National Innovation Systems in Angola and Mozambique

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NATIONAL INNOVATION SYSTEMS IN ANGOLA AND MOZAMBIQUE

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ABSTRACT

This work has as objective to approach the theme **"National Innovation Systems in Angola and Mozambique".**

We concluded that Angola and Mozambique need to define economics policy that have as objective to promote the growth of their GDP per capita and human development.

Both government need to define strategies for promotion the internet access for enlarging of knowledge about others cultures that can help on promotion of innovation, and these government should to promote the enlarging of investigators in R&D for also promotion of innovation on divers areas such health, education, etc. And both government should not forget to promote the increase of rate of adult alphabetization that pass for promotion to access of education for people more necessitated and should not forget to promote of protection of intellectual property, and so, firms and companies can employ skilled people and through use of technology advanced can promote innovation and commercialize that, and this skilled people can too discovery and develop better technology and improve innovation system for development of the both countries on globalization era.

Keywords: Innovation, National Innovation System

JEL Codes: M19, O14, O31, O32, O33, O34, O57

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INTRODUCTION

According to Lundvall (1992), **national innovation system** is a social system. A central activity in the system of innovation is learning, and learning is a social activity, which involves interaction between people. It is also a dynamic system, characterized both by positive feedback and by reproduction.

The most fundamental reason for scholars to begin to think in terms of innovation systems had to do with fact it was, increasingly, realized that innovation is an interactive process (Cassiolato, Lastres, et al, 2003). While production systems put the emphasis on the structural characteristics, there are completely neglected in the business system approach where the focus is an cultural, social and institutional dimension of national economies.

This work has as objective to approach the theme **"National Innovation Systems in Angola and Mozambique"**.

Methodology

The methodology adopted is based on method scientific of Thomas Khun, that permit us through statistical dates see state of a paradigm that in this case are intellectual property, technology (Manuel, 2006).

The methodology is based in statistical data from World Economic Forum.

1. THEORETICAL APPROACH OF NATIONAL INNOVATION SYSTEMS

The innovation system as an open system is part of a comprehensive hierarchy of systems. It consists of a number of subsystems and is linked to other systems of the economic system which represent the high-level system (Schienstock, 2004).

The importance of nation-specific factors in developing technological innovation has been boldly affirmed since the mid-1980s. Chris Freeman introduced the concept of national innovation system (NIS) to describe and interpret the performance of the economically most successful country of the post-war period, Japan (Archibugi and Michie, 1997). And over the subsequent years this concept has experienced a remarkable diffusion and has been applied to several countries and to different areas.

According to Edquist (1997), the concept of innovation system conveys the idea that innovation does not originate as isolated, discrete phenomena, but are generated by means of the interaction of a number of entities or actors/agents. The set of actors and interactions has some specific features that are conserved over time, and it behaves as a whole in a large number of circumstances, and these characteristics are shared by national, regional, sectoral, or technological innovation systems.

Nation-specific factors play a crucial role in shaping technological change. Some of these factors are institutional, such as education, public support to industrial innovation, and defence-related technology schemes.

They can all be represented as sets of institutional actors and interactions, having as their ultimate goal generation and adoption of innovations at some level of aggregation (country, region, industrial, sector, technology, etc).

2. THE ORIGIN OF THE CONCEPT OF NATIONAL SYSTEMS. FRIEDRICH LIST

In 1841 Friedrich List published his book on The National System of Political Economy, which even from the table of contents looked substantially different from the main Anglo-Saxon textbooks of his age. The first part was devoted to a discussion of the history of various peoples: the Italians, the Hanseatic League, the Flemish and the Dutch, the English, the Spanish and the Portuguese, the French, the Germans, the Russians, the North Americans. Economic theory proper was discussed after history, in the second part of the treatise. It is no coincidence that List was German.

At the beginning of the nineteenth century, German cultural life was dominated by the philosophy of history, which had as its main concern the explanation and prediction of the rise and fall of nations.

Influenced by the rise of American society, in which he lived for several years, List tried to provide an economic explanation for the changing positions of nations in history. He

was convinced that economic life played a crucial role in it, and therefore he was highly critical of those German philosophers who ignored the material aspects of civilization. He also insisted that economic growth depended heavily on the social and cultural resources accumulated by a nation.

Friedrich List can therefore be considered both a late exponent of the German philosophy of history and an early member of the German historical school in economics.

