COUNTRY LEAFLET - JORDAN

Project n°INCO-CT-2004-510696
ESTIME
Evaluation of Scientific, Technology and Innovation capabilities in MEditerranean countries

Françoise Laville, Jean Thèves
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SUMMARY

I. INTRODUCTION

The objective of the ESTIME project (6th Framework Programme of the European Commission: Project N° INCO-CT-2004-510696) is to propose a set of strategic policy instruments that can be built in order to establish a dynamic view of the research and innovation systems in Mediterranean Countries. This set of instruments should be understood as an aid for the better description of the research, technological development and innovation (RDI) institutions and RDI system as a whole. It will be developed in a close partnership between a European team and local partners.

Part of the project is the production of country leaflets devoted to macro-bibliometric analysis of each of the seven Mediterranean countries under study: Morocco, Tunisia, Algeria, Egypt, Lebanon, Syria, Jordan.

As a result, each leaflet is a first quantitative approach on the RDI activity of the country studied, helping underlining the scientific and technological activity of the country under study, as well as the student mobility and intensity of participation in the FP programs. As such the resulting leaflet is complementary to the field study that other ESTIME members have been undertaking in each of the Mediterranean countries.

The macro-bibliometric indicators presented in the leaflets are extracted from international databases, such as the Web of Science for the scientific publications, OEDC databases on Education or the Cordis database for the Framework Programme of the European Commission. Each leaflet is such constructed on the same scheme:
- characteristics of scientific publications of each country registered in the Web of Science. (with scientific production and specialisation index, relative impact of publications, ans indicators on international co-publications);
- student modility from each Mediterranean country to the EU Member States and USA.
- intensity of participation of each country in the successive EC Framework Programme, and the analysis of countries in the 4th and 5th FP, including INCO.

For each leaflet produced, aside from the Mediterranean country, three so called "context" countries have been chosen and presented. For all leaflets these three countries are Chile, South Africa and Thailand, from three different continents, in order to confront the indicators built for the focus country (Jordan in this leaflet) with other S&T systems. This also allows putting into context the overall bibliometric results of the country under study.

II. GENERAL CHARACTERISTICS OF THE JORDAN SYSTEM OF R&D

II.1. GENERAL DATA ON JORDAN

Table 1: General features of Jordan (year 2004)

Jordan: general socio-economical characteristics	
Capital	Amman
Currency	Jordan dinar
Superficy (km^2 in thousands)	89
Population (million of inhabitants)	5
Population : annual growth	2,6
Population density (inh./km^2)	56,2
Percentage of 0-14 years old (%)	37,2
Global GDP (billions US$)	10
GDP per capita (US$)	1 670
Purchasing power parity (US$)	3 756
Inflation rate (%)	3,5*
Unemployment rate (%)	16*
Exports (billions of US$)	4,5
Imports (billions of US$)	7,0
Balance of payments (billions of US$)	-2,5
World Perspective, DREE data	*OST - 2007*

Table 2: General features of South Africa, Chile and Thailand (year 2004)

General socio-economical characteristics	South Africa	Chile	Thailand
Capital	Pretoria	Santiago	Bangkok
Currency	Rand	Chilian peso	Baht
Superficy (km2 in thousands)	1 221	757	513
Population (million of inhabitants)	46,0	16,1	65,1
Population : annual growth (%)	0,9	1,2	0,9
Population density (inh./km2)	38	21	120
Percentage of 0-14 years old (%)	31,1	26,3	24
Global GDP (billions US$)	183,0	89,6	176,5
GDP per capita (US$)	4 117	5 552	3 182
Purchasing power parity (US$)	10 492	10 206	7 580
Inflation rate (%)	4,3	2,4	4,3
Unemployment rate (%)	26,7	8,8	1,7
Exports (billions of US$)	45,3	32,0	113,5
Imports (billions of US$)	47,2	23,0	102,4
Balance of payments (billions of US$)	-1,9	9,0	11,1
World perspective, DREE data			*OST - 2007*

III. JORDAN'S SCIENTIFIC PRODUCTION

Table 3: Number of articles in the publication database

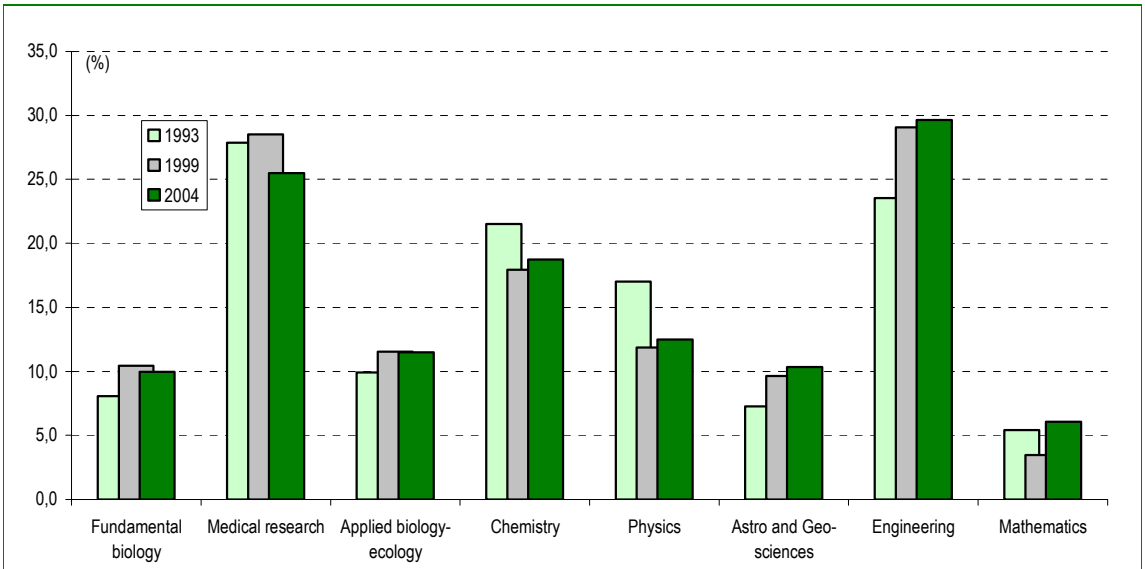
Number of publications in	1993	1999	2001	2004
world	607 604	720 317	743 886	769 398

Thomson Scientific data, OST computing *OST - 2007*

The indicators produced in this leaflet are calculated from the OST publications database that is itself founded on the Web of Science database, owned by Thomson Scientific (Philadelphia, USA). As a general context, we present in this table the total number of publications in "natural sciences" that are integrated in the database per year. For all the tables presented in this leaflet, the data for the year 2004 are not definitive. Due to the aggregative process of the database update, there is between 8 and 12% (depending on disciplines) of the total number of publications missing for the year 2004 in the version of the Web of Science database that Thomson Scientific delivered to OST in spring 2005. It is this version of the database that has been used to calculate the following indicators based on scientific publications. In annex II more details are given on the implications on calculated indicators.

