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Universal Innovation Scoreboards on the Example of Arab Countries of the Mediterranean Partnership with the European Union: Simulation Calculations

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Abstract: The paper includes several constructed universal innovation scoreboards on basis EIS, GCI and KA-methodologies for the Arab countries of MEDA and several countries of comparison that allowed to carry out a series of simulation calculations aimed to assist the lagging Arab countries in reaching of target characteristics of more developed countries of comparison. The trend diagnostic chart of competitiveness of the Arab countries of MEDA and four countries of comparison as of 2010 was constructed.

Key words: EIS-methodology % GCI-methodology % KA-methodology % Simulation calculations % Innovation scoreboard % Trend diagnostic chart % Arab countries of MEDA

INTRODUCTION

In the present paper, basing on EIS (European Innovation Scoreboard), GCI (Global Competitiveness Index) and KA (Knowledge Assessment)-methodologies, we will construct a number of universal innovation scoreboards and show how to do simulation calculations on their basis. Such calculations allow enacting various scenarios of innovative development for developing countries aimed at reaching the target characteristics of more developed countries.

The first version of the European Innovation Scoreboard (EIS), built in 2001 and containing 17 indicators of innovation performance of the EU countries, was of universal character, since the EU experts, while constructing this scoreboard, had tried to choose as many indicators as possible to describe various aspects of innovation performance of the countries. The further versions of the Scoreboard used an even bigger number of the innovation indicators. While selecting them for different countries, there were always problems with their comparability, as there is still no homogeneous record of these indicators in all the countries. The EU experts considered EIS as a procedure of territorial benchmarking [1].

GCI- and KA-methodologies provide broader perspectives for constructing universal innovation scoreboards like EIS for various regions of the world, as they involve most countries of the world as well as a wider range of innovation indicators.

In paper [2] we suggested using three aggregated indicators to construct an Innovation Scoreboard for the Arab MEDA countries (the countries of the Mediterranean partnership with the European Council), based on GCI-methodology: higher education and training, technological readiness and innovations, the original partial GCI-indicators for which were obtained from the Arab World Competitiveness Report 2007 [3]. The total number of partial indicators was 22.

Main Part: The Innovation Scoreboard for the Arab MEDA countries and three comparison countries, made on the basis of the above-mentioned aggregated GCI-indicators by analogy with EIS, can be seen in Table 1. In this Scoreboard, the Summary Innovation Index (SSI) (the term being used in the EIS-methodology) was calculated using two ways, without taking into account the weight coefficients [2]:

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Table 1: Innovation Scoreboard for the Arab MEDA Countries, Constructed on the basis of EIS - and GCI-methodologies, 2007

Partial indicators	MEDA Countries: Tunisia	Morocco	Algeria	Egypt	Jordan	Libya	Syria	Countries for comparison: Turkey	Qatar	UAE	Arithmetic mean value of specific indicator: Excluding countries for comparison	IncludingC countries for comparison	Source	Notes: 5.01 Secondary enrollment; 5.02 Tertiary enrollment
5.01. Secondary enrollment, %	81.3	47.6	80.7	87.1	87.4	104.0	63.2	79.2	96.8	66.4	78.8	79.37	UNESCO Institute for Statistics (June 2006); national sources	5.03 Quality of educational system 5.04 Quality of Math and Science education 5.05 Quality of management schools 5.06 Local availability to specialized research and training services
5.02. Tertiary enrollment, %	29.0	11.0	20.0	33.0	39.0	56.0	13.6	29.0	19.0	22.0	28.8	27.16	ibid. World Bank, World Development Indicators 2006	5.07 Extent of staff training
5.03. Quality of the educational system, 1-7	5.1	2.9	2.9	2.7	4.0	2.2	2.9	3.2	4.9	4.4	3.2	3.52	World Economic Forum, Executive Opinion Survey 2006	1 - do not meet the needs of competitive economy, 7 - meet the needs of competitive economy
5.04. Quality of math and science education, 1-7	5.6	4.4	3.7	3.2	4.3	3.5	3.7	4.3	4.7	4.5	4.1	4.19	ibid.	1 - strongly lagging behind the majority of states, 7 - at the level of major world countries
5.05. Quality of management schools, 1-7	5.3	5.1	3.5	3.5	3.7	2.9	3.2	4.2	4.6	4.4	3.9	4.04	ibid.	1 - limited or poor quality, 7 - at the level of major world countries
5.06. Local availability of specialized research and training services, 1-7	4.6	3.9	3.0	3.5	3.9	3.1	3.1	4.3	3.9	4.3	3.6	3.76	ibid.	1 - services are not available, 7 - available services rendered by world class institutions
5.07. Extent of staff training, 1-7	4.3	3.2	3.0	3.3	3.6	2.7	3.2	4.2	3.7	4.3	3.3	3.55	ibid.	1 - poor investments, 7 - big investments
7.01. Technological readiness, 1-7	4.8	3.6	2.5	3.7	4.3	3.0	3.1	4.1	4.9	5.6	3.6	3.96	ibid.	1 - strongly lagging behind the majority of states , 7 - at the level of major world countries
7.02. Firm-level technology absorption, 1-7	5.2	5.0	4.6	4.7	4.8	4.6	4.4	5.4	5.0	5.6	4.8	4.93	ibid.	1 - firms in the country are unable to absorb technologies, 7 - firms aggressively absorb new technologies
7.03. Laws relating to ICT, 1-7	4.0	3.2	2.9	3.1	3.7	1.9	2.2	4.0	4.2	4.4	3.0	3.36	ibid.	1 - practically not available, 7 - well developed
7.04. FDI and technology transfer, 1-7	5.3	5.2	4.2	5.1	4.9	4.3	3.9	5.0	5.7	5.6	4.7	4.92	ibid.	1 - practically do not bring new technologies, 7 - represent a sufficient source of new technologies
7.05. Mobile telephone subscribers, number/ 100 residents	56.3	40.9	41.5	18.4	28.9	4.1	15.5	59.6	92.2	100.9	37.4	45.83	International Telecomm-unication Union, World Tele-communication Indicators 2006	