List is remembered as fierce opponent of the theory of free trade as advocated by Adam Smith and his followers. It is certainly true that he was one of the few explicit supporters of trade protection – a doctrine that has received bitter criticism from economists, although less so from policy-makers and others. But it is important refer that, in List's native town Reutlingen, he is remembered as the pioneer of railways; he spent a large part of his life urging the princes who ruled "the Germany of the one hundred homeland" to develop transportation, and he understood that infrastructure which in his day meant, above all, the railways, was a fundamental component of any strategy for economic growth since it allowed commodities, individuals and information to circulate.

To get a balanced view List's idea it is perhaps necessary to combine the reminiscences of economists, with those of the inhabitants of Reutlingen. List was not in favour of protection for its own sake; rather, he understood that economic growth required the creation of endogenous capabilities based on what he called "intellectual capital" and learning.

3. THE THEORICAL JUSTIFICATION OF THE NATIONAL INNOVATION SYSTEMS (NIS's)

The concept of National Innovation System owes its origin to the strong historical and institutional specificity displayed by different countries, properties that in more abstract terms can be interpreted as path dependence, irreversibility, and multistability.

3.1. Evolutionary theories

The year 1982 can be considered a possible date for the official birth of evolutionary theories, due to the publication of Nelson and Winter's An Evolutionary Theory of Economic Change (Edquist, 1997). According to this author, several authors before them had evolutionary ideas, and, during the 1960s and 1970s a large number of innovation studies challenged the validity of the main assumptions of neo-classical economics, at least for what concerns the dinamics of technological change. However, all these institutions remained fragmented; Nelson and Winter's book represented the catalyst for the creation of a new, general approach. Considerable progress has been made in the intervening period, although at the same sense in which there is a neo-classical economics. Evolutionary theories of economic and technological change are still at an early phase of their life cycle, and they have not achieved a degree of articulation corresponding to that of neo-classical economics. They have been developed from a series of perceived shortcoming of neo-classical economics, especially for what concerns technological change.

3.1.1. Systems theory and non-equilibrium thermodynamics

From these two disciplines/research traditions we derive the fundamental distinction between closed and open systems. A closed system cannot exchange anything with its environment while an open system can exchange matter, energy, and information.

The two types of systems have very different properties. Closed systems achieve an equilibrium corresponding to the highest possible degree of disorder and randomness. On the other hand, open systems move away from equilibrium as the rate of exchanges with their environment increases. Their out of equilibrium processes are irreversible and can give rise to discontinuous transitions to states characterized by a greater degree of order and complexity than those that precede them. In other words, open systems can give rise to structure formation, to qualitative and structural change. In the vicinity of transitions the systems are that are possible after the transition. The number of such states may grow after the transition (multistability). Fluctuations can lead the system to a different final state each time the transition takes place. Historical events can influence fluctuations and lead to path dependence. The properties of open systems imply a limited determinism and, therefore, a limitation to our capacity to predict the outcome of processes.

In summary, systems theory and non-equilibrium thermodynamics predict structure formation, qualitative change, indeterminacy, irreversibility, path dependence, and multistability, properties that are commonly displayed by National Innovation Systems (NIS's).

3.1.2. Biology

The general properties predicted by systems theory and by non-equilibrium thermodynamics are displayed by biological, economic, and social systems. Systems theory and non-equilibrium thermodynamics provide a theoretical justification for all theses disciplines/research traditions. In this sense we can say that systems theory and non-equilibrium thermodynamics are in a hierarchically more fundamental position than the other disciplines/research traditions, but this does not imply that we can deductively infer the properties of biological or economic systems from systems theory and non-equilibrium thermodynamics. Historically, the theoretical legitimation comes ex-post and each discipline/research tradition develops concepts appropriate to its observation space.

In economic systems R&D or more in general search activities, contribute to variation, while regulation, and competition are the main forces responsible to selection. The use of a population approach as opposed to the typological approach used in economics, is common in biology. All these concepts and processes currently used in biology constitute a very good basis for the analysis of quantitative change and of the heterogeneity of agents, problems that are central to an evolutionary approach in economics. In other words, economics and biology have a considerable degree of similarity, both in structure and overall knowledge goals.

The main properties of socio-economic and of biological systems are thus predicted by systems theory and non-equilibrium thermodynamics. Biology has provided a number of concepts that are in principle applicable to economics. No mechanical transfer of concepts and models between different disciplines/research traditions is possible. Adaptation of general concepts is required in the specific context of each discipline/research tradition. Thus variation is blind or random in biological systems, corresponding to Darwinian evolution, while it acquires a Lamarckian character in economic systems, due to the intentionality and purposeful character of the latter. Biology can be a very powerful source of inspiration for evolutionay economics, but in the sence of allowing us to formulate new questions and problems and not in providing biological answers to economic problems.

