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A Strategic Approach to Improve Innovation in Less-Developed Country: The Case of Benin

Fabrice Boko, Prof. Qin Yuanjian

Abstract— This paper employs to present a global outlook of Benin experience in terms of economic integration related to innovation and technology. Throught case study method, we analyze the situation of the country's economy and technology with slight reference to China by finding out the problem which set back its innovation's development, by evaluating its technological needs. This country meet some difficulties related to its strategic direction for technological progress. Technology and innovation-related phenomena, corporate organization and the proper use of human resources in all the phases of the production procedure represent one of the main elements of competitiveness. By considering this fact, we present some strategic steps that should be taken to improve innovation and technology for the country's competitiveness on the global market and by the way its growth. The innovation theory of Schumpeter allow us to clarify the innovation's situation of the country and find out that Benin should promote research and development strategy, implement the results which come out and also invest in leaders' education to improve their skills in purpose of innovation development and so favor country growth.

Index Terms— Benin, Development, Global Innovation Index, Innovation, Strategy.

1 Introduction

Officially named the Republic of Benin, Benin is a country in Western Africa. Its short coastline to the south leads to the Bight of Benin. Its size is just over 112,000 kilometer square with a population of almost 9 millions. Its capital is the city of Porto Novo, but the seat of government is the city of Cotonou. Benin was known as Dahomey until 1975.

Benin is a developing country and its economy remains dependent on subsistence agriculture, cotton production, and regional trade. In the past seven years growth in output has averaged around 5%. In order to raise growth still further, Benin plans to attract more foreign investment, place more emphasis on tourism, facilitate the development of new food processing systems and agricultural products, and encourage new information and communication technology.

This brings a new approach of cooperation around notions of dynamic competitiveness and innovation [1]. Benin lacks of necessary technological structure to face challenges of a rapidly changing and increasingly competitive world market.

Government and enterprises end up with considering technology as one of the key components in a strategy for building competitiveness. It appears that technology and innovation in production process represent the main pillar of competitiveness. Thus innovation has become a principal link in the relation between trade and development. Benin lack integrated physical infrastructure and diversified economy required to weather shocks and to innovate by recombining existing resources in new ways or by introducing new products, processes, and organizational practices [2].

- *Fabrice Boko is currently pursuing PhD degree program in strategic management in School of Management in Wuhan University of Technology, China. E-mail: fbboko@yahoo.com*
- *Qin Yuanjian is currently Professor of strategic management in Department of Business Administration of School of Management in Wuhan University of Technology, China. E-mail: qyjhb@163.com*

Innovation becomes the key factor for economy growth. Innovation has driven economic progress, from the invention of the spinning jenny that transformed the textile industry during the 18th century, to the harnessing of electricity and the development of mass production [3].

In less developed country, the discussion about innovation is mainly related to the situation in developed countries. So mainy of them does not take in consideration the context of poor countries.

This paper aims to contribute to this research gap by discussing the situation closely related to innovation in Benin context. We will go throught innovation theory, process and model, and then based on Benin profile data, we will access the situation and draw the strategic approach to set out new orientation for Benin's process of innovation.

2 Innovation Theory and Process

2.1 Definition

Innovation is a process by which a novel idea is brought to the stage where it eventually produces money. It is a dynamic technical, economic and social process involving the interaction of people coming from different horizons, with different perspectives and different motivations. Innovation is the process of understanding the value of an idea in an economic, technical and social environment [4].

There is a distinction between invention and innovation. Invention is the first occurrence of an idea for a new product or process, while innovation is the first attempt to carry it out into practice" [5].

2.2 Innovation process and model

The Linear Model of Innovation is an early model of innovation that mentions technological change happens in a linear mode from Invention to Innovation to Diffusion.

In the economics and management books there is a wide range of reference mentioning the Trilogy of 'Invention-

Innovation-Diffusion'. The Schumpeterian trilogy divides the technological change process into three stages:

Fig. 1 Original model of three phases of the process of technological change

- Invention: the generation of new ideas
- Innovation: development of new ideas into marketable products and processes
- Diffusion: new products and processes spread across the potential market.

The Schumpeterian trilogy through "innovation" describes a special stage in the technological process. Innovation is used widely as a concept to describe the whole technological change process.

