are defined as the incurred cost by "using" the market (Williamson, 1975, 1985, 1996). Besides, this theory states that transaction costs emerge as a consequence of institutional events - for instance, market structures, norms and regulations. The capacity of a firm to deal with these institutional events is inversely proportional to its transaction costs.

Besides explaining firms' existence, Coase (1937) introduces the entrepreneur-coordinator, whose action is focused on the minimisation of the economic transaction costs, as a crucial agent inside the firm. As the Schumpeterian (1912, 1942) entrepreneur, the Coasean (1937) coordinator is more than a single manager or capitalist. In some way, it is as if the Schumpeterian (1912, 1942) entrepreneur gets together with the Coasean (1937) coordinator to redefine the role of planning and management activities within the firm and, therefore, redefine the role of the firm in the capitalist system.

The entrepreneur, thus, becomes directly responsible for finding alternative forms for organisation, in order to avoid the transaction costs which would decrease firms' profits. In other words, he is the responsible for avoiding unnecessary market operations, that are the ones in which the costs of internalising certain activities are more advantageous than the costs of acquiring them, being, for this reason, a source of value generation for the firm. This added value is the aim of every single firm. In this sense, a continuous process of new combination of resources, which result is validated by the market, must take place within firms (Phelan and Lewin, 2000). This process of resources recombination and market validation represents the Schumpeterian innovation process, in which innovation is concretised by commercial transactions.

It is worth keeping in mind that, as put by Coase (1937), each firm presents a individual limit delineated by its transaction costs. If the management of the transaction costs is a responsibility of the entrepreneur-coordinator, it seems reasonable to state that the limit of a firm is simply represented by the capacity of this agent to deal with an additional transaction. Hence, the entrepreneur-coordinator is the agent who based on his judgement capacity, gives birth to the firm and, besides that, projects its limits. According to Zander (2007), the entrepreneur-coordinator is the agent who, relying on a set of resources and capabilities, decides the actions to be undertaken internally in order to allow a firm to achieve its purpose - i.e., to add value. This fact highlights the existence of an internal deliberated decision-making process, even if based on personal judgements, which, in turn, underlines the requirement of an internal structure for choosing deliberated strategies.

In this context, supplying market needs is an intrinsically entrepreneurial activity which involves much more than the minimisation of transaction costs or the escape from contractual hazards; it involves value creation and aggregation (Alvarez and Barney, 2005). Even if temporarily, firms take on new structures to avoid transaction costs. As in the Schumpeterian (1942) approach, here firms are continuously engaged on the search for novelty that can bring extraordinary profits.

As a result, the need for deliberated processes of coordination and management is to some extent enlarged in the economic field, once, considering this context, it is necessary to go further than the static neoclassic approach for planning and management. In order to generate the new, it is not possible to take these functions as obvious and repetitive. In a context of continuous change and

bounded rationality of the economic agents (Simon, 1947), decision-making is a problem that concerns to firms.

Additionally, the Theory of the Firm recognises technological innovation as an endogenous variable, that is, internal to the firm. Although the innovation process is not directly investigated, it is considered as a process that is internal to and dependent of the firm. Therefore, it is possible to argue that this approach bring some contributions to the understanding of innovation activity, allowing it to be identified as an intra-organisational activity which requires formal structure and deliberation. This, in turn, is propelled by the action of the entrepreneur-coordinator and its projections of the limits of the firm.

When emphasising the role of the entrepreneur and the coordinator, Schumpeter (1912, 1942) and Coase (1937) respectively highlight the structuring deliberated entrepreneurial character of the managerial function. They are the agents who collect information, make decisions, analyse, synthesise, and reconfigure situations in the search for extraordinary profits.

Therefore, in order to sustain a permanent state of change - that is, innovation - in the search for extraordinary profits, firms should turn the solution-seeking process into a continuous effort to manage innovation. In this context of search for extraordinary alternatives, the prior steady world becomes a complicated scenario where the neoclassic theory is not able to explain the reality. In the 1980s, based on this argument a new set of ideas concerning innovation activity emerges, namely: the Evolutionary Theory of Economic Change.