III.1. SCIENTIFIC PUBLICATIONS

Figure 1: Weights of disciplines in scientific publications for Jordan (1993, 1999 and 2004)



Thomson Scientific data, OST computing

The weight of disciplines is calculated on fractional counts

In 2004, the weight of disciplines allows underlining the profile for Jordan's production of scientific publications (figure 1). Engineering (29%), medical research (25%) and chemistry (18%) are the disciplines that have a bigger share of publications in the total number of Jordanian publications. The number of publications in engineering, already the most

important at the national level, has been growing for the period studied while medical research has started to decrease from 1999 on. Mathematics is the least important disciplines (5%) in Jordanian scientific publications.

III.2. SCIENTIFIC PRODUCTION ALL DISCIPLINES

Table 4: World share (fractional and integer counts) of scientific publications of Jordan for all disciplines (1993, 1999, 2004 and evolution) ; comparison with Thailand, Chile and South Africa for 2004

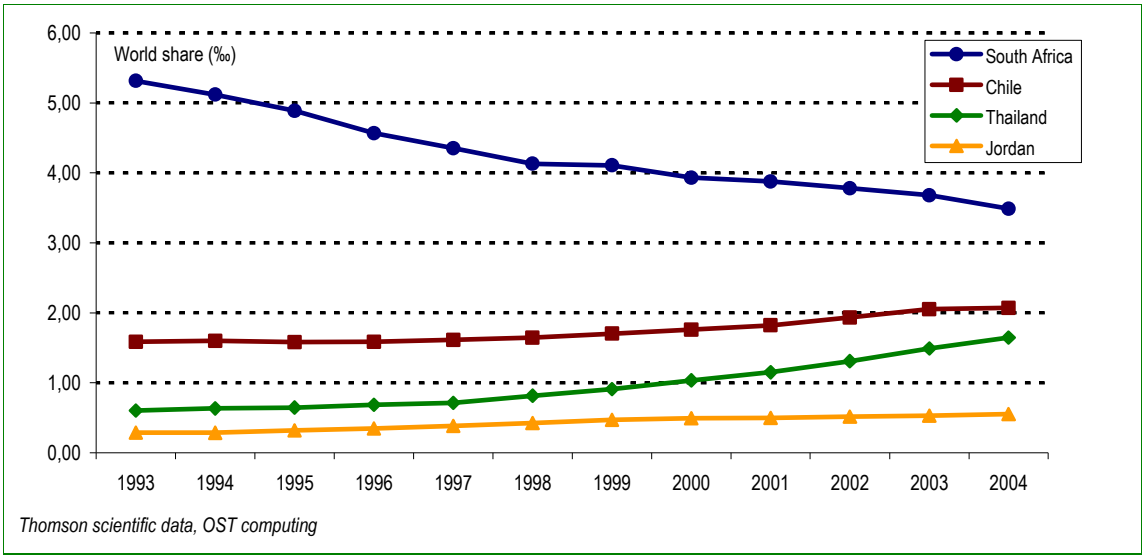
	Jordan					South Africa	Chile	Thailand
	1993	1999	2004	Evolution 2004/1993 (%)	Evolution 2004/1999 (%)	2004		
	Publications in fractional counts							
World share (‰)	0,29	0,47	0,55	+ 91	+18	3,49	2,07	1,65
Number of publications	176	339	426	+ 142	+ 26	2 683	1 594	1 267
	Publications in integer counts							
World share (‰)	0,35	0,59	0,69	+ 94	+ 17	4,64	3,04	2,43
Number of publications	215	422	528	+ 145	+ 25	3 570	2 338	1 870

Thomson Scientific data, OST computing *OST - 2007*

Fractional counts: contribution to world science. Each actor in co-published contributions is fractioned in order to obtain a count of one for each article (or 100% on the whole group of authors of the contribution). This type of counting, called "fractional counting", where each article has a unit weight, permits to make counts of publications for a country or a discipline, since all totals add-up. It is thus well adapted to macro analysis.
Integer counts: participation in world science. Each actor is credited with a unit as long as he is present in a publication. The number of participations does not add-up, because of multiple counts. This kind of count produces a sum of publications superior to 100% and the data vary with the scale changes. Despite this inconvenience, the integer count is well adapted to micro analysis and is easier to comment for co-publications.

The number of scientific publications of Jordan has more than doubled from 1993 to 2004, and its world share, as well, almost doubled during the same period of time, from 0,29‰ to 0,55‰ (table 4).

Figure 2: Evolution of world share of scientific publications from 1993 to 2004 of Jordan; comparison with Thailand, Chile and South Africa



Thomson scientific data, OST computing

The world share is calculated on fractional counts

The evolution of the world share of the scientific publications of Jordan is an increase, more stable since 2001 (figure 2).

III.3. SCIENTIFIC PRODUCTION PER DISCIPLINE

III.3.1. WORLD SHARE OF PUBLICATIONS

Table 5: World share of scientific publications of Jordan for 8 disciplines (1993, 1999, 2004 and evolution); comparison with Thailand, Chile and South Africa for 2004

	World share (‰) of scientific publications							
	Jordan					South Africa	Chile	Thailand
	1993	1999	2004	Evolution 2004/1993 (%)	Evolution 2004/1999 (%)	2004		
Discipline								
Fundamental biology	0,12	0,21	0,25	+ 104	+ 20	2,27	1,76	1,60
Medical research	0,23	0,42	0,44	+ 86	+ 5	3,05	1,61	1,87
Applied biology-ecology	0,34	0,60	0,81	+ 139	+ 34	10,59	3,98	2,77
Chemistry	0,36	0,45	0,49	+ 37	+ 8	2,43	1,96	1,69
Physics	0,28	0,29	0,42	+ 50	+ 45	1,46	1,52	0,54
Astro and Geo-sciences	0,25	0,66	0,68	+ 165	+ 3	7,22	4,55	1,69
Engineering	0,60	1,08	1,19	+ 97	+ 10	2,85	1,70	1,93
Mathematics	0,47	0,45	0,95	+ 101	+ 110	3,18	3,24	0,61
Total	0,29	0,47	0,55	+ 91	+ 18	3,49	2,07	1,65
Number of publications	176	339	426	+ 142	+ 26	2 683	1 594	1 267

Thomson Scientific data, OST computing *OST - 2007*

Fractional counts: contribution to world science. Each actor in co-published contributions is fractioned in order to obtain a count of one for each article (or 100% on the whole group of authors of the contribution). This type of counting, called "fractional counting", where each article has a unit weight, permits to make counts of publications for a country or a discipline, since all totals add-up. It is thus well adapted to macro analysis.