2.3 Innovation Theory

Schumpeter considers that innovation and entrepreneur must to be linked according to his theory which corresponds to five elements:

1. Introducing new products
2. Introducing new production functions
3. Providing new consumers through opening new markets
4. Conquering new sources of materials
5. Creating new organization of industries.

This theory considers innovation in its largest context and only focuses on an industrialized countries situation. The interpretation of situation of Third World of which Benin belongs is not full applicable to this theory. The Third World situation and economic structure are not developed compared to industrialized countries. Schumpeter's theory which considers innovation also called technical change or technological change satisfies the Western countries' economies rather than the Third World's economy.

For Schumpeter, carry out successful innovation brings economic growth. Generally this works in capitalist economies with free market and huge technological ability. In the other aspect, Schumpeter's concept of the entrepreneur is different to the one that of the entrepreneur in the Third World.

This concept is limited since it doesn't take into account both the two worlds. Innovation means develop new strategy in terms or production, marketing. In the Third World, innovation arises to modify and improve completely existing technology and then focuses on experimentation, research and implementation.

From this point and considering the technological and economic situation in the Benin, major innovation can not take place since the country does not have suitable infrastructure. In such condition technology transfer can play major role to contribute to the technology development.

2.4 Theoretical context

Rcently studies have contributed to analyzing factors affecting the innovative and competitive performance of clusters in developed countries. Innovation theories in developed countries emphasize the role of technological advance and radical innovations [6]. Policy recommendations directed to the promotion of scientific and technological outputs – scientific research and development (R&D), technical manpower, patents and scientific publications [7].

The literature review undertaken in this paper is to ask how much and what exactly we know about innovation in very less developed countries and whose inhabitants are sometimes referred to as the Bottom Billion [8]. Recent review of innovation studies produced no evidence that less developped countries ever enjoyed much attention in the field [9].

Science, technology and innovation are very important for less developed countries'growth. But since the developmental deficits and needs of poor countries are evidently of a different order of magnitude from those of other developing countries, constraints on science, technology and innovation must be even better understood than elsewhere so that they can be appropriately addressed. By then many concepts can be brought out from innovation researches to highlight the relevant issues in these countries.

There is lack of linkages between government, industry and education in the researches made up to the mid-1970s, and the widespread irrelevance of public-sector research for either industry or the problems of their countries at large; the absence of high-level coordination of scientific activities; the lack of demand for innovation by an industrial sector entrenched in sub-optimal equilibria and monopolistic markets with no incentive for upgrading; the dominance of multinational enterprises which controlled unassailable technological assets against small or medium-sized local firms with very circumscribed capabilities and the effects this may have on competition; and the nascence of assembly industries geared to exports which assigned subordinate roles to local producers. In sum, problems existed with respect to demand for and supply and coordination of science, technology and innovation activities [10].

The decline in investments in research & developpement conduct to insufficient critical mass of activity to yield any outcomes [11] and criticized the gap between policy commitments and incentives [12].

Some argument states that even in the face of an increasing share both of global R&D and national income generated in less developed coutries, innovation capacity has lagged because the attendant technology development was often oriented to first-world needs and thus inappropriate [13].

The conditions under which innovation takes place or not, according to the case, differ fundamentally between advanced and very poor countries. Theses conditions are: missing or outdated infrastructure, inadequate access to requisite materials and equipment, lack of institutional support for building capabilities and of appropriately skilled human capital, and of resources. Learning has characteristics different from those found in developped countries where the availability of inputs

is less of an issue. And although by definition no environment is without (incidental) scarcity, only developing countries face systemic scarcity. In the extreme, scarcity can obviously prevent innovation and development. But scarcity can also induce innovations, even though they may end up being intensely local and thus not scale up particularly well. As such, they may also remain hidden from view which is one reason why there might be less literature on innovation in less-developped contries than desirable, and why much of it might be country-specific rather or otherwise idiosyncratic rather than producing more general insights [14].

Innovation is a complex, cumulative process resulting from continuous interactions between government, firm and education system.