3.5. The evolutionary theory of economic change

It is notably guided by the Schumpeterian (1912, 1942) perspective that Nelson and Winter (1982) establish the principles of the Evolutionary Theory of Economic Change, in which the term change is a synonym for technological development. The authors seek to understand the differences among firms in term of innovation. Here, the question addressed is why some firms overcome others.

According to the evolutionary theorists, the development of new technologies is made possible by intra-organisational efforts that firms undertake in their search for a competitive position in the market, which, a propos, is achieved by technological development. Firms undergo a natural selection process, in which the survivors are those more innovative. This process of technological development, in turn, is guided by firms' organisational routines.

Nelson and Winter (1982) define organisational routines as a set of fundamental organisational skills for the development of firms' core competences. In other words, organisational routines represent the predictable behavioural patterns of a specific organisation.

The productive activity, in turn, corresponds to a learning process that takes place through a routine. This routine is continuously challenged by unpredictable problems, which, evidently, require a solution. And this solution is sought via projects. The application of an originated solution corresponds to a learning process. This is a ceaseless cycle which represents the central mechanism of the problem-solving activity and of the improvement of organisational routines and techniques. It is in the course of this cycle that firms develop their technological capabilities.

According to Lall (1992) and Bell and Pavitt (1993), the technological capabilities of a firm represent the resources required to generate and manage technical change, embedded into individual and organisational systems. Amongst these resources, it is important to highlight experience, knowledge, and its tacit and explicit dimensions, and the institutional structures and relations intern and extern to firms.

When dealing with technological capabilities, it is worth distinguishing between the concepts of productive and innovative capacity. It is important to consider the differences between routine capabilities - capability to use - and innovative capabilities - capability to change. The idea of productive capacity is related to routine capabilities, which are the resources required to produce goods and services into certain degree of efficiency, using a set of factors, such as, abilities, equipment, products and production specifications, and organisational systems and methods. The innovative capacity embodies additional and distinct resources to generate and manage technological change.

The development and accumulation of technological capabilities are crucial for firms to engage in innovative activities. This fact is even more critical for emerging economies' firms, which, generally stating, need to catch up. According to Dosi (1982), the differences among firms' performance can be understood as an implication of the differences in capabilities accumulation, which leads firms to engage in distinct technological paths.

In brief, the concern of the evolutionary theorists about what happens inside firms makes possible to highlight the need for looking at the innovation activity anchored in another angle, that is, the firm intra-organisational one. By doing so, the evolutionary theory stresses the process that take place inside firms, together with firms themselves, as the unit of analysis. Moreover, it adds new elements to innovation activity, such as routines, knowledge, learning, technological capabilities, and problem-solving, which surpass research and development activities. For that reasons, these elements can be useful to support the creation of new indicators on innovation.

3.6. Summarising the contribution of the economic theory to the development of a new perspective to evaluate innovation activity

Throughout this section, five streams of thoughts of the economic theory were emphasised with the aim to search for theoretical concepts and elements that could support the creation of new and broader innovation indicators. These key-concepts are summarised in Figure 2, below.

Figure 2: Key-elements to be considered for the development of new indicators on innovation

ECONOMIC THEORY	KEY-CONCEPT
§ Classic (Marx)	§ Value, technology
§ Neoclassic	§ Planning, management
§ Schumpeterian	§ Invention, innovation, entrepreneur
§ Coasean	§ Structure, limit, entrepreneur-coordinator
§ Evolutionary	§ Dynamism, uncertainty, change, technological capabilities

The role attributed to value in the economic development process by the classic theory makes possible to highlight the importance of technological evolution in the process of wealth creation and accumulation. Technological change is regarded as the element which propels the maintenance and evolution of the capitalist system, through a process of goods acceptance and estimation. For that reason, when measuring innovation, it seems important to pay attention to the generation of novelties which allow them to aggregate value. Currently, this is, to some extent done by a number of the traditional output indicators which focus on aspects like number of new products and turnover increase from them, for example. However, there are other outputs aspects which still suffer from lack of measurement (Knell, 2008).