In 2004, the total number of publications of Jordan in the database is 426 (table 5). The disciplines that have a higher world share are engineering (1,19‰) and mathematics (0,95‰). The world share of applied biology-ecology (0.81‰) is also higher than the average national world share (0.55‰). Those three disciplines are the ones that have increased significantly during the period, along with astro and geo sciences. All disciplines have increased their world shares during this period, but the increase in the last five years (1999 to 2004) is slower than the previous period.

III.3.2. SPECIALISATION INDEX

Table 6: Specialisation index for Jordan in 8 disciplines (1993, 1999, 2004 and evolution); comparison with Thailand, Chile and South Africa for 2004

	Specialisation index							
	Jordan					South Africa	Chile	Thailand
	1993	1999	2004	Evolution 2004/1993 (%)	Evolution 2004/1999 (%)	2004		
Discipline								
Fundamental biology	0,43	0,45	0,46	+ 7	+ 2	0,65	0,85	0,97
Medical research	0,81	0,88	0,79	- 3	- 11	0,87	0,78	1,13
Applied biology-ecology	1,17	1,28	1,46	+ 25	+ 14	3,04	1,92	1,68
Chemistry	1,23	0,96	0,88	- 29	- 8	0,70	0,95	1,02
Physics	0,97	0,62	0,76	- 22	+ 23	0,42	0,73	0,33
Astro and Geo-sciences	0,88	1,39	1,22	+ 39	- 13	2,07	2,20	1,03
Engineering	2,08	2,29	2,14	+ 3	- 6	0,82	0,82	1,17
Mathematics	1,63	0,96	1,71	+ 5	+ 79	0,91	1,56	0,37
Total	1,00	1,00	1,00	0	0	1,00	1,00	1,00

Thomson Scientific data, OST computing *OST - 2007*

The *specialisation index* for a given discipline is the ratio of the world share of publications in the discipline considered to the world share for all disciplines. The index varies below and above one. When this index is above one, it shows a specialisation in the discipline, or a non specialisation if it is below one. By definition, the neutral value is 1.

In 2004, the specialisations of Jordan, measured by the specialisation index, confirm the same trends as the pattern of world share of publications. Engineering (2.14), mathematics (1.71) applied biology-ecology (1.46) and astro and geo-sciences (1.22) are 4 specialisations of Jordan (table 6). The specialisation index of these disciplines has increased between 1993 and 2004. Chemistry, which was amongst Jordan's specialisation in 1993, is no longer a discipline of specialisation in 2004.

Figure 3: Specialisation index for Jordan in 8 disciplines (1993, 2004)

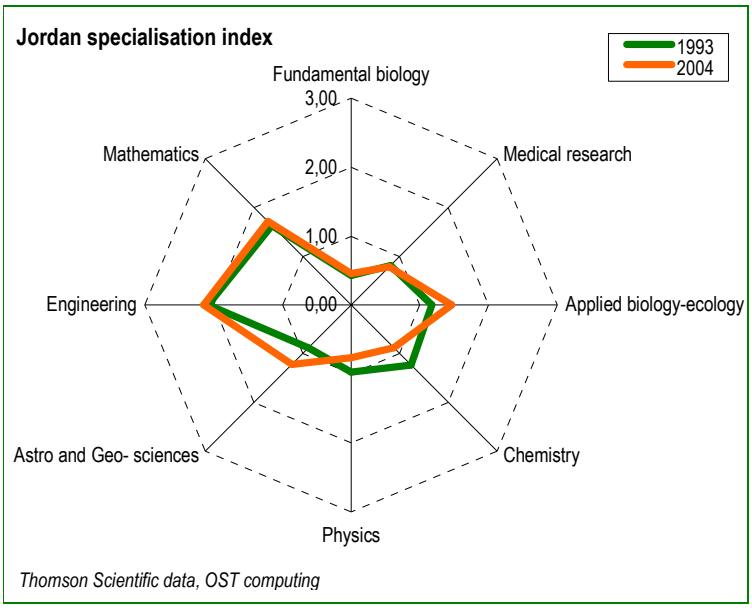
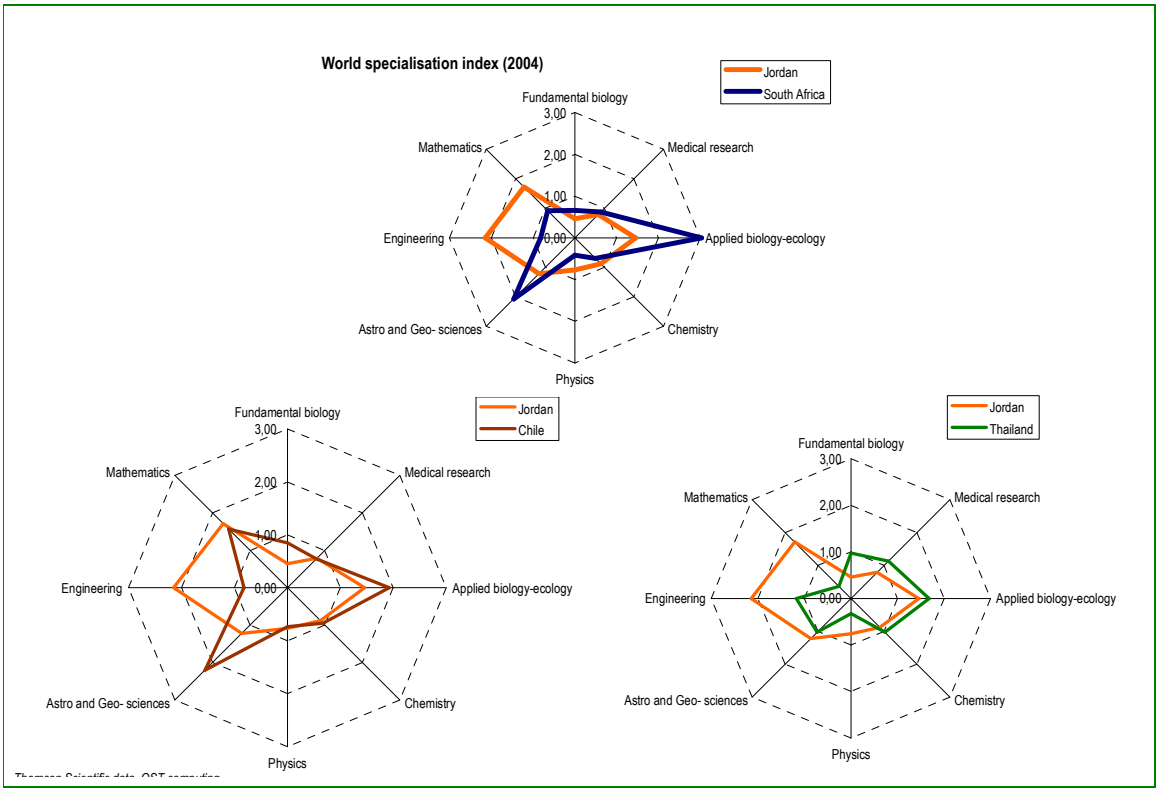


Figure 3 highlights the slight increase of specialisation of astro and geo-sciences as well as applied biology-ecology, and the decrease of chemistry.