Table 1: Continued

7.06. Internet users, number/ 100 residents	9.5	15.2	5.8	6.8	11.2	3.6	5.8	21.9	28.2	31.1	8.3	13.91	ibid.	
7.07. Personal computers, number/ 100 residents	5.6	2.4	1.1	3.8	5.3	2.3	4.2	5.1	17.9	19.8	3.5	6.75	ibid.	
9.01. Quality of scientific research institutions, 1-7	4.4	3.4	3.4	3.2	3.6	3.3	2.9	3.9	4.0	3.8	3.5	3.59	World Economic Forum, Executive Opinion Survey 2006	1 - non sufficient, 7 - best in their research areas
9.02. Company spending on R&D, 1-7	3.7	3.0	2.8	2.7	2.7	2.3	2.6	3.2	3.4	3.4	2.8	2.98	ibid.	1 - do not spend funds on R&D, 7 - spend considerable funds on R&D compared to major international companies
9.03. University-industry research collaboration in R&D, 1-7	3.7	3.0	2.5	2.6	2.8	2.5	2.2	3.4	3.1	3.3	2.8	2.91	ibid.	1 - weak or insufficient, 7 - intensive and continuous
9.04. Government procurement of advanced technology products, 1-7	5.0	3.8	4.1	3.5	3.5	3.4	3.0	3.8	4.4	4.7	3.8	3.92	ibid.	1 - based on price factor only, 7 - based on technical design and innovation
9.05. Availability of scientists and engineers, 1-7	5.8	5.4	5.4	4.9	5.3	4.3	4.8	4.8	4.1	4.1	5.1	4.89	ibid.	1 - insufficient and rare, 7 - large-scale
9.06. Utility patents /1 mln residents	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.7	0.03	0.1	US Patent and Trademark Office (March 2006)	Issued in the period from January 1 to December 31 2005
9.07. Intellectual property protection, 1- 7	4.6	3.8	3.3	3.6	4.2	2.8	2.9	3.3	4.8	4.8	3.6	3.81	World Economic Forum, Executive Opinion Survey, 2006	1 - weak or insufficient, 7 - complies to the best world practices
9.08. Capacity for innovation, 1-7	4.1	2.7	2.3	2.9	2.9	2.4	2.5	3.5	3.2	3.0	2.8	2.95	ibid.	1 - companied obtain technology exclusively on the basis of licenses or imitate activity of foreign companies; 7 - companies conduct their own R&D and create their own new products and processes
SII1	1.17	0.88	0.79	0.88	0.95	0.76	0.72	1.08	1.21	1.57		1	Calculated with the account of the countries for comparison	
SII2	0.83	0.65	0.59	0.62	0.69	0.56	0.54	0.74	0.82	0.89		0.69		

$$SSI_1^j = \frac{1}{22}\left(\frac{x_{1j}}{\overline{x_1}} + \frac{x_{2j}}{\overline{x_2}} + \ldots + \frac{x_{ij}}{\overline{x_i}} + \ldots + \frac{x_{22j}}{\overline{x_{22}}}\right) = \frac{1}{22}\sum_{i=1}^{22}\frac{x_{ij}}{\overline{x_i}}, \quad (1)$$

where, $\overline{x_i} = \frac{1}{7}\sum_{j=1}^{7} x_{ij}$;

$$SSI_2^j = \frac{1}{22}\left(\frac{x_{1j}}{\max_j\{x_{1j}\}} + \frac{x_{2j}}{\max_j\{x_{2j}\}} + \ldots + \frac{x_{ij}}{\max_j\{x_{ij}\}} + \ldots + \frac{x_{22j}}{\max_j\{x_{22j}\}}\right) = \frac{1}{22}\sum_{i=1}^{22}\frac{x_{ij}}{\max_j\{x_{ij}\}}, \quad (2)$$

where x_{ij} is the value of an i^{th} innovation indicator for an j^{th} country, 1 # *i* # 22, 1 # *j* # 10, *n* = 22 - the number of partial indicators, *m* = 0 - the number of Arab MEDA countries and three comparison countries.