3.1.3. Organization theories

The term organization theory refers to a number of heterodox theories of the firm and to theories and concepts that have emerged in management science and in business history.

These theories have two aspects in common: 1) they differ from neo-classical theories, because they do not assume optimizing behavior; 2) they open up the black box of the firm, or of other organizations, by introducing explicitly organizational structure and internal conflicts. Satisfying behavior and internal conflits are emphasized by behavioral theories of the firm. The distinction between strategy and structure and the emergence of qualitatively different forms of organizational structure have been studied by Chandler. Competences have been stressed, for example by Penrose, Mckelvey, Teece, and Tushman, and Anderson. Satisfying behavior, routines, and selection rules have been introduced into their evolutionary scheme by Nelson and Winter. The growing role played by knowledge creation and utilization in the performance of firms, a topic that has become very important in evolutionary theories of the firm, has been perceived an developed mostly within this research tradition.

3.1.4. Economic antecedents of evolutionary theories

In the past, according to Edquist (1997), a number of economists have had institutions that represent true antecedents of modern evolutionary theories. For example, Marshall is very often quoted as having said that “Mecca of the economist lies in economic biology rather than in economic dynamics. Marshall clearly recognized that ‘economics, like biology, deals with a matter, of which the inner nature and constitution, as well as the outer form, are constantly changing’, a relatively clear reference to quantitative and structural change in economics. However, in spite of recognizing the value of biological metaphor, Marshall did not use it and relied more on economic statics that on economic dynamics.

Herbert Spencer was among the first to develop an evolutionary approach to social development. While some of these ideas can be interpreted in a pro-aristocratic, racist, and sexist way, others are quite relevant for modern evolutionary developments.

Spencer defined evolution as a change from an indefinite, incoherent, homogeneity, to a definite, coherent heterogeneity through differentiations, and though that evolution necessarily involves progress, and that complexity is generally associated with fitter and more

adaptable forms. These considerations anticipate the formation of structure and diversity growth.

Veblen made a very explicit use of a biological metaphor, and for Veblen 'idle curiosity' was the source of diversity or mutation in the evolutionary process. The institution became the unit of selection, but also in the mean time the replicator. Institutions were characterized by relative stability and continuity through time. They could thus transmit diversity from one period to the next ensuring that selection had relatively stable units on which to operate. Variation, selection, and inheritance were thus present in Veblen's analysis.

Schumpeter defined economic development as the carrying out of new combinations of productive means by entrepreneurs.

For Schumpeter, these new combinations are new products, new processes, new markets, new sources of raw materials and new organizational forms. All these new combinations give rise to them. In more modern terms one would say that Schumpeter attached a great importance to radical innovations as ingredients of economic development.

Thus in his view qualitative change and the generation of economic diversity are central to long-term economic development. Furthermore, Schumpeter stressed the non-equilibrium aspects of capitalist development. The creative destruction that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one is one the fundamental mechanisms of capitalist economic development, and curiously, this author rejected the use of biological metaphor in economics.

Hayek attached a great importance to the role of rules. Hayek spoke of the genetic primacy of rules of conduct. A rule is defined by Hayek as a regularity of conduct of individuals. The durability of rules is due to replication through imitation. This mechanism accounts for the much faster rate of cultural evolution compared to the sluggish biotic process of genetic change and selection. The selection procedure for rules, is quite interesting. Rules are selected on the basis of their human survival value, that is, they are indirectly selected through association with a particular group. Also, the idea of spontaneous order, which he compared to the concepts if autopoiesis, cybernetics, homeostasis, self-organization, and synergetics, was a central for Hayek, and in support of spontaneous order he quoted Prigogine and his school.

While evolutionary theories can give some advantages in the analysis of quantitative change, radical uncertainly inherent in economics and in the social sciences in general. Thus neo-classical theory, the economic system is determined to go towards equilibrium and to stay

there, except for temporary displacements, leaving agents only the freedom to optimize. Even in evolutionary theories path dependence may be considered to compel agents to stay within a path that they have not chosen. Such determinism is never complete in evolutionary theories, because:

1) even after having chosen a given path or trajectory, agents still have a considerable amount of residual freedom, which influences their performance. Such freedom does not allow them to redesign radically the technological or conceptual system on which they base their competitive capabilities, but it can manifest itself in terms of incremental innovation.

