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## **IMMATURE NATIONAL SYSTEMS OF INNOVATION: INTRODUCING A COMPARISON BETWEEN BRAZIL, MEXICO, INDIA, AND SOUTH AFRICA**

### **I- OBJECTIVE**

The objective of this paper is to present and analyse data in order to evaluate immature National Systems of Innovations. It aims also at suggesting a methodological approach to compare NSIs with similar degrees of development.

Taking the Brazilian NSI as a typical immature NSI, this paper presents analytical and statistical evidence for the assessment of the Brazilian situation, introducing a characterisation of immature NSIs. From this characterisation, briefly presented below, the paper will make a comparative analysis of four immature NSIs (Brazil, Mexico, India and South Africa).

### **II- THE CONCEPT OF NSI AND A SUGGESTION OF A TYPOLOGY FOR LESS-DEVELOPED COUNTRIES**

Nelson (1993) pushes forward the research about National Systems of Innovation (NSI), with a comparative analysis about the differences, diversity, and specificity of NSIs.

This paper suggests a qualification of the concept of NSI, to improve its suitability for less-developed countries. These countries, as it is known have not yet a sufficiently developed national system of innovation. In a tentative typology for developing and less-developed countries it was suggested that there is an evolutionary path by which NSI

evolve (Albuquerque, 1999). So, a trend from immature NSIs (Brazil, Russia, Malaysia, Indonesia etc), catching up countries as the dividing line (Korea and Taiwan are obvious examples) and mature NSIs (United States, Japan, Germany, Sweden etc) was proposed. According to this typology, Brazil, India, Mexico, and South Africa may be classified in the same category: systems with a relatively developed scientific infrastructure, not significant technological activities of national firms, important participation of transnational corporations in key sectors of the economy, inequality and concentration of economic and technological resources within these systems.

## II- THE BRAZILIAN CASE AS A TYPICAL IMMATURE SYSTEM OF INNOVATION

On the basis of an analysis of patenting activity in Brazil from 1980 to 1995 (Albuquerque, 2000) one could point out at least six major differences between the Brazilian NSI and those of developed countries: a) the relative importance of patents belonging to individuals as opposed to firms; b) the relatively low productivity (in terms of patenting) of firms' technological efforts; it is not only that firms underinvest in R&D and innovation in Latin American countries, but also that relatively little patenting activity result from such low effort; c) the lack of continuity in patenting activity by firms; in Brazil, between 1980 and 1995, 1,207 firms (62% of patent owner firms) were granted only one patent; only 35 firms were granted at least one patent a year in the referred period; d) a concentration of patenting in some sectors, particularly those presenting relatively low dynamism; e) the absolute as well as relative decline in the number of patents of the machinery sector; this is certainly related to the systematic decline of the productive investments, during the 1980s and 1990s (and the development in this sector is key for "catching up" processes); f) the relative importance of patenting by foreign-owned firms (13.7% of the total between 1980 and 1995), and the preliminary evidence of the low level of internalisation of technological activities by transnational corporations (Biazzi & Albuquerque, 2001).

The character of the innovations generated by these firms nevertheless indicate the predominance of adaptive innovations, confirming conjectures carried out by Barre (1996),

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which suggest a kind of co-action between firms from countries with a “strong” innovation system and their subsidiaries in countries with “weak” systems.

### III- COMPARING THE BRAZIL WITH MEXICO, INDIA AND SOUTH AFRICA

This section will present statistical information about patenting activities of these four countries (using USPTO data) scientific publications (according to the ISI).

Research for this paper has already gathered 5,999 USPTO patents. Table I shows general information about these patents. Two types of patents constitute the databases. First, patents granted by the USPTO to at least one assignee resident in those four countries (ASS in Table I). Second, patents granted by the USPTO with at least one inventor resident in those countries and without any assignee resident in those countries (INV, in Table I).

TABLE I  
Patents granted by the USPTO to assignees residents in the country (ASS), and to inventors resident in the country (INV)  
(Brazil, India, Mexico and South Africa)  
(1981-2001)

ANOS	INDIA		SOUTH AFRICA		MEXICO		BRAZIL	
	ASS	INV	ASS	INV	ASS	INV	ASS	INV
1981-1985	12	63	215	251	72	163	55	95
1986-1990	25	95	255	363	77	162	96	125
1991-1995	54	172	235	359	78	206	188	150
1996-2001	270	360	287	409	174	358	241	334
TOTALS	361	690	992	1,382	401	889	580	704

SOURCE: USPTO, author’s elaboration

The database is organised differentiating between the nature of the assignee (individual, institutions, domestic firms and foreign-owned firms), and identifying the technological class of the patent (according to the WIPO classification). Using these data, a profile of the technological specialisation of these countries is calculated.

Second, data about scientific papers from the ISI is analysed to investigate the scientific infrastructure and the scientific specialisation of these countries (Albuquerque,

2001). The data also refers to the years between 1980 and 1999. In 1999, for example, India published 17,077 papers, Mexico 2,791, South Africa 3,410, and Brazil 9.668 papers.

Third, general data about education, industrial structure, income etc will be gathered to complete a general picture of these four NSIs.

The analysis of these data will help in establishing a framework for a comparison between these different NSIs. Although all these countries may be characterised as “immature”, according to the typology already mentioned, it is expected significant differences in terms of the leading patenting institutions, the patterns of technological and scientific specialisation, the matching (or mismatching) of these specialisations, etc. These differences will be singled out and analysed. However, general similarities between these immature NSIs will also be pointed out and a broad differentiation of these NSIs vis-à-vis, on the one hand, the more developed NSIs, and on the other hand, the less developed NSIs should also be emphasised.

#### IV- PRELIMINARY CONCLUSIONS AND AN AGENDA FOR FURTHER RESEARCH

This paper concludes summarising the main findings of this research, evaluating whether or not a category of immature NSIs makes any conceptual sense.

The paper will also attempt at assessing, in a preliminary way, if the use of these databases (USPTO and ISI) are suitable for a comparative work between NSIs of less-developed countries. If the results the paper are sufficiently robust, there might be some ground for starting joint research involving scholars and students interested in these countries. A preliminary agenda, including a balanced mix of case studies and statistical evaluation, will be proposed at the end of the paper.

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