When using the first method of calculating SSI, standardization of the partial indicator x_{ij} values is carried out on their average value for all the ten countries (the same way as in EIS), when using the second method - standardization of these indicators is carried out on their maximal value in these countries.

Since EIS is considered as an analytical procedure of innovation benchmarking to provide for defining the aims of innovative development, it should include the major EU competitors - the USA and Japan. In our case, we can add to this list the least developed Mediterranean countries of the EU - Spain and Greece, as well as Turkey and Israel.

But the above-mentioned Arab World Competitiveness Report does not mention any of these countries, except Turkey. That is why in addition to Turkey we have chosen rich countries of the Arabian Peninsula as countries of comparison - Qatar and the United Arab Emirates (the UAE).

Let us do three simulation calculations in order to approximate the SSI_1 index value for Tunisia (the innovation leader of the Arab MEDA countries) to the value of the same index for the innovation leader of the Arab world - the UAE (Table 2). The logic of assigning partial innovation indicators for Tunisia when doing the first simulation was the following. The values of the first seven partial indicators for Tunisia (5.01-5.07) were not less than those for the UAE; that is why we did not change them. The values of the further four indicators for Tunisia obtained through innovation surveys (7.01-7.04) were less than those for the UAE and we decided to increase their values by 10%.

The values of the remaining three indicators of Group 7 correspond to the statistical data. These indicators responsible for the development of information and communication technologies are highly dynamic, so we increased their values for Tunisia by 20% compared to the basic variant. The values of indicators 9.01-9.05 were left unchanged for Tunisia, because they did exceed the values of the corresponding indicators for the UAE. The values of indicator 9.06 were doubled, those of 9.07 were increased by 10% and those of 9.08 were left unchanged.

As a result of the first simulation done according to the formula (1), we have received an increase in the SSI_1 index by 11.1% for Tunisia and a decrease in this index by 2.6% for the UAE (Table 3).

In the second simulation, we kept the input data for Tunisia on the same level as in the first simulation, but increased the number of patents for inventions per 1 ml of population five times compared to the basic variant. It resulted in an increase in SSI_1 index by 18.0% for Tunisia and its decrease by 6.4% for the UAE compared to the basic variant.

Hence, the growth of Tunisian patent activity from 0.2 to 0.5 patent per 1 ml of population for the input data of the first simulation allowed increasing SSI_1 by 6.2 % (from 1.30 to 1.38) and improving the proximity between the values of this index for Tunisia and the UAE by 17.7% - 6.5% = 11.2%.

Now let us see how we can obtain the close results by applying an easier way - by increasing only the potential of using information and communication technologies (partial indicators 7.05 - 7.07). To do this, starting with the basic variant, we increase the values of these partial indicators up to the level of the values of the UAE. Unlike improving the levels of other partial indicators, this can be done much faster, by purchasing in bulk mobile telephones and computers, connecting the latter to the Internet and conducting the training of the users of mobile phones and the Internet. By doing the third simulation (Table 3), we received slightly better results compared to the first simulation, having improved the convergence of the SSI_1 values for Tunisia and the UAE to 14.3%.

The further development of this type of simulation calculation should involve developing an iterative computational algorithm on an annual basis, when annual growth rates of partial indicators of a catching-up country exceed the growth rates of the corresponding partial indicators of a leader-country (the strategy of catching-up innovation development).

It is impossible to do any simulation calculations with the Competitiveness Scoreboard built only on the basis of the GCI-methodology, unlike the universal Innovation Scoreboard built on the basis of EIS- and GCI-methodologies, due to the complicated links between the initial, aggregated and final GCI-indicators. However, the availability of such scoreboards for different years and adding countries of comparison to them allow constructing diagnostic trend charts used in the EIS-methodology [1, 4]. To do so, let us make up a series of Competitiveness Scoreboards for the Arab MEDA countries and four countries of comparison (Spain, Greece, Turkey and Israel) for 2008-2010 (Table 4). On their basis, we calculated the average value of GCI 2010 and an average annual increase in this indicator over the period under study (Table 5).