2) in the vicinity of transitions leading to qualitative change, fluctuations lead to very high uncertainly, destroy previously accumulated competences, and temporarily disrupt pat dependence. In these conditions agents freedom is considerable. Of course, agents are not necessarily aware of being in a transition phase. In these conditions, uncertainly usually means greater risk and greater opportunities than in a mature, stable market. Transition phases represent conditions more anything, evolutionary theories leave greater room for uncertainly, intentionality, and individual freedom than neo-classical ones.

In summary, the main features that differentiate neo-classical from evolutionary theories are:

1. Qualitative change, or change in the composition of the system, resulting from the balance of variation, the creation of new 'species', and selection, which is based on differential adaptation. Inheritance too affects the rate and type of qualitative change.
2. Uncertainly, path dependency, and multistability, all features arising from the out-of-equilibrium nature of systems and processes.
3. Heterogeneity of agents, requiring a population approach, emphasizing not only representative agents and mean values of properties, but also their distribution within a population.

Such differences can both provide a more realistic analysis of innovation systems and justify some of their main properties, such as historical specificity and the multiplicity of institutional configurations, which are impossible to justify in terms of neo-classical theory.

4. DEFINITION OF NATIONAL INNOVATION SYSTEM (NIS)

According to Lundvall (1992) the concept of national innovation system presumes the existence of nation states and this phenomenon has two dimensions: the national – cultural and the étatist-political. The idea, abstract, nation state is one where the two dimensions

coincide, i.e, where all individuals belonging a nation – defined by cultural, ethnical and linguistic characteristics – are gathered in on single geographical space controlled by one central state authority (without foreign nationalities).

According to Lança (2001), **national innovation system** is a social system and dynamic where it is developing a production and reproduction of knowledge of the individual agents and collectives, fundamental resource of the societies contemporaneous. The process of learning, essentially interactive, it makes fundamental in this problematic.

According to this author, national innovation system include not only the sub-system of R&D (universities, laboratories, technologic institutes, and department of R&D of the enterprises, as well all institutional fits that affect the creation, diffusion and assimilation of knowledge and, however, the modalities of organization of the enterprises and relations between of the enterprises; the paper of public sector; the intensity and forms of organization of R&D; the framework and development of teaching sub-system and of professional sub-system; the institutional fit of financial sub-system; extension and vitality of the "intermediate" institutions, translators of the levels of knowledge and different languages (technologic centres, business enterprises to industry, etc).

In the figure 4.1 we can see the national innovation system and their components.