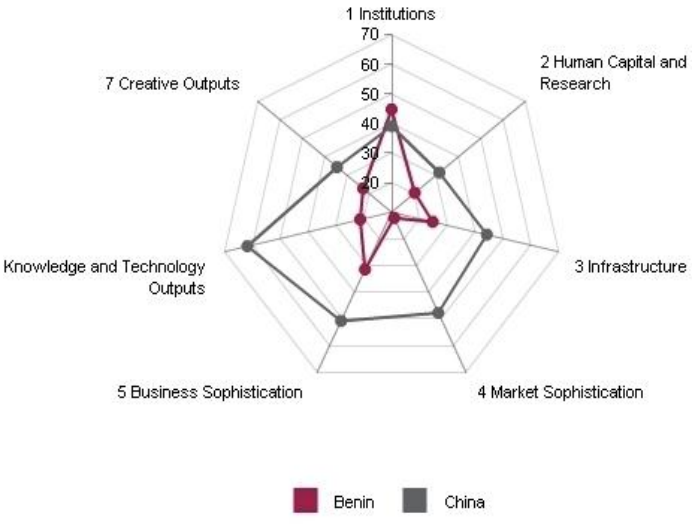
3 MAJOR PROBLEMS IN THE GLOBAL ENVIRONMENT

Innovation performance index demonstrated the backlog in the field of exportation and could be explained by their inability to compete, and therefore to innovate.

TABLE 1
GLOBAL INNOVATION INDEX RANKINGS

Country/ Economy	Score (0–100)	Rank T=141	Income	Rank	Region	Rank
Benin	24.4	125	LI	13	SSF	21
China	45.4	34	UM	3	SEAO	8

Note: World Bank Income Group Classification (April 2012): LI = low income; UM = upper-middle income; Regions are based on the United Nations Classification (20 September 2011): SEAO = South East Asia and Oceania; SSF = Sub-Saharan Africa. T = The total of 141 countries.
Source: The Global Innovation Index2012, Soumitra Dutta, INSEAD



Source: The Global Innovation Index2012, Soumitra Dutta, INSEAD
Fig. 2 Radar chart overall comparison of global innovation index of Benin & China

The detailled data of Figure 2 is in appendix.

Benin's rank is 125 out of 141 countries or economies. This just show the this lack of innovation that has many causes, including: weak technological skills, low level of foreign direct investment, low use of the intellectual property system for technology transfer, high producing cost, poor product quality about some product and poor integration of new information technologies and communication.

(1) Low competitive performance index of African industries

According to UNIDO, United Nations Industrial Developement Organization, the performance criteria in terms of competitiveness in the industrial field are: - The manufacturing value added (MVA) per capita - Exports of manufactured goods per capita - The share of medium and high technology in the MVA - The share of medium and high technology in manufactured exports.

The competitive performance index (CPI) of African industries is below expectations. The CPI of the industry is focused on performance in the production and export of manufactured goods as well as on the technological structure of these performances. Classification of certain developing countries in the CPI shows that sub-Saharan Africa is declining as their technological structure of industrial production and exports. In this context the low level of technological development is seen as the key factor which contributes to the inability of African countries to develop their agricultural and pastoral potential. Indeed, the development of technology is crucial if African countries can compete in globalized markets. The development of technology is the way forward for African countries to engage in exports of products to competitive on world markets.

(2) Lack of technology skills

Benin has a cheap labor, but not highly qualified. It should improve its human capital in every sector of the economy. The use of new technologies calls for skills from technical training in special schools. Benin government has limited resources and for political reasons, chooses to invest in general education accessible to a larger number at the expense of institutions offering technical training.

(3) Low level of research and development and non valorization of research results

Research and development contributes significantly to enhancing the technological capabilities and skills to master the technology, including new technologies. Benin spends significant amounts on research and development and do not attract transnational investment materials research and development. If support is offered for research, equivalent amount of fund is never provided for the valuation of research results. The consequence is that many search results are not be used since the creation of research institutions. In the absence of recovery of innovations derived from research, products of good quality and competitive products have been unavailable on the African markets and international markets where competition is in full swing.

(4) Non-qualified manufactured products

As a result of several factors including:

- Non-control technologies for processing and preserving food
- Failure to comply with the standards and the lack of quality control
- Packing inappropriate
- Lack of labeling
- Poor storage conditions and storage

(5) Producing cost very high

The main reason is the high energy costs and raw materials, transportation, lack of tax incentives for tax reduction and exemption of taxes on certain imports.

(6) Poor integration of new technologies of information and communication

Some of area still lack of computer, and Internet which have not yet mastered. New technologies of information and communication are now indispensable in all areas.