Table 2: Simulation Calculations for SSI_1 Index for Tunisia Aimed to Reach the Value of This Index for the UAE

	Base case			Simulation 1			Simulation 2			Simulation 3		
Specific Indicators	Tunisia	UAE	0_i	Tunisia	UAE	0_i	Tunisia	UAE	0_i	Tunisia	UAE	0_i
5.01	81.3	66.4	79.37	81.3	66.4	79.37	81.3	66.4	79.37	81.3	66.4	79.37
5.02	29.0	22.0	27.16	29.0	22.0	27.16	29.0	22.0	27.16	29.0	22.0	27.16
5.03	5.1	4.4	3.52	5.1	4.4	3.52	5.1	4.4	3.52	5.1	4.4	3.52
5.04	5.6	4.5	4.19	5.6	4.5	4.19	5.6	4.5	4.9	5.6	4.5	4.19
5.05	5.3	4.4	4.04	5.3	4.4	4.04	5.3	4.4	4.04	5.3	4.4	4.04
5.06	4.6	4.3	3.76	4.6	4.3	3.76	4.6	4.3	3.76	4.6	4.3	3.76
5.07	4.3	4.3	3.55	4.3	4.3	3.55	4.3	4.3	3.55	4.3	4.3	3.55
7.01	4.8	5.6	3.96	5.3	5.6	4.01	5.3	5.6	4.01	4.8	5.6	3.96
7.02	5.2	5.6	4.93	5.7	5.6	4.98	5.7	5.6	4.98	5.2	5.6	4.93
7.03	4.0	4.4	3.36	4.4	4.4	3.4	4.4	4.4	3.4	4.0	4.4	3.36
7.04	5.3	5.6	4.92	5.8	5.6	4.97	5.8	5.6	4.97	5.3	5.6	4.92
7.05	56.3	100.9	45.83	67.6	100.9	46.96	67.6	100.9	46.96	100.9	100.9	50.29
7.06	9.5	31.1	13.91	11.4	31.1	14.10	11.4	31.1	14.10	31.1	31.1	16.07
7.07	5.6	19.8	6.75	6.7	19.8	6.86	6.7	19.8	6.36	19.8	19.8	8.17
9.01	4.4	3.8	3.59	4.4	3.8	3.59	4.4	3.8	3.59	4.4	3.8	3.59
9.02	3.7	3.4	2.98	3.7	3.4	2.98	3.7	3.4	2.98	3.7	3.4	2.98
9.03	3.7	3.3	2.91	3.7	3.3	2.91	3.7	3.3	2.91	3.7	3.3	2.91
9.04	5.0	4.7	3.92	5.0	4.7	3.92	5.0	4.7	3.92	5.0	4.7	3.92
9.05	5.8	4.1	4.89	5.8	4.1	4.89	5.8	4.1	4.59	5.8	4.1	4.89
9.06	0.1	0.7	0.10	0.2	0.7	0.11	0.5	0.7	0.14	0.1	0.7	0.1
9.07	4.6	4.8	3.81	5.1	4.8	3.86	5.1	4.8	3.86	4.6	4.8	3.81
9.08	4.1	3.0	2.95	4.1	3.0	2.95	4.1	3.0	2.95	4.1	3.0	2.95
SSI_1	1.17	1.57	1	1.30	1.53	1.0	1.38	1.47	1.0	1.33	1.52	1.0

Table 3: Changes and Proximity Between the Values of SSI_1 Indices for Tunisia and the UAE as a Result of Simulation Calculations

	Tunisia		UAE		
Calculation stages	SSI_1	) SSI_1, %	SSI_1	) SSI_1, %	Proximity, %
Base case	1.17	0	1.57	0	34.2
Simulation 1	1.30	11.1	1.53	-2.6	17.7
Simulation 2	1.38	18.0	1.47	-6.4	6.5
Simulation 3	1.33	13.7	1.52	-3.2	14.3

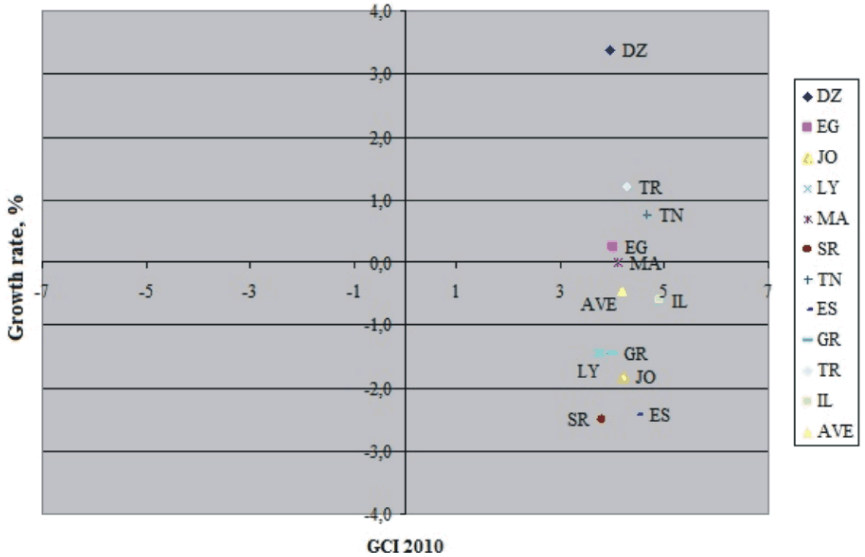

Fig. 1: Diagnostic Trend Chart of Competitiveness of the Arab MEDA Countries and Four Countries of Comparison, 2010