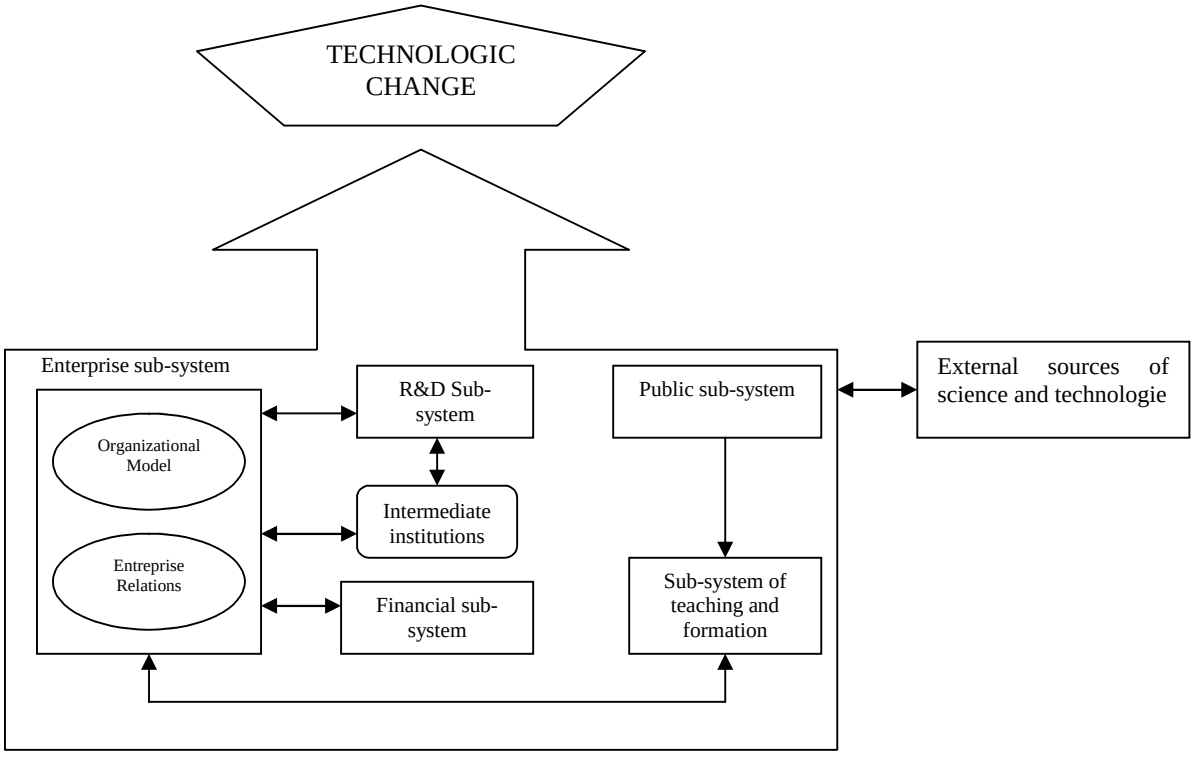

FIGURE 4.1 – National Innovation System

Source: Adapted from Lança, 2001, p.61.

Chris Freeman (1987) defined the concept of national innovation system as the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies (Archibugi and Michie, 1999).

5. NATIONAL INNOVATION SYSTEM IN ANGOLA AND MOZAMBIQUE

The analyse of national innovation system in Angola and Mozambique is based on methodology adopted by Gregory (1993) in *National Innovation Systems – A Comparative Analysis*[2], where this author had used indicators such as **GDP per capita; Human Development Index (HDI); Investigators in R&D**, as well others indicators defined by me such as:

1) Performance

- GDP per capita;
- Human Development Index (HDI);

2) Information Infrastructure;

- Principals lines of telephone(per 1000 people);
- Internet Users (per 1000 people);
- Investigators in R&D(per million of people);

3) Innovation Index;

4) Business Investment in R&D;

5) Firm-level Technology absorption;

6) Subsidies for firms-level research and development;

7) Company Spending on Research and Development;

8) Protection of Intellectual Property;

9) Human Capital advanced;

10) Technology Index;

11) Rate of adult alphabetization (% 15 years and over).

According to Human Development Report (1993 and 2005), Angola registered 2.344 USD of the GDP per capita and Mozambique 1.231 USD of GDP per capita, and this value increased comparatively with 1990, because, how we can see in the table 1 (see annex),

[2] For furthermore informations see GREGORY, Robert G. (1993), "The Australian Innovation System", *National Innovation Systems*, edited by Richard R. Nelson, Oxford University Press, New York, pp.324-352.

Angola had registered in 1990, 840 USD of the GDP per capita, whereas Mozambique had registered 1.072 USD of the GDP per capita in this year.

Angola registered better human development index (HDI) than Mozambique in 2003, by fact in this year Angola has registered an HDI of 0,445, whereas Mozambique registered and HDI of 0,379. But in 1990, Mozambique had registered an HDI of 0,154 and Angola an HDI of 0,143 (see annex – table 1). In 1990 and 2003, both countries had registered values very low of the GDP per capita and human development index. Both countries are classified as countries of human development low.

Angola and Mozambique had registered same number of internet users in 2003, and both countries had registered only 6 internet users per 1000 people, compared, for example, with countries such as Mauritius (123 internet users, per 1000 people) (see annex – table 2).

Angola had registered mores investigators in R&D (per million of people) in 1990-2003, by fact Angola had registered 286 investigators (per million of people) and Mozambique 47 investigators (per million of people).

Both countries had registered low values of investigators in R&D (per million of people) compared, for example, with Seychelles that it had registered 452 investigators (per million of people) (see annex – table 2).

According to World Economic Forum (2004), Mozambique has better innovation index than Angola, that is mean that Mozambique has better performance of national innovation system than Angola, in spite of both countries have poor innovation index at World level. Angola how we can see in the table 3 (see annex), it is in 104th on World ranking and Mozambique in 101st.

Angola and Mozambique do not protect intellectual property as others African countries such South Africa, Namibia and Tunisia, because if we can see in the table 4 (see annex) of protection of intellectual property on different countries of the World we can understand that Angola (104th) and Mozambique (89th) are in poor position on World ranking in this area compared with South Africa that is in 22nd, Namibia (33rd) and Tunisia (26th) that are better classified than Portugal (30th), Spain (31st) and Brazil (51st) (see annex – table 4).