4 Study and Technological Needs Assessment

Considering the low index of industrial performance of Benin, we can say that it fail to meet needs to be competitive in the markets. The positioning of Benin businesses in the global marketplace require to be competitive through innovation. Innovation means the improvement of products and technologies as well as management and organization systems. Innovation also requires that companies adopt new technologies, acquire new skills or improve existing ones. To accomplish all these requirements of innovation, companies need expertise in several areas.

(1) The technology of processing, preserving and packaging of products

Depending on the raw materials, the quality of the finished product depends on the technology used, how it is preserved, its packaging and labeling. The mastery of the technology referred to the finished product based on the raw material is a first step towards competitiveness. Without this control it is very difficult to innovate. It is also important to master the technological characteristics of raw materials. This happens through the development of human resources in science or technology transfer by a foreign direct investment.

(2) Exportation technology

Benin enterprises need to set up standards quality by the target and it should be done according to international regulation.

(3) Support services for innovation and technology transfer

They will be responsible of supporting enterprises in building and technology transfer through the intellectual property system. They include both national patent offices as centers of technological innovation.

(4) Financial support

Access to finance is a major obstacle to the creation and growth of Industries in Benin. Benin businesses need financial assistance from the government in the form of loan or grant for financing research and development and marketing of innovations. It consists of taking some measures that can support industries. This assistance could also consist of tax measures to encourage research and development and acquisition of equipment.

(5) Technical Assistance

Industries need to be assisted according to technology needs and allow them to solve various problems relating to human resources, marketing, organization and management of agribusiness.

(6) The training of human resources

It is important industries and companies to train all types of managers to acquire skills in various areas in the field new technology of information and communication and to accelerate the adoption of innovative approaches.

5 New orientations and strategies

Innovation, like many business functions, is a management process that requires specific tools, rules, and discipline (Davila et al. 2006). This point of view emphasizes the introduction of news ideas to the organization process leading to significant improvements in terms of internal processes, new products and services.

The comparative advantages offered by the abundance natural resources are a major opportunity for Benin and African countries to promote productivity. In the era of globalization characterized by competition, businesses should be competitive through technological innovation.

(1) Training and development of technology skills

The development of expertise is a prerequisite for the mastery of competitiveness and technology. The know-how is becoming increasingly important in a global economy based on knowledge. Human capital, namely education and training contribute to economic development through increased worker productivity and effective use of technology. Proficiency, use and adaptation of new technologies require the expertise of various levels and in various fields.

A strategy to have a strong human capital, with emphasis on technical training to meet the demand for specialized labor and to promote research and innovation is essential.

(2) Infrastructure, Information and Documentation

The country should increase capabilities of information systems. New opportunities for communication of scientific and technological information should be available to any potential inventors and innovators. Energy and telecommunications are the operational determinants of competitiveness. Internet plays a very important role. The country needs to set up some laboratories to conduct researches.

(3) Research and development

Innovation and research and development are crucial for the development, promotion and deepening of technological capabilities. A specific strategy in terms of research and

should be given special attention, with particular emphasis on research in the private sector and businesses.

(4) Promoting the use of intellectual property for technology transfer

This is a key area that should be taken into account since it's leading to a low level of innovative activities, therefore a lack of competitiveness. The country should strengthen the intellectual property to protect the creation and by the way encourage initiatives.

(5) Standardization and quality control

Particular emphasis will be placed on the institutional and legislative framework in this area:

- Setting up structures of standardization, certification, calibration and laboratory quality control and accreditation
- The adoption of international standards
- Access to information industry and information on packaging and quality control.

(6) Technological Advice and Consultations

This is mainly to advice on the choice of valid technologies as well as the formulation, planning and implementation of policies and programs in science and technology. The activities include the implementation of a strategy for technological innovation resulting from the determination of priorities and constraints identified in the production, packaging, storage, processing, handling and marketing of various categories of food.

(7) Intelligence and Technical Cooperation

Maintaining a flow of exchanges of information or experience is necessary for the stimulation of research, transfer and technological innovation and industrial production. Very often, researchers, inventors or African industrialists do not have the required scientific environment, due to lack of local research capacity development, the absence of a scientific and technological well-organized such as associations (e.g. physics, chemistry, biology, etc..) or corporation (e.g. agronomists, nutritionists, etc..) and participating actively in solving local problems of development.

(8) Promote direct investment A good strategy to promote foreign direct investment could contribute to a rapid technological development. It brings not only the technological know-how, but also equipment and industrial machinery. A thorough review of the institutional and regulatory framework is one of the elements of this strategy.