Regarding the neoclassic approach, despite the fact that the here called into question traditional innovation indicators relies on the neoclassic approach - once they stem from the linear neoclassic model -, planning and management play are elements that play an important role on the innovation process. The point is that, since technology represents more than a static production factor, it is impossible to rely on the assumption that once a firm has all its activities planned, they will be repeatedly undertaken in the same optimising way. However, even though not mechanical, planning and management do are essential activities for innovation. And the fact that these elements are not mechanical and sometimes neither systematically arranged - especially at emerging economies' firms - seems to give reason for considering them as key-elements for the creation of new indicators.

In this non-mechanical uncertain context, the character of the Schumpeterian (1912, 1942) entrepreneur gains notability. He is the agent who, in his seek for extraordinary profits, foments the process of creative destruction, which is the essential fact about capitalism (Schumpeter, 1942).

Besides, when joining the Coasean (1937) view to this concept, it is possible to go further and understand the entrepreneur as the agent who helps to redefine the role of the former mentioned planning and management activities and, therefore, the entire function and structure of the firm in the capitalist system. Hence, aspects like structure, limits, and, obviously, the entrepreneur-coordinator are considered useful to give rise to new indicators.

Finally, the dynamic intra-organisational perspective of the evolutionary theory emphasises the need for evaluating the way innovation process take place inside firms. Once each firm presents a singular path of technological development, it is important to pay attention to a bulk of specific resources on which firms rely to perform innovative activities, like the previously mentioned uncertainty, routines, knowledge, and technological capabilities.

If innovation represents an uncertain activity in institutionally stable environments, the situation is much more fragile in emerging economies' firms. That is why the concepts here underlined are considered the building blocks - i.e., key-elements - for the development of a set of new indicators on innovation.

4. The Proposition of a Set of New Indicators on Innovation

As previously mentioned, in order to go beyond the inputs and outputs measures and, therefore, widen the focus of the traditional indicators, new indicators on innovation should be able to measure aspects related to the way the innovation process takes place within firms (Arundel, 2006; Godinho, 2007; Zawislak and Marins, 2007). In the specific case of firms operating in emerging economies, this process is not always formally deliberated or structured.

Based on some of the building blocks of the theories discussed on the former section, this section presents the proposed set of new indicators on innovation, which it is here believed to be of help for emerging economies' firms to better measure innovation. Specifically, the previously highlighted key-elements give rise to a set of indicators which are here divided into four factors, namely: (i) Entrepreneurship; (ii) Structure; (iii) Coordination; and (iv) Value. Four indicators are proposed for each one of these factors, as presented in Table 1.

In terms of Entrepreneurship, the indicators proposed are: creativity, achievement capacity, project champions, and errors. The first one, Creativity, assesses the amount of ideas generated and converted into projects in a certain period of time. The Project champions' indicator evaluates the medium number of individuals who propels innovation projects. The Achievement capacity measures the number of innovation projects that turn into an innovation. The last indicator, Errors, evaluates the mistakes related to innovation projects and the lessons learnt from them.

Table 1: Proposition of a new set of indicators on innovation

FACTOR	INDICATOR
ENTERPREUNERSHIP	Creativity
	Project champions
	Achievement capacity
	Errors
STRUCTURE	Integration
	Equipment
	Technology nature
	Technological maturity
COORDINATION	Innovation strategy
	Innovation projects' portfolio
	Cadence
	Partnerships
VALUE	New products and process
	New markets
	Time to profit
	Value aggregation

Regarding the factor Structure, the first indicator is Integration, which measures the extent to which firms' innovative activities are internally and externally distributed. The indicators Equipment assess the bulk of machinery, equipment and software related to innovative activities. Technological nature evaluates the kind of technologies the firm deals with. Finally, Technological maturity measures the level of evolution of the technologies firms are dealing with.