We should not lead to refer that Angola and Mozambique don't have human capital advanced compared with others African countries such as South Africa, Tunisia and Namibia as well as developed countries such United States, Finland and United Kingdom, and we can see in the table 5 (see annex) that Angola and Mozambique occupy poor positions on World ranking effected by World Economic Forum (2004) and we can also see that Angola is poor country of the World in this level and it is in 104th on World ranking.

By fact these countries don't have human capital advanced is an obstacle on absorption of technology for promotion of innovation, welfare state and promotion of competitiveness[3].

We can see in the table 5 (see annex) that Angola and Mozambique occupy poor position on World ranking at level of technology index, being Angola in 102nd and Mozambique in 94th compared with countries such South Africa (40th), Namibia (66th) and Egypt (65th), for example.

According to table 7 (see annex), in 2004, Mozambique effected more business investment in R&D than Angola and same happen with absorption of technology by firms, by fact how we can see Mozambique was in 81st on World ranking at level of business investment in R&D and it was in 97th at level of absorption of technology by firms.

Already Angola was in 102nd on World ranking of the business investment in R&D in 2004 and it was in 103rd at level of absorption of technology by firms. Both countries are considered poor countries in this area.

Mozambique was registered in better position than Angola at level of concession of subsidies for firms for R&D and where the company spending more on R&D, because how we can see in the table 8 (see annex), Mozambique was in 84th on World ranking effected by World Economic Forum (2005) ate level of subsidies for firms for research and development and it was in 81st at level of spending on research and development by companies. Already Angola was registered poor position in both areas, it was in 94th at level of subsidies for firms for R&D and it was in 102nd at level of spending on R&D by companies, according to World Economic Forum (2004) (see annex – table 8).

[3] Also we should to refer that Angola and Mozambique have low rate of adult alphabetization being that Angola has a rate of adult alphabetization of 66,8% and Mozambique, 46,5%, compared with South Africa (82,4%), Zimbabwe (90%) and Lesotho (81,4%) (see annex - table 6).

CONCLUSIONS

We saw of theoretical approach of national innovation systems, the origin of the concept of national system, according to Friedrich List, the theoretical justification of the National Innovation Systems (NIS's), the definition of National Innovation System and their state in Angola and Mozambique.

We concluded that Angola and Mozambique need to define economics policy that have as objective to promote the growth of their GDP per capita and human development.

Economics policy for promotion the growth of GDP per capita consist on planning family for reduction of birth rate that is very high and reduction of debt external and promotion of policies for reduction of poverty for population to have same opportunities to access to good of first necessity.

Both government need to define strategies for promotion the internet access for enlarging of knowledge about others cultures that can help on promotion of innovation, and these government should to promote the enlarging of investigators in R&D for also promotion of innovation on divers areas such health, education, etc. And both government should not forget to promote the increase of rate of adult alphabetization that pass for promotion to access of education for people more necessitated and should not forget to promote of protection of intellectual property, and so, firms and companies can employ skilled people and through use of technology advanced can promote innovation and commercialize that, and this skilled people can too discovery and develop better technology and improve innovation system for development of the both countries on globalization era.

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ANNEXES

TABLE 1

Performance of African countries

Countries	GDP per capita PPP US$		Human Development Index (HDI)	
	1990	2003	1990	2003
Angola	840	2.344	0,143	0,445
Mozambique	1.072	1.231	0,154	0,379
Botswana	3.419	8.714	0,552	0,565
Democratic Republic of Congo	367	697	0,262	0,385
Lesotho	1.743	2.561	0,431	0,497
Malawi	640	605	0,168	0,404
Mauritius	5.750	11.287	0,794	0,791
Namibia	1.400	6.180	0,289	0,627
Seychelles	4.191	10.232	0,761	0,821
South Africa	4.865	10.346	0,673	0,658
Swaziland	2.384	4.726	0,458	0,498
Tanzania	572	621	0,270	0,418
Zambia	744	877	0,314	0,394
Zimbabwe	1.484	2.443	0,398	0,505

Source: Human Development Rapport, 1993 and 2005

TABLE 2

Information Infrastructure in African countries

Countries	Principals lines of telephone (per 1000 people)		Internet Users (per 1000 people)		Investigators in R&D (per million of people)
	1990	2003	1990	2003	1990-2003
Angola	8	7	0	6	286
Mozambique	3	...	0	6	47
Botswana	2	75	0	...	...
Democratic Republic of Congo	1	...	0	...	...
Lesotho	7	16	0	14	42
Malawi	3	8	0	3	...
Mauritius	52	285	0	123	0,3
Namibia	39	66	0	34	...
Seychelles	124	256	0	...	452
South Africa	93	...	0	...	192
Swaziland	17	44	0	26	...
Tanzania	3	4	0	7	...
Zambia	8	8	0	6	47
Zimbabwe	13	...	0	...	...