6 Conclusion

With the strengthening of economic globalization, under the auspices of radical changes and technological innovations, there is an urgent need to promote, in Benin and the African States, a vigorous promotion of inventions, and the transfer of technological innovation based primarily on the development of local resources and involving both research institutions, governments and business and domestic consumers.

African governments have recognized the need to develop new systems of training to enhance the knowledge and skills conducive to innovation. They try to put in place a policy framework more challenging. To complement these initiatives, it will be necessary to create a mechanism to encourage enterprises to innovate and to gather local resources [1].

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APPENDIX: THE GLOBAL INNOVATION INDEX2012, SOUMITRA DUTTA, INSEAD 2012

Country/Economy Profiles

The following tables provide detailed profiles for each of the 141 economies in the Global Innovation Index 2012. They are constructed around three sections.

1 Three key indicators at the beginning of each profile are intended to put the economy into context. They present the population in millions,[1] GDP per capita in PPP current international dollars,[2] and GDP in US$ billions.[3] While coming from different sources, the three series were extracted from the World Bank *World Development Indicators* database in April 2012.

2 The next section provides the economy's scores and rankings on the Global Innovation Index (GII), the Innovation Input Sub-Index, the Innovation Output Sub-Index, and the Innovation Efficiency Index.

The GII ranking for the 2011 edition comes next, followed by the economy's 2012 rank among the 125 economies included in the 2011 edition. Note that because of the inclusion of 16 additional economies in 2012 (from 125 to 141), and because of adjustments made to the GII framework in 2012, the GII 2011 and 2012 are not directly comparable. Please refer to Annex 2 of Chapter 1 for details.

Scores are normalized in the [0, 100] range except for the Efficiency Index, for which scores revolve around the number 1 (this index is calculated as the ratio between the Output and Input Sub-Indices).

The Innovation Input Sub-Index score is calculated as the simple average of the scores in the first five pillars, while the Innovation Output Sub-Index is calculated as the simple average of the last two pillars.

3 The value/normalized score and the rank for each pillar (identified by its single-digit number), sub-pillar (two-digit number), and indicator (three-digit number) are reported. For example, *indicator 1.3.1, Ease of starting a business,* appears under *sub-pillar 1.3, Business environment,* which in turn appears under *pillar 1, Institutions.*

When data are either not available or out of date (the cutoff year is 2001), 'n/a' is used.

The 2012 GII includes 84 indicators and three types of data. Composite indicators are identified with an asterisk (*), survey questions from the World Economic Forum's Executive Opinion Survey are identified with a dagger (†), and the remaining indicators are all hard data series.

For hard data, the original value is provided (except for indicators 7.3.1, 7.3.2, and 7.3.4, for which the raw data were provided under the condition that only the normalized scores be published). Normalized scores in the [0, 100] range are provided for everything else (index and survey data, sub-pillars, pillars, and indices).

For further details, see Appendix III, Sources and Definitions, and Appendix IV, Technical Notes.

4 To the far right of each column, a plain circle indicates that an indicator is one of the strengths of the country/economy in question, and a hollow circle indicates that it is a weakness.

All top ranks (of 1) are highlighted as strengths; for the remaining indicators, strengths and weaknesses of a particular economy are based on the percentage of economies with scores that fall below its score (i.e., percent ranks).

- ● Strengths are all scores with percent ranks greater than the 10th largest percent rank among the 84 indicators in a specific economy.
- ○ Weaknesses are all scores with percent ranks lower than the 10th smallest percent rank among the 84 indicators in a specific economy.

Percent ranks embed more information than ranks and allow for comparisons of ranks of series with missing data and ties in ranks. Examples from Poland illustrate this point:

1. Poland's best rank is its 8th position out of 140 in *4.1.1 Ease of getting credit*★. But because 13 economies are tied with Poland at rank 8, only 86% have lower scores than Poland (percent rank: 0.86).
2. Even if Poland's rank in *1.1.1 Political stability*★—where it ranks 15th out of 141— is lower than its rank of 8th in indicator 4.1.1, it is Poland's major strength because 90% of the economies in the sample have lower scores in this indicator than Poland does (its percent rank is 0.90, the highest among the 84 indicators).
3. Following that criteria, Poland's major weakness is *5.2.5 PCT patent filings with foreign inventor,* with a rank of 89 out of 102 but a percent rank of 0.13. However, here the fact that data are missing for 39 economies does not allow a straightforward reading of the rank (89).
4. In contrast, Poland's worst rank is 110th out of 133 in *7.1.4 ICT & organizational model creation†,* although only 17% of economies have lower scores than Poland (its percent rank is 0.17, lower than for indicator 5.2.5).