The indicators for Coordination compress indicators related to the organisation of innovation. Innovation strategy tracks the internal process of innovation strategy selection, assessing the degree of deliberation involved. Innovation projects' portfolio comprises the joint evaluation of the nature of the innovation projects, the area, the time frame, and the amount of funding dedicated to them. Cadence measures the number of projects that a firm is able to carry out in a certain period of time.

In terms of Value, New products and process refers to the number of new products (goods or services) launched and processes implemented in a certain period of time. New markets is the indicator which evaluates firms' entrance and performance in new markets due to innovations. Time to profit estimates firms' medium time to profit from new products and processes. Finally, Value aggregation measures the percentage of value aggregated to firms via innovation.

5. Concluding Remarks

By tradition, innovation measurement relies on inputs and outputs indicators, which guide academic, managerial, and policy-related actions. These indicators, however, are only able to evaluate the

extremes of innovation activity, once they do not capture the intra-organisational process of innovation. This is especially prejudicial for emerging economies' firms.

The focus of this paper was to propose a set of new indicators on innovation that might be more adequate to the reality of firms located in emerging economies, centring on the way innovation activities process takes place within the firms. Creating new innovation indicators, however, is far away from being an easy task. The development of the proposed indicators relied on key-concepts dug up from five approaches of the economic theory.

Certainly, the measures presented in this paper so far represent theoretical prepositions. For them to really become useful new indicators innovation, one step further is required, which is their test and refinement. If recognized as new valid indicators on innovation, they could shed some light on the role emerging economies' firms play at world's innovative activities. This, in turn, would elucidate the strengths and weakness of these firms for managers and policy-makers, giving them better support to design and implement innovation strategies and policies.

References

- Adams, R., J. Bessant and R. Phelps. 2006. "Innovation management measurement: A review", *International Journal of Management Review*, 8:1, pp. 21-47.
- Alvarez, S. and J. Barney. 2005. "How do entrepreneurs organize firms under conditions of uncertainty?", *Journal of Management*, 31:5, pp. 776-973.
- Archibugi, D. and A. Coco. 2005. "Measuring technological capabilities at the country level: A survey and a menu for choice", *Research Policy*, 34:7, pp. 175-194.
- Arocena, R. and J. Sutz. 1999. "Looking at national systems of innovation from the South", Conference paper for the DRUID Summer Conference on National Innovation Systems, Industrial Dynamics and Innovation Policy, Aalborg, Denmark, 9-12 June.
- Arundel, A. 2006. "Innovation survey indicators: Any progress since 1996?" Paper for the G20 at the Leader's level Workshop (L20 Workshop), Maastricht, The Netherlands.
- Associação Nacional de Pesquisa, Desenvolvimento e Engenharia das Empresas Inovadoras (ANPEI). 2001. "*Indicadores empresariais de capacitação tecnológica: Resultados da base de dados ANPEI 2000*". São Paulo, Brazil: ANPEI.
- Becheikh, N., R. Landry and N. Amara. 2006. "Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993-2003", *Technovation*, 26:5, pp. 644-664.
- Bell, M. and K. Pavitt. 1993. "Technological accumulation and industrial growth: Contrasts between developed and developing countries", *Industrial and Corporate Change*, 2:2, pp.157-211.