Table 4: A Series of Competitiveness Scoreboards for the Arab MEDA Countries and Countries of Comparison for 2008-2010

	Algeria			Egypt			Jordan			Libya		
Aggregated indicators	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
1. Institutions	3.45	3.20	3.46	4.25	4.13	4.03	4.98	4.97	4.64	3.93	3.88	3.34
2. Infrastructure	2.96	2.91	3.49	3.74	4.07	3.97	4.3	4.45	4.11	2.47	2.83	3.22
3. Macroeconomic stability	6.08	6.39	4.75	3.56	3.46	3.35	4.24	3.97	4.19	6.03	6.19	5.72
4. Health and primary education	5.34	5.28	5.56	5.19	5.20	5.42	5.67	5.56	5.73	4.65	4.61	4.53
5. Higher education and training	3.28	3.30	3.59	3.56	3.62	3.59	4.46	4.45	4.32	3.83	3.84	3.63
6. Goods market efficiency	3.52	3.36	3.57	4.00	3.99	3.94	4.55	4.46	4.36	3.56	3.61	3.20
7. Labor market efficiency	3.30	3.45	3.74	3.26	3.46	3.43	4.13	3.97	3.92	3.27	3.11	2.81
8. Financial market sophistication	2.94	2.79	2.82	3.68	4.01	4.00	4.61	4.45	4.31	2.95	3.14	2.99
9. Technological readiness	2.52	2.56	2.98	3.04	3.35	3.32	3.59	3.75	3.71	2.79	2.94	2.87
10. Market size	4.17	4.27	4.26	4.67	4.81	4.80	3.08	3.27	3.25	3.31	3.53	3.64
11. Business sophistication	3.03	3.13	3.33	3.93	3.98	3.98	4.41	4.3	3.91	3.51	3.35	2.86
12. Innovations	2.66	2.64	2.75	3.15	3.03	2.97	3.40	3.27	3.1	2.82	2.73	2.38
GCI	3.71	3.95	3.96	3.98	4.04	4.00	4.37	4.30	4.21	3.85	3.90	3.74
	Morocco			Syria			Tunisia			Spain		
Aggregated indicators	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
1. Institutions	4.05	3.92	3.94	4.2	4.04	3.76	5.15	5.02	5.19	4.59	4.38	4.25
2. Infrastructure	3.50	3.62	3.78	3.30	3.28	2.88	4.56	4.62	4.50	5.30	5.36	5.67
3. Macroeconomic stability	4.73	5.24	5.21	4.61	4.52	4.75	4.87	4.77	5.09	5.53	4.68	4.60
4. Health and primary education	5.39	5.17	5.37	5.42	5.38	5.74	6.09	5.95	6.23	5.96	5.82	6.01
5. Higher education and training	3.57	3.40	3.51	3.28	3.24	3.31	4.85	4.70	4.89	4.75	4.69	4.85
6. Goods market efficiency	4.34	4.19	4.08	3.94	3.83	3.69	4.80	4.57	4.68	4.63	4.45	4.20
7. Labor market efficiency	3.54	3.42	3.47	3.67	3.43	3.43	4.07	4.07	4.26	4.11	4.08	3.88
8. Financial market sophistication	3.88	3.81	4.07	3.28	3.10	3.19	4.09	3.97	4.27	4.93	4.47	4.28
9. Technological readiness	3.18	3.41	3.49	2.64	2.75	2.92	3.68	3.82	3.86	4.59	4.77	4.64
10. Market size	3.91	4.06	4.04	3.63	3.76	3.75	3.63	3.69	3.72	5.47	5.52	5.47
11. Business sophistication	3.99	3.83	3.75	3.94	3.64	3.45	4.51	4.24	4.34	4.89	4.74	4.46
12. Innovations	3.02	2.88	2.98	2.97	2.71	2.49	3.91	3.64	3.85	3.61	3.55	3.47
GCI	4.08	4.03	4.08	3.99	3.76	3.79	4.58	4.50	4.65	4.72	4.59	4.49
	Greece			Turkey			Israel					
Aggregated indicators	2008	2009	2010	2008	2009	2010	2008	2009	2010			
1. Institutions	4.10	3.83	3.67	3.72	3.49	3.61	4.53	4.64	4.84			
2. Infrastructure	4.28	4.31	4.57	3.54	3.92	4.21	4.48	4.42	4.89			
3. Macroeconomic stability	4.37	4.02	3.61	4.79	4.66	4.47	5.15	4.62	4.71			
4. Health and primary education	5.89	5.81	6.13	5.33	5.32	5.65	6.10	5.82	6.05			
5. Higher education and training	4.52	4.43	4.67	3.87	3.88	4.04	5.02	4.60	4.82			
6. Goods market efficiency	4.22	4.09	3.91	4.38	4.30	4.21	4.67	4.40	4.58			
7. Labor market efficiency	3.89	3.8	3.71	3.57	3.65	3.57	4.85	4.78	4.88			
8. Financial market sophistication	4.29	4.02	3.88	4.11	4.06	4.23	5.46	5.14	5.07			
9. Technological readiness	3.50	3.86	4.06	3.53	3.83	3.85	4.87	5.11	4.89			
10. Market size	4.52	4.59	4.52	5.16	5.22	5.17	4.19	4.28	4.24			
11. Business sophistication	4.13	4.04	3.83	4.51	4.28	4.16	4.95	4.67	4.79			
12. Innovations	3.18	3.14	3.00	3.91	3.11	3.10	5.26	5.06	5.30			
GCI	4.11	4.04	3.99	4.15	4.16	4.25	4.97	4.80	4.91			