Percent ranks are not reported in the Country/Economy Profiles but are presented in the Data Tables (Appendix II), included in the digital copy only and available online at http://globalinnovationindex.org.

Notes

1 World Bank estimates based on various sources.

2 World Bank, International Comparison Program database.

3 World Bank national accounts data, and OECD National Accounts data files.

Benin

Key indicators

Population (millions)	9.9
GDP per capita, PPP$	1,491.5
GDP (US$ billions)	7.5

	Score (0–100) or value (hard data)	Rank	
Global Innovation Index 2012 (out of 141)	**24.4**	**125**	
Innovation Output Sub-Index	22.0	108	
Innovation Input Sub-Index	26.7	132	
Innovation Efficiency Index	0.8	36	●
Global Innovation Index 2011 (out of 125)		118	
GII 2012 rank among GII 2011 economies (125)		115	
1 Institutions	**44.7**	**102**	
1.1 Political environment	*57.3*	*66*	●
1.1.1 Political stability*	72.7	53	●
1.1.2 Government effectiveness*	26.9	100	
1.1.3 Press freedom*	72.3	70	●
1.2 Regulatory environment	*64.4*	*77*	
1.2.1 Regulatory quality*	43.5	94	
1.2.2 Rule of law*	28.4	105	
1.2.3 Cost of redundancy dismissal, salary weeks	11.6	47	●
1.3 Business environment	*12.4*	*136*	○
1.3.1 Ease of starting a business*	7.1	130	
1.3.2 Ease of resolving insolvency*	22.3	109	
1.3.3 Ease of paying taxes*	7.9	129	
2 Human capital & research	**20.5**	**123**	
2.1 Education	*36.7*	*114*	
2.1.1 Current expenditure on education, % GNI	4.3	65	●
2.1.2 Public expenditure/pupil, % GDP/cap	17.0	79	
2.1.3 School life expectancy, years	9.4	120	
2.1.4 PISA scales in reading, maths, & science	n/a	n/a	
2.1.5 Pupil-teacher ratio, secondary	23.9	108	
2.2 Tertiary education	*4.6*	*137*	○
2.2.1 Tertiary enrolment, % gross	6.0	116	
2.2.2 Graduates in science & engineering, %	n/a	n/a	
2.2.3 Tertiary inbound mobility, %	n/a	n/a	
2.2.4 Gross tertiary outbound enrolment, %	0.4	103	
2.3 Research & development (R&D)	*20.1*	*73*	●
2.3.1 Researchers, headcounts/mn pop.	123.3	95	
2.3.2 Gross expenditure on R&D, % GDP	n/a	n/a	
2.3.3 Quality of scientific research institutions†	39.4	79	
3 Infrastructure	**24.8**	**106**	
3.1 Information & communication technologies (ICT)	*12.7*	*129*	
3.1.1 ICT access*	22.2	113	
3.1.2 ICT use*	1.2	132	○
3.1.3 Government's online service*	19.6	132	○
3.1.4 E-participation*	7.9	98	
3.2 General infrastructure	*30.2*	*99*	
3.2.1 Electricity output, kWh/cap	13.5	124	○
3.2.2 Electricity consumption, kWh/cap	87.9	122	○
3.2.3 Quality of trade & transport infrastructure*	37.0	74	●
3.2.4 Gross capital formation, % GDP	25.8	37	●
3.3 Ecological sustainability	*31.5*	*65*	●
3.3.1 GDP/unit of energy use, 2000 PPP$/kg oil eq	2.9	101	
3.3.2 Environmental performance*	50.4	77	
3.3.3 ISO 14001 environmental certificates/bn PPP$ GDP	n/a	n/a	
4 Market sophistication	**12.1**	**141**	○
4.1 Credit	*10.5*	*121*	
4.1.1 Ease of getting credit*	2.8	126	○
4.1.2 Domestic credit to private sector, % GDP	23.1	109	
4.1.3 Microfinance gross loans, % GDP	1.9	22	●