- Bloch, C. 2008. "Innovation indicators and performance: An analysis for Danish firms", Conference Paper for the 2nd PRIME Indicators Conference, Oslo, Norway, 28-30 May.
- Cassiolato, J. and H. Lastres. 2000. "Local systems of innovation in Mercosur countries", *Industry and Innovation* 7:1, pp.33-54.
- Cassiolato, J., H. Lastres, M. Szafiro and M. Vargas. 2001. "Local systems of innovation in Brazil, development and transnational corporations: A preliminary assessment based on empirical results of a research project". Conference Paper for the DRUID Nelson-Winter Conference, Elsinore, Denmark, 14-16 June.
- Cimoli, M. and J. KATZ. 2003. "Structural reforms, technological gaps and economic development: A Latin American perspective", *Industrial and Corporate Change*, 12: 2, pp. 387-407.
- Coase, R. 1937. "The nature of the firm", *Economica*, 4:16, pp. 386-405.
- Dosi, G. 1982. "Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change", *Research Policy*, 11:3, pp. 147-162.
- Fagerberg, J. 2003. "Innovation: a guide to the literature". Working Paper number 20031012 on Innovation Studies for the Centre for Technology, Innovation and Culture. University of Oslo, Oslo, Norway.
- Figueiredo, P. 2001. "*Technological learning and competitive performance*". Cheltenham, UK, and Northampton, USA: Edward Elgar.
- _____. 2006. "Introduction", *International Journal of Technology Management*, 36: 1-3, pp. 1-13.
- Foss, N. 1998. "Firms and the coordination of knowledge: Some Austrian insights". Working Paper number 29 for the Danish Research Unit for Industrial Dynamics (DRUID). Elsinore, Denmark.
- Godin, B. 2002. "The rise of innovation surveys: Measuring a fuzzy concept". Working Paper for the Canadian Science and Innovation Indicators Consortium, Project on the History and Sociology of S&T Statistics. Montreal, Canada.
- _____. 2004. "The obsession for competitiveness and its impacts on statistics: The construction of high-technology indicators", *Research Policy*, 33:8, pp. 1217-1229.
- Godinho, M. 2007. "Indicadores de C&T, inovação e conhecimento: Onde estamos? Para onde vamos?", *Análise Social*, 62:182, pp. 239-274.
- Instituto Brasileiro de Geografia e Estatística (IBGE). 2005. "*Pesquisa industrial de inovação tecnológica (PINTEC)*". Rio de Janeiro, Brazil: IBGE.
- Instituto de Pesquisa Econômica Aplicada (IPEA). 2005. "*Inovações, padrões tecnológicos e desempenho das firmas industriais brasileiras*". Brasília, Brazil: IPEA.
- Katz, J. 2004. "The limits of the prevailing orthodoxy: Technology and education as restrictions to productivity growth and international competitiveness in Latin America". Conference Paper for the DRUID Summer Conference on Industrial Dynamics, Innovation and Development. Elsinore, Denmark, 14-16 June.