Table 5: Data to Construct a Diagnostic Trend Chart of Competitiveness of the Mediterranean countries

	GCI 2008	GCI 2010	) GCI, %
Algeria	3.71	3.96	3.4
Egypt	3.98	4	0.3
Jordan	4.37	4.21	-1.8
Libya	3.85	3.74	-1.4
Morocco	4.08	4.08	0.0
Syria	3.99	3.79	-2.5
Tunisia	4.58	4.65	0.8
Spain	4.72	4.49	-2.4
Greece	4.11	3.99	-1.5
Turkey	4.15	4.25	1.2
Israel	4.97	4.91	-0.6
Average value	4.23	4.19	-0.5

Basing on this Table, we constructed a diagnostic trend chart in the GCI 2010 coordinates and defined the growth rate ( ) GCI, %). The latter indicator was calculated by the formula) GCI = ((GCI 2010 - GCI 2008)/(2 GCI 2008))*100%. The lines GCI 2010 = GCI 2010 avg. = AVE and) GCI = 0 divide the right half-plane into four quadrants. In the first quadrant on the Diagnostic Trend Chart (Fig. 1), there are leading countries, enjoying a positive growth rate of the GCI indicator, the value of this indicator exceeding the average in the whole sampling of countries; in the second quadrant there are catching-up countries, having a positive growth rate of the GCI indicator, the value of this indicator being below the average in the whole sampling of countries; in the third quadrant, there are lagging countries (outsiders) with a negative growth rate of the GCI indicator, the value of this indicator being below the average in the whole sampling of countries; in the fourth quadrant, there are countries losing the competitiveness potential, having a negative growth rate of the GCI index, but the value of this indicator is above the average in the whole sampling of countries. This distribution of the countries looks as follows:

- Quadrant I (leading countries) - Turkey (TR) and Tunisia (TN);
- Quadrant II (catching-up countries) - Algeria (DZ), Egypt (EG) and Morocco (MA) (zero growth);
- Quadrant III (outsiders) - Libya (LY), Greece (GR) and Syria (SR);
- Quadrant IV (countries losing the competitiveness potential) - Israel (IL), Spain (ES) and Jordan (JO).

This classification of the countries is quite provisional, since the growth rate of the GCI indicator can quickly change from positive to negative and vice versa. That is why in the opinion of the developers, The European Innovation Scoreboard often refers the countries with a slight negative growth rate of the total innovation index to the leading countries. In this connection, in addition to the countries already placed in Quadrant IV, we can refer at least Israel to the leading countries.

Wider opportunities for constructing universal innovation scoreboards are given by Knowledge Assessment-methodology (KAM), because it includes almost all innovation indicators of countries [5, 6].

The innovation scoreboard built under KAM for the recent year can be used for simulation calculations connected with enacting the scenarios to improve the positioning of a country according to the aggregated and integral indicators. Let us do such calculations for Morocco within the framework of the Basic Scoreboard-2009 for the Arab MEDA countries. In Table 6, there are initial specific and relative as well as standardized values of partial indicators for the current condition and their expected values for the two target benchmarks. The values of the indicators for a short-term forecast were selected from the Basic Scoreboard-2009 in the sampling of the Arab MEDA countries (target country in Table 6) in such a way that they were higher than the initial ones (current condition) and did not jump over the adjacent gradation of the classification scale of the development levels of the knowledge economy (Table 3) [6].