4.2 Investment	*3.6*	*129*	○
4.2.1 Ease of protecting investors*	7.1	123	
4.2.2 Market capitalization, % GDP	n/a	n/a	
4.2.3 Total value of stocks traded, % GDP	n/a	n/a	
4.2.4 Venture capital deals/tr PPP$ GDP	0.0	65	○
4.3 Trade & competition	*22.4*	*140*	○
4.3.1 Applied tariff rate, weighted mean, %	15.4	138	○
4.3.2 Non-agricultural mkt access weighted tariff, %	8.8	138	○
4.3.3 Imports of goods & services, % GDP	27.7	115	
4.3.4 Exports of goods & services, % GDP	14.1	133	○
4.3.5 Intensity of local competition†	59.0	89	
5 Business sophistication	**31.5**	**118**	
5.1 Knowledge workers	*38.5*	*93*	
5.1.1 Knowledge-intensive employment, %	n/a	n/a	
5.1.2 Firms offering formal training, % firms	32.4	57	●
5.1.3 R&D performed by business, %	n/a	n/a	
5.1.4 R&D financed by business, %	n/a	n/a	
5.1.5 GMAT mean score	464.0	102	
5.1.6 GMAT test takers/mn pop. 20–34	18.6	114	
5.2 Innovation linkages	*26.2*	*117*	
5.2.1 University/industry research collaboration†	38.5	86	
5.2.2 State of cluster development†	27.2	119	
5.2.3 R&D financed by abroad, %	n/a	n/a	
5.2.4 JV–strategic alliance deals/tr PPP$ GDP	0.0	114	○
5.2.5 PCT patent filings with foreign inventor, %	n/a	n/a	
5.3 Knowledge absorption	*29.8*	*97*	
5.3.1 Royalty & license fees payments/th GDP	0.5	91	
5.3.2 High-tech imports less re-imports, %	n/a	n/a	
5.3.3 Computer & comm. service imports, %	25.0	84	
5.3.4 FDI net inflows, % GDP	1.7	87	
6 Knowledge & technology outputs	**21.2**	**101**	
6.1 Knowledge creation	*19.7*	*77*	
6.1.1 Domestic resident patent ap/bn PPP$ GDP	0.7	73	
6.1.2 PCT resident patent ap/bn PPP$ GDP	0.1	78	
6.1.3 Domestic res utility model ap/bn PPP$ GDP	n/a	n/a	
6.1.4 Scientific & technical articles/bn PPP$ GDP	3.5	66	●
6.2 Knowledge impact	*16.8*	*127*	
6.2.1 Growth rate of PPP$ GDP/worker, %	n/a	n/a	
6.2.2 New businesses/th pop. 15–64	n/a	n/a	
6.2.3 Computer software spending, % GDP	n/a	n/a	
6.2.4 ISO 9001 quality certificates/bn PPP$ GDP	1.1	112	
6.3 Knowledge diffusion	*27.2*	*65*	●
6.3.1 Royalty & license fees receipts/th GDP	0.0	96	
6.3.2 High-tech exports less re-exports, %	n/a	n/a	
6.3.3 Computer & comm. service exports, %	24.2	76	
6.3.4 FDI net outflows, % GDP	0.5	58	●
7 Creative outputs	**22.8**	**110**	
7.1 Creative intangibles	*41.7*	*63*	●
7.1.1 Domestic res trademark reg/bn PPP$ GDP	n/a	n/a	
7.1.2 Madrid resident trademark reg/bn PPP$ GDP	n/a	n/a	
7.1.3 ICT & business model creation†	40.7	113	
7.1.4 ICT & organizational model creation†	42.8	87	
7.2 Creative goods & services	*1.1*	*136*	○
7.2.1 Recreation & culture consumption, %	n/a	n/a	
7.2.2 National feature films/mn pop. 15–69	n/a	n/a	
7.2.3 Paid-for dailies, circulation/th pop. 15–69	10.7	114	
7.2.4 Creative goods exports, %	0.1	119	
7.2.5 Creative services exports, %	0.3	91	
7.3 Online creativity	*6.6*	*121*	
7.3.1 Generic top-level domains (TLDs)/th pop. 15–69	0.3	117	
7.3.2 Country-code TLDs/th pop. 15–69	1.0	125	
7.3.3 Wikipedia monthly edits/mn pop. 15–69	n/a	n/a	
7.3.4 Video uploads on YouTube/pop. 15–69	18.6	123	