Figure 4: Specialisation index for Jordan and the context countries in 8 disciplines (2004)



Compared to the three context countries, the specialisations of Jordan are quite specific, towards engineering and mathematics (figure 4).

III.4. VISIBILITY INDICATORS PER DISCIPLINE

III.4.1. WORLD SHARE OF CITATIONS

Table 7: World share of citations (2 year window) of Jordan for 8 disciplines (1993, 1999, 2004 and evolution)

	Jordan: world share (‰) of 2 year window citations				
Discipline	1993	1999	2004	Evolution 2004/1993 (%)	Evolution 2004/1999 (%)
Fundamental biology	0,02	0,03	0,06	+ 223	+ 89
Medical research	0,04	0,10	0,09	+ 110	- 9
Applied biology-ecology	0,04	0,17	0,19	+ 388	+ 16
Chemistry	0,15	0,11	0,14	- 8	+ 27
Physics	0,08	0,07	0,13	+ 64	+ 72
Astro and Geo-sciences	0,05	0,13	0,18	+ 245	+ 32
Engineering	0,20	0,45	0,63	+ 213	+ 40
Mathematics	0,14	0,13	0,50	+ 248	+ 271
Total	0,06	0,09	0,12	+ 110	+ 34

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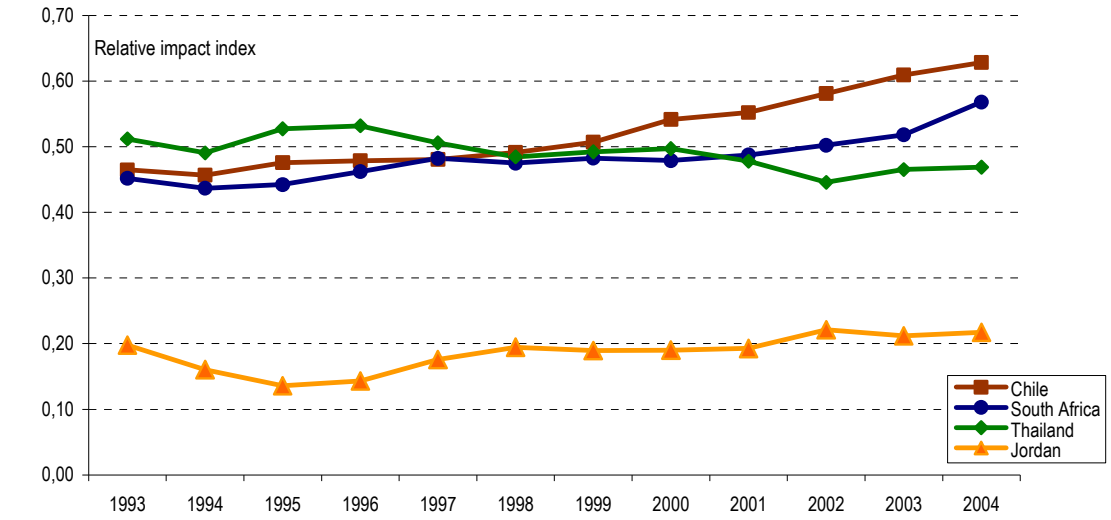
The *world share of citations* is the ratio of the number of citations received over 2 years (years N and N+1 for articles published in year N) by researchers of the country under study to the total number of citations received for the same 2 years by all the worldwide publications of the database; it is a measure of visibility of science of this country.

In 2004, engineering has the higher world share of citations (0,63‰), followed by mathematics (0,50‰), while the other disciplines are less cited, from 0,06‰ (fundamental biology) to 0,19‰ (applied biology-ecology) (table 7). The world share of citations of Jordan, as a whole, is quite low (0,12‰), but slowly improving (+110% from 1993 to 2004).

III.4.2. RELATIVE IMPACT INDEX

Figure 5: Evolution of impact index in scientific publications all disciplines from 1993 to 2004 of Jordan; comparison with Thailand, Chile and South Africa



Thomson scientific data, OST computing

The *relative impact index* is the ratio of the world share of citations received over 2 years to the world share of publications of the year indicated. The neutral value of this index is 1. A value above 1 indicates that the country considered received more citations per publication (hence is more visible) than the world average. A value of less than 1 indicates that the country's publications are less visible than the world average.

The Relative impact index of Jordan has been decreasing during the 90s' but is now slightly higher than its level of 1993 (figure 5).

Table 8: Relative impact index for Jordan in 8 disciplines (1993, 1999, 2004 and evolution)

	Jordan: relative impact index				
Discipline	1993	1999	2004	Evolution 2004/1993 (%)	Evolution 2004/1999 (%)
Fundamental biology	0,16	0,16	0,25	ns	+ 56
Medical research	0,19	0,24	0,21	+ 13	- 13
Applied biology-ecology	0,12	0,28	0,24	ns	- 14
Chemistry	0,43	0,25	0,29	- 33	+ 17
Physics	0,28	0,26	0,30	+ 9	+ 19
Astro and Geo-sciences	0,20	0,20	0,26	ns	+ 28
Engineering	0,34	0,42	0,53	+ 58	+ 27
Mathematics	0,30	0,30	0,52	ns	ns
Total	0,20	0,19	0,22	+ 10	+ 15

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The *relative impact index* is the ratio of the world share of citations received over 2 years to the world share of publications of the year indicated. The neutral value of this index is 1. A value above 1 indicates that the country considered received more citations per publication (hence is more visible) than the world average. A value of less than 1 indicates that the country's publications are less visible than the world average.
The grey parts are for the number of publications inferior to 20, meaning the impact index is not significant.

The impact index of Jordan is higher in 2004 (0,22) than in 1993 (0,20) but has been to a lower level at the end of the 90s' (table 8). Engineering is the discipline that has the higher impact index (0,53) followed by mathematics (0,52). The other disciplines have a relative impact index equal or lower than 0,30.