Source: Relatório do Desenvolvimento Humano, 2005

TABLE 3

Innovation Index of the different countries of the World

Innovation Index		
Countries	**Ranking**	**Score**
Canada	11.º	4.36
United States	1.º	6.41
Mexico	61.º	2.20
Sweden	5.º	5.37
Netherlands	15.º	4.04
Belgium	19.º	3.95
Ireland	22.º	3.47
United Kingdom	14.º	4.05
Singapore	13.º	4.06
Malaysia	41.º	2.65
Thailand	37.º	2.71
Zimbabwe	94.º	1.58
Kenya	87.º	1.70
Madagascar	92.º	1.63
Nigeria	90	1.66
Gambia	99.º	1.54
Tanzania	96.º	1.57
Zambia	98.º	1.55
Malawi	100.º	1.46
Angola	104.º	1.28
Chad	103.º	1.31
Ethiopia	102.º	1.34
Mozambique	101.º	1.42
Mali	93.º	1.60

Source: WORLD ECONOMIC FORUM, 2004

TABLE 4

Protection of Intellectual Property on different countries of the World

Countries	Protection of intellectual property	
	Ranking	Score
Sweden	1	6.3
Denmark	2	6.3
United States	3	6.2
Germany	4	6.2
Finland	5	6.1
United Kingdom	6	6.1
Netherlands	10	6.0
Singapore	13	5.7
France	14	5.7
Austria	15	5.7
Canada	16	5.7
Luxembourg	17	5.6
Belgium	18	5.5
Ireland	21	5.2
South Africa	22	5.0
Malaysia	25	4.8
Tunisia	26	4.8
Portugal	30	4.6
Spain	31	4.5
Slovenia	32	4.5
Namibia	33	4.5
Greece	35	4.3
Hungary	37	4.2
Egypt	38	4.1
Thailand	39	4.0
Cyprus	41	3.9
Ghana	44	3.9
Italy	45	3.9
Indonesia	47	3.9
Slovak Republic	49	3.8

Source: WORLD ECONOMIC FORUM, 2004

TABLE 4

Protection of Intellectual Property on different countries of the World

(Continueing)

Countries	Protection of Intellectual Property	
	Ranking	**Score**
Malta	50	3.7
Brazil	51	3.7
Uruguai	53	3.6
Mauritius	55	3.5
Malawi	57	3.5
Botswana	58	3.5
Lithuanian	61	3.4
Mexico	62	3.3
Mali	66	3.3
Gambia	67	3.2
Madagascar	69	3.1
Zimbabwe	70	3.1
Kenya	71	3.1
Latvia	72	3.1
Nigeria	73	3.0
Tanzania	74	3.0
Zambia	75	3.0
Algeria	77	2.9
Poland	79	2.8
Philipines	82	2.7
Uganda	85	2.7
Argentina	88	2.5
Mozambique	89	2.5
Peru	90	2.4
Vietnan	93	2.4
Equador	95	2.3
Paraguai	97	2.2
Ethipia	99	2.2
Chad	102	2.0
Angola	104	1.8

Source: WORLD ECONOMIC FORUM, 2004

TABLE 5

Human Capital Advanced and Technology on divers countries of the World

Countries	Human Capital advanced		Technology	
	Ranking	Score	Ranking	Score
United States	4	5.01	1	6.24
Finland	1	5.36	3	5.92
Denmark	3	5.06	6	5.34
Sweden	2	5.10	4	5.80
Germany	19	4.62	12	5.08
Singapore	12	4.81	11	5.11
United Kingdom	17	4.72	18	4.92
Netherlands	9	4.84	16	4.98
Canada	10	4.83	13	5.05
Françe	11	4.82	30	4.65
Austria	13	4.81	22	4.85
Spain	25	4.30	20	4.86
South Africa	50	3.57	40	4.33
Portugal	38	3.78	23	4.78
Namibia	78	2.84	66	3.66
Latvia	29	4.00	36	4.46
Hungary	32	3.96	29	4.66
Egypt	56	3.44	65	3.68
Brazil	48	3.61	42	4.24
Mauritius	63	3.19	44	4.19
Botswana	71	3.03	64	3.70
Mexico	66	3.14	48	4.13
Vietnam	77	2.85	92	2.92
Algeria	81	2.77	98	2.67
Ghana	86	2.71	78	3.21
Uruguay	55	3.49	56	3.92
Poland	37	3.83	45	4.19
Nigeria	84	2.73	89	2.99
Uganda	90	2.51	77	3.22
Gambia	87	2.54	85	3.12
Kenya	82	2.76	72	3.31
Madagascar	95	2.26	99	2.64