- Kline, S. and N. Rosenberg. 1986. "An overview of innovation". In: Landau, R. and N. Rosenberg. (eds), *The positive sum strategy: Harnessing technology for economic growth*. Washington, DC: National Academies Press, pp. 275-305.
- Knell, M. 2008. IGNOREd: Key factors for innovation and growth in the Nordic economies. Presentation for the Nordic Innovation Centre Seminar on Evaluation of Innovation for Policymaking and Better Use of Innovation Indicators. Oslo, Norway, 27 June.
- Lall, S. 1992. "Technological capabilities and industrialization", *World Development*, 20:2, pp. 165-186.
- Marx, K. 1863. "*O capital*". São Paulo, Brazil: Nova Cultural, 1985. (for the Brazilian translation)
- Ministério da Ciência e Tecnologia (MCT). 2007. "*O sistema de C&T como parte do sistema nacional de inovação*". Brasília, Brazil: MCT.
- Nelson, R. and S. Winter. 1982. "*An evolutionary theory of economic change*". Cambridge, UK: Harvard University.
- Organization of American States (OAS). 2007. "*Ciência, tecnologia, engenharia e inovação para o desenvolvimento: Uma visão para as Américas no século XXI*". Washington, DC: OAS.
- Organisation for Economic Co-operation and Development (OECD). 2002. "*Frascati Manual 2002: Proposed standard practice for surveys on research and experimental development*". France, Paris: OECD.
- Phelan, S. and P. Lewin. 2000. "Arriving at a strategic theory of the firm", *International Journal of Management Review*, 2:4, pp. 305-323.
- Possas, M. 2002. "Concorrência Schumpeteriana". In: Kupfer, D. and L. Hasenclever. (eds), *Economia industrial: Fundamentos teóricos e prática no Brasil*. Rio de Janeiro, Brazil: Campus.
- Rosenberg, N. 1985. "*Inside the black box*". Cambridge, UK: Cambridge University Press.
- Salazar, M. and A. Holbrook." 2004. A debate on innovation surveys", *Science and Public Policy*, 31:4, pp. 254-266.
- Schibany, A. and G. Streicher. "How not to compare innovation performance: A critical assessment of the European Innovation Scoreboard". Conference Paper for the 2nd PRIME Indicators Conference, Oslo, Norway, 28-30 May.
- Schumpeter, J. 1912. "*A teoria do desenvolvimento econômico*". São Paulo, Brazil: Abril, 1985 (for the Brazilian translation).
- _____. 1942. "*Capitalismo, socialismo e democracia*". Rio de Janeiro, Brazil: Fundo de Cultura, 1961 (for the Brazilian translation).
- Simon, H. 1947. "*Administrative behavior*". New York, USA: Free Press.
- Smith, A. 1776. "*A riqueza das nações: Investigação sobre sua natureza e suas causas*". São Paulo, Brazil: Abril Cultural, 1983 (for the Brazilian translation).

- Tidd, J., J. Bessant, and K. Pavitt. 2005. “*Managing innovation: Integrating technological, market and organizational change*”. Canada: John Wiley & Sons.
- Tigre, P. 2005. “Paradigmas tecnológicos e teorias econômicas da firma”, *Revista Brasileira de Inovação*, 4:1, pp. 187-223.
- Varian, H. 1999. *Microeconomia: princípios básicos*. Rio de Janeiro, Brazil: Campus.
- Vedovello, C. and P. Figueiredo. 2006. “*Capacidade tecnológica industrial e sistema de inovação*”. Rio de Janeiro, Brazil: FGV.
- Viotti, E. 2000. “Passive and active national learning systems: A framework to understand technical change in late industrializing economies and some evidences from a comparative study of Brazil and South Korea”. Conference Paper for the 4th International Conference on Technology Policy and Innovation, Curitiba, Brazil, 28-31 August.
- Williamson, O. 1975. “*Markets and hierarchies: Analysis and antitrust implications*”. New York, USA: Free Press.
- _____. 1985. “*The economic institutions of capitalism*”. New York, USA: Free Press.
- _____. 1996. “Economics and organization: A primer”, *California Management Review*, 38:2, pp.131-146.
- Winter, S. 1993. “On Coase, competence, and the corporation”. In: Williamson, O. and S. Winter. (eds), *The nature of the firm: Origins, evolution, and development*. New York, USA, and Oxford, UK: Oxford University Press, pp. 179-193.
- _____. 2006. “Towards a neo-Schumpeterian theory of the firm”, *Industrial and Corporate Change*, 15:1, pp. 125-141.
- Zander, I. 2007. “Do you see what I mean? An entrepreneurship perspective on the nature and the boundaries of the firm”, *Journal of Management Studies*, 44:7, pp. 1141-1164.
- Zawislak, P. 2004. “Nota técnica: Economia das organizações e a base para o pensamento estratégico”. In: Clegg, S., C. Hardy and D. Nord. (eds), *Handbook de estudos organizacionais*. São Paulo, Brazil: Atlas, pp.180-185.
- Zawislak, P. and L. Marins. 2007. “Strengthening the innovative activity in developing countries: A proposal of total innovation management system and non-conventional indicators”. Conference Paper for the 16th International Conference on Management of Technology, Miami, EUA, 14-17 May.

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