III.5. SCIENTIFIC PRODUCTION PER SUB-DISCIPLINE

Table 9: World share of scientific publications for Jordan, for 31 sub-disciplines (1993, 2001, 2004 and evolution)

	Jordan: world share (‰) of scientific publications			
	1993	2001	2004	Evolution 2004/2001 (%)
Sub-disciplines				
Biochemistry, cellular & molecular biology,	0,07	0,08	0,09	+ 10
Immunology	-	0,07	0,09	+ 23
Microbiology, virology, infectious diseases	0,37	0,64	0,59	- 7
Genetics, evolution	0,36	0,31	0,16	- 49
Oncology	0,07	0,12	0,08	- 34
Gastroenterology, cardiovascular system	0,11	0,16	0,15	- 6
Epidemiology, public health	0,30	0,61	0,44	- 28
Neurosciences, neuropathology	0,03	0,08	0,09	+ 18
Medicine, miscellaneous	0,18	0,60	0,90	+ 50
General & internal medicine	0,25	1,02	1,20	+ 18
General biology	0,14	0,18	0,22	+ 19
Endocrinology, reproductive systems	0,11	0,20	0,38	+ 94
Ecology, environment	0,26	0,74	0,70	- 6
Plant science, agronomy	0,49	1,05	1,03	- 1
Food science & nutrition	0,44	0,70	0,71	+ 1
Dairy & animal science, animal pathology	0,22	0,83	1,22	+ 46
Analytical chemistry	0,39	0,46	0,51	+ 12
Medical chemistry, pharmacy	0,73	0,88	0,96	+ 9
Chemistry	0,45	0,49	0,60	+ 21
General & nuclear physics	0,22	0,39	0,57	+ 47
Applied physics	0,37	0,30	0,37	+ 26
Optics, electronics, signal processing	0,45	0,39	0,77	+ 97
Physical chemistry, spectroscopy	0,19	0,20	0,30	+ 48
Astronomy, astrophysics	-	0,10	0,03	- 72
Geosciences	0,32	0,79	0,60	- 24
Materials science, metallurgy, crystallography	0,20	0,21	0,21	+ 2
Chemical engineering, polymer science	0,57	0,87	0,92	+ 6
Mechanical engineering, fluid mechanics	0,88	1,94	1,83	- 5
Computer & information science	0,15	0,62	0,52	- 17
Biomedical engineering	0,29	0,26	0,39	+ 48
Mathematics, statistics	0,47	0,48	0,96	+ 101
Total	0,29	0,50	0,55	+ 11
Number of publications	176	370	426	+ 15

Thomson Scientific data, OST computing *OST - 2007*

The indicators must be interpreted with care considering the possible low number of publications per sub-disciplines.
see annexe II.

In 2004, the world share of publications of Jordan is higher than 1‰ in four out of 31 sub-disciplines, which shows an important raise in scientific production since none of the sub-disciplines reached this level in 1993 (table 9). Two of these disciplines are related with agro-sciences. Some other sub-disciplines are not far from 1‰, which are mathematics, statistics (0,96‰), medical chemistry (0,96‰) and chemical engineering (0,92‰). The total world share of Jordan has being increasing steadily these last years (+11%).

Table 10: Specialisation index of Jordan for important sub-disciplines (2001, 2004 and evolution; ordered by the 2004 index value)

	Jordan: specialisation index		
Sub-disciplines	2001	2004	Evolution 2004/2001 (%)
Mechanical engineering, fluid mechanics	3,90	3,31	- 15
Dairy & animal science, animal pathology	1,67	2,19	+ 31
General & internal medicine	2,05	2,17	+ 6
Plant science, agronomy	2,10	1,86	- 11
Mathematics, statistics	0,96	1,73	+ 80
Medical chemistry, pharmacy	1,77	1,73	- 3
Chemical engineering, polymer science	1,75	1,66	- 5
Medicine, miscellaneous	1,21	1,63	+ 35
Optics, electronics, signal processing	0,78	1,38	+ 77
Ecology, environment	1,49	1,27	- 15

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The sub-disciplines shown in this table are those with more than 10 publications and a specialisation index superior to 1,10 in 2004.
see annexe II.

The world specialisation index of Jordanian sub-disciplines reflects the national activity of publications (table 10). In 2004, most of the sub-disciplines that have a high specialisation index are also sub-disciplines that have increased during the time period studied except the most important specialisation (mechanical engineering, fluid mechanics) or and the less important one (ecology, environment) whose specialisation indexes have decreased (-15%). Strong increase in specialisation indexes has occurred for mathematics, statistics (+80%) and optics, electronics, signal processing (+77%).

Table 11: Specialisation index for important sub-disciplines (2004; ordered by index value) and relative impact index

	Jordan (2004)	
	Specialisation index	Relative impact index
Mechanical engineering, fluid mechanics	3,31	0,40
Dairy & animal science, animal pathology	2,19	0,42
General & internal medicine	2,17	0,07
Plant science, agronomy	1,86	0,11
Mathematics, statistics	1,73	0,47
Medical chemistry, pharmacy	1,73	0,21
Chemical engineering, polymer science	1,66	0,39
Medicine, miscellaneous	1,63	0,38
Optics, electronics, signal processing	1,38	0,29
Ecology, environment	1,27	0,35

Thomson Scientific data, OST computing *OST - 2007*

The sub-disciplines shown in this table are those with more than 10 publications and a specialisation index superior to 1,10 in 2004.
see annexe II.

In 2004, mathematics and statistics, with an index of 0,47, is the sub-discipline with the highest index (table 11). Dairy & animal science (0,42) and mechanical engineering (0,40) are the two following sub-disciplines in terms of impact index. Still, these indexes are lower than 0,50, which underlines the low visibility of the Jordanian scientific activity.

IV. JORDAN'S INTERNATIONAL COOPERATION

IV.1. INTERNATIONALISATION OF SCIENTIFIC PRODUCTION

Table 12: Share of international co-publications in publications (integer counts) of Jordan (1993, 2001, 2004 and evolution); comparison with Thailand, Chile and South Africa in 2004

	Share (%) of international co-publications							
	Jordan					South Africa	Chile	Thailand
	1993	2001	2004	Evolution 2004/1993 (%)	Evolution 2004/2001 (%)	2004		
Discipline								
Fundamental biology	28,8	38,1	41,1	+ 43	+ 8	51,6	51,4	63,3
Medical research	31,1	26,1	31,2	-	+ 20	41,4	35,9	52,7
Applied biology-ecology	28,1	20,7	28,6	+ 2	+ 38	38,2	44,2	66,7
Chemistry	38,1	39,7	43,4	+ 14	+ 9	40,7	47,5	55,5
Physics	31,8	51,4	35,4	+ 11	- 31	58,2	55,0	60,3
Astro and Geo-sciences	42,6	30,8	44,5	+ 5	+ 45	49,6	76,6	59,9
Engineering	28,9	32,9	30,2	+ 4	- 8	33,1	48,0	52,7
Mathematics	40,0	40,0	37,5	- 6	- 6	50,7	65,4	42,3
Total	33,7	33,8	35,3	+ 5	+ 4	43,5	53,5	56,9

Thomson Scientific data, OST computing *OST - 2007*

Integer counts are used for calculating co-publications since a co-signed article is presumed to be the result of ties between two or more institutions regardless of the total number of co-signing laboratories.
The *share of international co-publications* is the ratio of the number of Jordan's international co-publications to the total number of Jordan's publications.