Paraguay	93	2.37	91	2.94
Zambia	88	2.54	90	2.98
Malawi	92	2.37	97	2.74
Tanzania	97	2.20	84	3.12
Mali	99	2.11	101	2.52
Mozambique	101	1.99	94	2.89
Zimbabwe	83	2.74	86	3.04
Ethiopia	102	1.98	103	2.17
Chad	103	1.62	104	1.81
Angola	104	1.57	102	2.30

Source: WORLD ECONOMIC FORUM, 2004

TABLE 6

Rate of adult alphabetization

(15 year and over)

Countries	**Rate of adult alphabetization (15 year and over)**	
	1990	**2003**
United Sates	99,0%	...
Canada	99,0%	...
Mexico	87,6%	...
Angola	42%	66,8%
Mozambique	33%	46,5%
Botswana	68,1%	78,9%
Democratic Republic of Congo	47,5%	65,3%
Lesotho	78,0%	81,4%
Mauritius	79,8%	84,3%
Namibia	74,9%	85,0%
Seychelles	89,0%	91,9%
South Africa	81,2%	82,4%
Swaziland	71,6%	79,2%
Zambia	68,2%	67,9%
Zimbabwe	80,7%	90,0%

Sources: Human Development Report 1993 and 2005

TABLE 7

Business Investment in R&D and Firm-level Technology absorption

Business Investment in R&D, 2004 (1)			Firm-level Technology absorption, 2004 (2)	
Country	**Ranking**	**Score**	**Ranking**	**Score**
Tunisia	37	3.46	24	5.31
South Africa	24	4.03	28	5.22
Kenya	32	3.66	71	4.21
Uganda	38	3.42	66	4.27
Namibia	42	3.29	45	4.77
Botswana	44	3.21	70	4.22
Nigeria	47	3.15	75	4.05
Mauritius	50	3.12	55	4.47
Madagascar	55	3.03	48	4.70
Zimbabwe	62	2.97	90	3.57
Morocco	66	2.94	74	4.11
Ghana	67	2.92	60	4.40
Tanzania	69	2.90	69	4.22
Egypt	72	2.85	37	5.05
Gambia	73	2.85	86	3.81
Malawi	77	2.81	88	3.64
Zambia	80	2.73	64	4.29
Mozambique	81	2.72	97	3.16
Mali	82	2.68	72	4.17
Algeria	94	2.42	57	4.47
Angola	102	1.93	103	2.78
Chad	103	1.91	99	3.13
Ethiopia	104	1.85	96	3.26

Source: World Economic Forum, 2005

TABLE 8

Subsidies for firms-level research and development and Company spending on research and development

Subsidies for firms-level research and development, 2004 (1)			Company spending on research and development (2)	
Country	**Ranking**	**Score**	**Ranking**	**Score**
Tunisia	13	4.62	37	3.5
Kenya	67	2.67	32	3.7
Gambia	61	2.75	73	2.8
Botswana	34	3.41	44	3.2
Morocco	42	3.30	66	2.9
Ghana	69	2.61	67	2.9
Mauritius	54	2.94	50	3.1
Namibia	47	3.17	42	3.3
Uganda	41	3.31	38	3.4
Zimbabwe	79	2.33	62	3.0
Nigeria	52	2.99	47	3.1
Zambia	72	2.61	80	2.7
South Africa	39	3.31	24	4.0
Malawi	81	2.29	77	2.8
Algeria	45	3.21	94	2.4
Egypt	35	3.38	72	2.8
Ethiopia	87	2.08	104	1.8
Tanzania	46	3.19	69	2.9
Mozambique	84	2.23	81	2.7
Mali	38	3.32	82	2.7
Madagascar	69	2.61	55	3.0
Chad	89	2.04	103	1.9
Angola	94	1.75	102	1.9

Source: World Economic Forum, 2004 and 2005