For example, for the generally mostly dynamically developing indicator of Internet users, which in Morocco initially amounted to the average development rate (5.34), in the short term, we set its standardized value at 7.19 (Lebanon) in order not to go beyond the high level of development. Since among the Arab MEDA countries there were no other countries with this indicator over 5.34, for a long term forecast we borrowed the value of this indicator from an Islamic ASEAN country - Malaysia, this indicator there already being on a very high level. In the same way, when moving from a short-term aim to a long-term one, we never jumped over the adjacent gradation of the classification scale of the development levels of the knowledge economy.

From 12 variable partial indicators of the Basic Scoreboard-2009, Morocco used Tunisia as its short-term target four times and Jordan as its long-term target five times.

On the basis of the constructed table, we can calculate new values of the aggregated (four indices) and integral (KEI, KI) indicators which are used in the Basic Scoreboard and which meet short-term and long-term goals (Table 8).

Table 6: Initial data for the First Two Scenarios of Simulation Calculation Using the Basic Scoreboard-2009 for Morocco (weighted indicators)

	Current state		Short-term objective			Long-term objective		
Indicators	A[1]	S[2]	A	S	Target country	A	S	Target country
Tariff and Nontariff Barriers, 2009	68.00	2.03	78.80	5.10	Jordan	80.80	6.01	Lebanon
Regulatory Quality, 2007	-0.11	4.86	0.15	5.41	Tunisia	0.35	6.10	Jordan
Rule of Low, 2007	-0.15	5.48	0.32	6.37	Tunisia	0.51	6.78	Jordan
Adult Literacy Rate (% of 15-year-olds and over), 2007	55.58	0.82	72.04	1.99	Egypt	83.12	2.95	Syria
Gross Secondary Enrollment rate, %, 2007	55.85	2.50	72.08	3.26	Syria	83.22	4.38	Algeria
Gross Tertiary Enrollment rate, %, 2007	11.31	2.54	24.02	4.20	Algeria	30.81	4.86	Tunisia
Royalty Payments and receipt (US $/pop.), 2007	1.73	3.03	2.44	3.53	Tunisia	3.94	4.29	Egypt
S&E Journal Articles/Mil. People, 2005	14.70	4.51	22.76	4.93	Egypt	50.78	6.32	Jordan
Patents Granted by USPTO/Mil. People, avg. 2003-2007	0.05	3.63	0.09	4.11	Egypt	0.22	4.86	Jordan
Total Telephones per 1000 people, 2007	730	4.45	890	5.00	Tunisia	930	5.27	Jordan
Computers per 1000 People, 2007	40	3.31	70	4.58	Jordan	100	5.56	Lebanon
Internet users per 1000 People, 2007	210	5.34	380	7.19	Lebanon	560	8.49	Malaysia

1 actual data

2 standardized data

Table 7: Classification scale of levels of country development according to the KAM indicators

Indicator alteration	Level of development
0 # I < 2	Very low
2 # I < 4	Low
4 # I < 6	Middle
6 # I < 8	High
8 # I # 10	Very high

Table 8: Simulation Calculations for Aggregated and Integral Indicators of the Basic Scoreboard-2009 and Their Ranking for the Two Scenarios of the Knowledge Economy Development in Morocco (weighted indicators)

	Current state		Short-term objective			Long-term objective		
Indices	Normalized estimate	Range	Normalized estimate	Range	Difference in Range positions	Normalized estimate	Range	Difference in Range positions
KEI, Knowledge Economy Index	3.54	99	4.64	79	20	5.49	64	35
Economic and Institution Regime Index	4.12	85	5.63	61	24	6.30	54	31
KI, Knowledge Index	3.35	104	4.31	88	16	5.22	69	35
Education index	1.95	115	3.15	103	12	4.06	97	18
Innovation index	3.72	91	4.19	81	10	5.16	67	24
ICT index	4.37	85	5.59	65	20	6.44	52	33

Table 9: Basic Scorecard Arab MEDA countries and four comparison countries, KAM 2009

	Arab MEDA countries							Comparison countries			
Weighted aggregated and integrated indices	Algeria	Egypt	Jordan	Lebanon	Morocco	Syria	Tunisia	Spain	Greece	Israel	Turkey
Economic incentives and institutional regime	2.18	3.59	5.99	4.42	4.12	1.65	4.04	8.60	6.82	8.24	6.98
Innovations	3.59	4.44	5.59	4.53	3.72	3.17	4.65	8.14	7.57	9.40	5.83
Education	3.66	4.35	5.62	4.92	1.95	3.10	4.08	8.33	8.21	6.86	4.46
ICT	3.46	3.92	4.95	5.35	4.37	4.43	4.88	8.07	6.94	7.54	4.92
KEI	3.22	4.08	5.54	4.81	3.54	3.09	4.42	8.28	7.39	8.01	5.55
KI	3.57	4.24	5.39	4.93	3.35	3.57	4.54	8.18	7.58	7.93	5.07
Non-weighted aggregated and integrated indices											
Economic incentives and institutional regime	2.18	3.59	5.99	4.42	4.12	1.65	4.04	8.60	6.82	8.24	6.98
Innovations	4.73	6.73	5.35	3.96	5.40	3.92	4.74	8.98	7.47	8.54	7.60
Education	3.66	4.35	5.62	4.92	1.95	3.10	4.08	8.33	8.21	6.86	4.46
ICT	3.46	3.92	4.95	5.35	4.37	4.43	4.88	8.07	6.94	7.54	4.92
KEI	3.51	4.65	5.48	4.66	3.96	3.28	4.44	8.49	7.36	7.79	5.99
KI	3.95	5.00	5.31	4.74	3.91	3.82	4.57	8.46	7.54	7.65	5.66