The world share of scientific international co-publications of Jordan hasn't changed very much from 33,7% in 2001 to 35,3% in 2004 (+4%) (table 12). Jordan is then keeping its level of scientific partnership, slightly increasing it. Three disciplines have more than 40% of international co-publications: fundamental biology (41.1%), chemistry (43.4%) and astro and geo-sciences (44.5%).

IV.2. CO-PUBLICATIONS INDICATORS FOR ALL DISCIPLINES

Table 13: Share of Jordan's international co-publications for the top 10 scientific partner countries (2001, 2004) all disciplines

	The top 10 scientific partners of Jordan (all disciplines)			
	2001		2004	
Rank	Country	%	Pays	%
1	United States	31,1	United States	26,8
2	United-Kingdom	15,9	Germany	18,8
3	Germany	12,8	United-Kingdom	15,6
4	Saudi Arabia	9,3	Saudi Arabia	12,2
5	Canada	7,2	Canada	5,0
6	Italy	4,3	Oman	4,7
7	France	4,1	Israel	3,6
8	Israel	3,7	Italy	3,4
9	Turkey	ns	Egypt	ns
10	Egypt	ns	Finland	ns
Number of international co-publications		153		186

Thomson Scientific data, OST computing *OST - 2007*

"ns" : not significant if the number of co-publications is lower than 5
Integer counts are used for calculating co-publications since a co-signed article is presumed to be the result of ties between two or more institutions regardless of the total number of co-signing laboratories.

In 2004, the number of co-publications of Jordan is 186 (table 13). The United States are the first scientific partner of Jordan for less than a third of Jordan co-publications (and the tendency is a decrease), followed by United Kingdom and Germany. Among the top 10 partner countries, we underline Saudi Arabia as the fourth partner, with an almost equal share of co-publications than UK or Germany. Oman and Egypt are also among its top partner countries.

Table 14: Comparison with the top 10 scientific partners of Thailand, Chile and South Africa for 2004

	The top 10 scientific partners in 2004 of:					
	South Africa		Chile		Thailand	
Rank	Country	%	Country	%	Country	%
1	United States	31,7	United States	36,9	United States	35,7
2	United Kingdom	21,7	France	15,4	Japan	24,5
3	Germany	12,2	Spain	15,0	United Kingdom	13,4
4	Australia	9,3	Germany	14,8	Australia	9,2
5	France	8,7	United Kingdom	10,3	China	5,5
6	Netherlands	6,6	Brazil	7,2	France	4,5
7	Canada	6,2	Argentina	7,1	Germany	4,1
8	Belgium	4,4	Italy	6,5	Canada	3,6
9	Switzerland	3,5	Canada	4,6	Myanmar	3,0
10	Italy	3,5	Mexico	3,8	Netherlands	2,5
Number of international co-publications		1 552		1 251		1 065

Thomson Scientific data, OST computing *OST - 2007*

Integer counts are used for calculating co-publications since a co-signed article is presumed to be the result of ties between two or more institutions regardless of the total number of co-signing laboratories.

IV.3. CO-PUBLICATIONS INDICATORS PER DISCIPLINE

Table 15: Share of Jordan's international co-publications with its top 5 scientific partner countries (2004) for 4 disciplines (fundamental biology, medical research, applied biology-ecology, and chemistry)

Jordan: the top 5 scientific partners in 2004								
	Fundamental biology		Medical research		Applied biology-ecology		Chemistry	
Rank	Country	%	Country	%	Country	%	Country	%
1	United Kingdom	29,2	United Kingdom	28,6	United States	34,6	Germany	35,7
2	United States	27,7	United States	25,4	Germany	26,9	United States	20,9
3	Germany	18,5	Saudi Arabia	16,7	Italy	15,4	Saudi Arabia	13,2
4	Italy	9,2	Canada	7,9	United Kingdom	11,5	Finland	9,3
5	France	ns	Egypt	5,6	Czech republic	ns	Italy	7,8
Number of international co-publications		22		42		17		43

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"ns" : not significant if the number of co-publications is lower than 2 per discipline
Integer counts are used for calculating co-publications since a co-signed article is presumed to be the result of ties between two or more institutions regardless of the total number of co-signing laboratories.

Table 16: Share of Jordan's international co-publications with its top 5 scientific partner countries (2004) for 4 disciplines (physics, astro- and geo-sciences, engineering and mathematics)

Jordan: the top 5 scientific partners in 2004								
	Physics		Astro and Geo-sciences		Engineering		Mathematics	
Rank	Country	%	Country	%	Country	%	Country	%
1	United States	31,4	Germany	39,7	United States	26,1	United States	38,9
2	United Kingdom	18,6	United States	16,4	United Kingdom	18,3	Saudi Arabia	30,6
3	Germany	12,9	Canada	11,0	Saudi Arabia	16,9	Oman	ns
4	Saudi Arabia	12,9	Israel	11,0	Oman	11,3	Poland	ns
5	Oman	11,4	United Kingdom	ns	Germany	8,5	India	ns
Number of international co-publications		23		24		47		12

Thomson Scientific data, OST computing *OST - 2007*

"ns" : not significant if the number of co-publications is lower than 2 per discipline
Integer counts are used for calculating co-publications since a co-signed article is presumed to be the result of ties between two or more institutions regardless of the total number of co-signing laboratories.

In 2004, engineering and medical research are the disciplines which account for the most important number of co-publications of Jordan (table 15 and 16). If taken for each discipline, United States is the first scientific partner in four disciplines (Mathematics, Engineering, Physics and Applied Biology-ecology), while Germany (with Astro and Geo-sciences and Chemistry) and the UK (with Fundamental biology and Medical research) are for two disciplines each.

V. MOBILITY OF JORDANIAN STUDENTS

Table 17: Foreign students enrolled in higher education (1998, 2002) for a selection of countries: number and share of total enrolled students

	Foreign enrollments in higher education		Ratio (%) of foreign enrollment to total students	
	1998	2002	1998	2002
Host country				
France	148 000	165 437	7,3	8,2
Germany	171 151	211 210	8,2	9,8
United Kingdom	209 550	227 273	10,8	10,1
Belgium*	36 137	40 354	11,9	13,2
Italy	23 206	28 447	1,2	1,5
Spain	29 000	44 860	1,7	2,4
United States	430 786	582 992	3,2	3,7
Japan	35 700	63 630	0,9	1,6

OECD data on education, OST computing — *OST - 2007*

* : data for Belgium is for 1999

Data used correspond to the "*tertiary education*" part, which is composed of both levels ISCED 5 and ISCED 6, established by UNESCO/UIS, the OECD, and EUROSTAT

In 2002, the United States welcomes the most foreign students amongst the countries presented, followed by the United Kingdom, Germany and France (table 17). Compared to the total number of students in each country, Belgium is the country whose ratio of foreign students is the most important, followed by the United Kingdom, Germany and France

Table 18: Jordanian students enrolled in higher education for a selection of countries (1998, 2002 and evolution): number and share to total foreign students.

	Jordanian students enrolled in :			Ratio (%) of Jordanian students to total foreign students enrolled		
	1998	2002	Evolution 2002/1998 (%)	1998	2002	Evolution 2002/1998 (%)
Host country						
France	157	190	+ 21	0,1	0,1	+ 8
Germany	1 232	1 039	- 16	0,7	0,5	- 32
United Kingdom	668	790	+ 18	0,3	0,3	+ 9
Belgium*	25	11	-56	0,1	0,0	- 61
Italy	257	122	- 53	1,1	0,4	- 61
Spain	76	61	- 20	0,3	0,1	- 48
United States	1 814	2 417	+ 33	0,4	0,4	- 2
Japan	15	23	+ 53	0,0	0,0	- 14

OECD data on education, OST computing — *OST - 2007*

* : data for Belgium is for 1999

Data used correspond to the "*tertiary education*" part, which is composed of both levels ISCED 5 and ISCED 6, established by UNESCO/UIS, the OECD, and EUROSTAT

Jordanian students represent few foreign students in the total number of foreign students (table 18). The main countries welcoming Jordanian students are Germany, France, United Kingdom and United States. Germany as a destination in 2002 is less attractive compared to 1998 (-16%).

Table 19: World share of Jordanian students enrolled abroad in higher education for a selection of countries (2002), comparison with South African, Chilean and Thai students

	World share (%) of foreign students enrolled in higher education (2002)				
Host country	Jordan	South Africa	Chile	Thailand	Total foreign students
European Union (25)	46,9	56,6	65,0	38,6	55,5
Austria	0,9	0,2	0,4	0,1	1,5
Belgium	0,2	0,8	2,1	0,1	2,1
Finland	0,2	0,2	0,2	0,1	0,4
France	3,5	1,2	7,4	1,7	8,8
Germany	19,0	2,8	9,1	2,8	11,2
Italy	2,2	0,2	1,5	0,0	1,5
Spain	1,1	0,1	15,6	0,1	2,4
Netherlands	0,1	0,9	0,6	0,1	1,0
Sweden	0,4	0,6	5,0	0,3	1,2
United Kingdom	14,5	18,3	4,7	10,7	12,0
Czech Republic	0,6	0,1	0,0	0,0	0,5
Hungary	0,5	0,0	0,0	0,0	0,6
Poland	0,8	0,1	0,0	0,0	0,4
United States	44,3	39,3	31,0	51,5	30,8
Japan	0,4	0,3	0,7	5,6	4,0
Switzerland	0,4	0,3	1,5	0,1	1,6
Total	100,0	100,0	100,0	100,0	100,0
Number of students abroad	5 459	5 678	5 346	22 546	1 889 989

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Data used correspond to the "*tertiary education*" part, which is composed of both levels ISCED 5 and ISCED 6, established by UNESCO/UIS, the OECD, and EUROSTAT

Jordanian students abroad are mostly going almost equally to the EU25 (46.9%) and to the US (44.3%) (table 19). In the EU countries, Germany is the country that welcomes the most Jordanian students, followed by UK, Italy and France.

Table 20: Evolution of world share of Jordanian students enrollee abroad in higher education for a selection of countries (1999, 2002); comparison with South African, Chilean and Thai students

	Evolution 2002/1999 (%) of world share of foreign enrollements in higher education				
Host country	Jordan	South Africa	Chile	Thailand	Total foreign students
European Union (25)	-12	-41	-33	-27	-24
Austria	-33	-11	-16	-5	-27
Belgium	ns	-71	-45	-65	-29
Finland	ns	ns	ns	ns	+7
France	+4	ns	-22	+35	-3
Germany	-19	-27	-27	+39	-9
Italy	-31	-78	+7	ns	-7
Spain	ns	ns	+5	+6	+5
Netherlands	ns	-9	-57	ns	+7
Sweden	ns	+1	-18	+7	-10
United Kingdom	-9	-48	-29	-36	-16
Czech Republic	-11	ns	ns	ns	+64
Hungary	-16	ns	ns	ns	+2
Poland	-35	ns	ns	ns	+0
United States	+19	-22	-11	-26	-1
Japan	ns	ns	-16	-3	+2
Switzerland	ns	ns	-10	ns	-11
Total	0	0	0	0	0
Number of students abroad	+8	+69	+47	+37	+30

OECD data on education, OST computing *OST - 2007*

ns : not significant because the number of students is too low (less than 20 per year)
Data used correspond to the "*tertiary education*" part, which is composed of both levels ISCED 5 and ISCED 6, established by UNESCO/UIS, the OECD, and EUROSTAT

The trends for the number of students are positive for the US (+19%) and negative for the EU (-12%) for the period 1998 to 2002 (table 20)

VI. JORDAN'S PARTICIPATION IN THE EUROPEAN COMMISSION FRAMEWORK PROGRAMS (FP)

VI.1. PARTICIPATION IN THE 4TH AND 5TH FP

Table 21: Number of participations in the 4th FP for Jordan

	Participations in 4th FP (types of programs)		
Country	ESPRIT4	INCO	NNE-JOULE C
Jordan	1	20	1

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Table 22: Number of participations in the 5th FP for Jordan

	Participations in 5th FP (types of programs)	
Country	INCO 2	IST
Jordan	43	2

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The participation of Jordan in both the 4th and 5th FP is mostly in the INCO program which is devoted to international cooperation (table 21 and 22). There has been an increase in the total number of Jordanian participations for the 4th to the 5th FP.

VI.2. CO-PARTICIPATION IN 5TH FP

Table 23: Number of co-participations in 5th FP between Jordan and the EU25 countries

	Number of co-participations of Jordan in 5th FP
Country	Jordan
Italy	46
Turkey	39
France	33
Spain	32
Malta	25
Greece	22
Germany	16
Cyprus	9
Portugal	8
Netherlands	7
United Kingdom	6
Austria	4
Denmark	2
Belgium	1
Ireland	1
Czech Republic	1

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The number of co-participations corresponds to the number of times a Jordanian partner co-participates with a partner from the European country. It is not the number of projects in which Jordan and the country are present together. The numbers can not be added.