On their basis using the global KA-methodology rankings, we can define the ranks of the values of the computed indicators. In Table 8, the changes in ranks are shown relating to the current condition.

From Table 8, we can see that Morocco, having relatively high initial values of the indices of the economic and institutional regime, as well as that of information and communications technologies (ICT) (the average development level of the knowledge economy in the spheres under study), in a long-term perspective can reach a high level of the development of the knowledge economy in the spheres under study. There we can also see the most considerable change in the rank of these indices.

For the ICT index, in can be proved by the fact that now almost all developing countries witness an explosive growth of using the results of the scientific and technological advance in the sphere of information and communications technologies (mobile communication, personal computers and Internet access). The worst situation in Morocco is in the educational sphere, its initial index in this sphere being on a very low level of development and only in the long run can Morocco manage to go above the low level of development of the knowledge economy in the educational sphere.

In this domain, along with the sphere of innovations, we can see the smallest changes in the rank of the corresponding indices. Indeed, it is much more difficult to raise public literacy and increase the number of people with higher education, to say nothing about increasing the number of convertible scientific papers and patents, than to buy mobile phones and personal computers. Similar simulation calculations can be done also for aggregated indicators of the Basic Scoreboard when making a forecast of a catch-up development for two countries, one of which lagging behind and the other being the leader. To do so, let us construct a Basic Scoreboard for seven Arab MEDA countries and four countries of comparison (Table 9). Let us set a goal for the Jordan's weighted aggregated indicators included in the Knowledge Index (KI) to reach the corresponding indicators of Israel. In other words, we need to define how great is the percentage by which Jordan needs to increase its aggregated indicators to reach those of Israel.

To find it out, we need to solve these simplest equations: 5.59 + $. 5.59 = 9.40; 5.62 + " . 5.62 = 6.86; 4.95 + (. 4.95 = 7.54, whence $ = 0.68, " = 0.22, (= 0.52. Therefore, to reach the Israel's indicator under the Knowledge Index (KI=7.93), Jordan needs to increase its indices of innovation, education and ICT by 68, 22 and 52 % respectively. Because when using the KAM-methodology, variables are aggregated through defining the arithmetical mean and the partial indicators making up each of the three aggregative indices can be increased by the same percentage. For example, in order to increase the educational index by 22%, one needs to increase each of the partial indicators that make it up (literacy of the adult population, gross secondary enrollment and gross tertiary enrollment) by 22%.

CONCLUSION

So in the paper, basing on the EIS (European Innovation Scoreboard), GCI (Global Competitiveness Index) and KA (Knowledge Assessment)-methodologies there were built a few universal Innovation Scoreboards for the MEDA countries and several countries of comparison. On their basis, there were made a few simulation calculations for the lagging Arab MEDA countries to achieve the desired characteristics of more developed countries.

Such EIS and GCI-based simulation calculations of the integral index SSI and target values for the UAE were carried out for Tunisia.

Similar simulation calculations for Basic Scoreboard- 2009 were carried out for Morocco, where as their short-term goals they often would use partial indicators of Tunisia and as long-term goals - the indicators of Jordan.

The related simulation calculations were carried out for the aggregated indicators of the Basic Scoreboard of Jordan and Israel. We proved that in order to achieve the target of Israel index KI = 7.93, Jordan needs to increase the indices of innovation, education and ICT by 68%, 22% and 52% respectively. In this case, for example, in order to increase the index of education by 22%, it is sufficient to increase by 22% each of the components of its partial indicators.

What is the further perspective of developing and using such simulation calculations? Evidently, to change any one of the 12 variable indicators of the Basic Scoreboard involves certain costs. At this point, it is reasonable to introduce a cost indicator, connected with a 1-percent increase in each indicator. Then, for instance, one can pose a combinatorial goal to minimize the total costs associated with reaching the preset level of any aggregated or integral indicators of a country's knowledge economy. Such a task is not a trivial one and requires developing special mathematical and combinatorial algorithms.

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