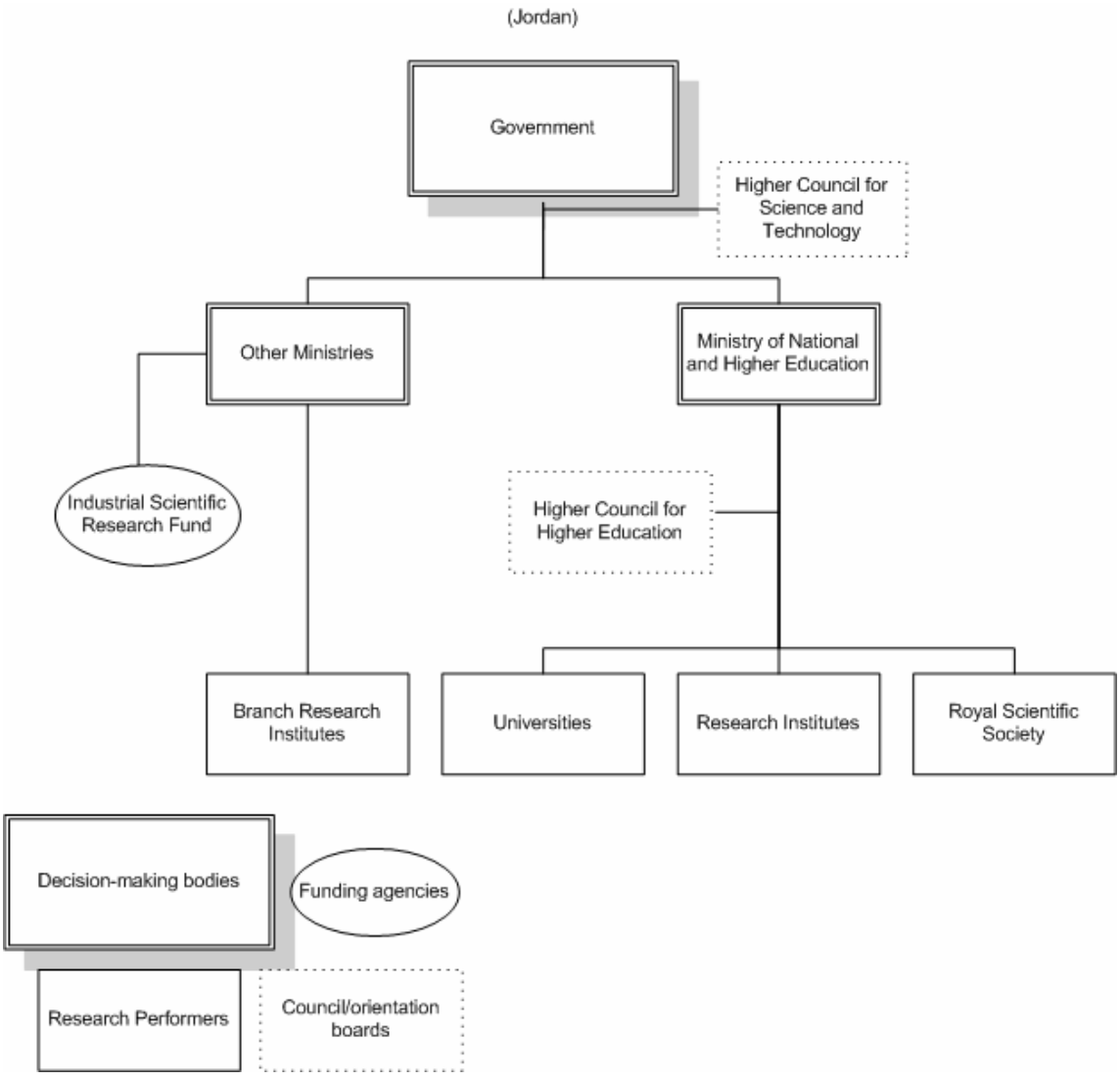
The countries with which Jordan has the most co-participations are southern European countries: Italy, France, Spain, Greece (table 23).

VII. LIST OF TABLES

VIII. LIST OF FIGURE

IX. ANNEX 1 : ORGANIZATIONAL CHART OF JORDAN'S R&D SYSTEM

The following organisational chart of Jordan's R&D system presents the situation in 2002.



X. ANNEX 2 : METHODOLOGY – INDICATORS BASED ON SCIENTIFIC PUBLICATIONS

It seems essential to explain the methodology used in this study, by first describing the source of information, the procedure of affectation of a scientific publication to a given country as well as the various indicators used and their construction process.

1. General points

Publications in scientific journals constitute for a researcher one of the main dissemination modes of his work. The information that describes each publication is registered in large bibliographic databases. The "bibliometric" analysis of such databases requires the use of statistics and data treatments in order to process that information: information on sources (journals, authors and their affiliations), descriptive texts (titles, key-words, abstracts…), field or disciplinary classification information and sometimes references to other publications (cited bibliographical references).
The exploitation of this data in order to produce indicators based on scientific publications includes an analysis of the volume of publications, the volume of citations received and of the scientific relationships through co-signed articles. The potential biases of the database used and statistical limits can make the resulting indicators very sensitive to methodological choices: therefore they must be interpreted with caution and the methodology used clearly explained.

2. Database used

The bibliographic database used by the OST is the Web of Science, produced by Thomson Scientific. It is considered as a reference tool for the production of indicators worldwide. The characteristics of this database are very important to understand since they have a consequence on most of the international statistics on scientific publications. In general, the statistical quality of this database – created as a documentary source and not as a source to be used to build indicators – is a non exhaustive survey of the best scientific journals throughout the world.
The choice of the Web of Science as a reference tool for the production of bibliometric indicators relies on its characteristics. It covers several thousands of scientific journals (about 8 000 in 2004), selected as having well known editorial management, a good scientific level, and a good international visibility level, which relies particularly on the average number of citations received by articles in the different journals. Nevertheless this journal selection is not necessarily a guaranty of a well-balanced representativeness between disciplines and sub-disciplines. The database has recently included more conference proceedings and electronic journals.
The most usual criticism on the Web of Science concerns favouring of Anglo-American science, but other influences also exist, like the over-representation of the national literature for some countries. The majority of the publications registered in the Web of Science are in English and the proportion is growing. This is the result of a linguistic favoritism of the database and the consequence of the domination of an international model of science.
The representativeness of Web of Science is generally accepted in the most internationalised fields such as physical sciences or fundamental biology. The situation can be less accurate for

scientific fields with a strong national specificity, those using dissemination other than "scientific articles", those with a high degree of application, and for small size fields.
Social sciences and humanities are excluded from the bibliometric indicators presented in the leaflets, because the corresponding bases produced by Thomson Scientific (Social Science Citation Index – SSCI, Arts & Humanities Citation Index – A&HCI) have potentially very important biases depending on the discipline and country considered.

3. From data to indicators

▪ Journals and documents selected

The journal coverage of the Web of Science changes with international visibility of the scientific journals. For calculating the bibliometric indicators, the OST follows the principle of a "dynamic group" of journals, more representative in time than the alternative solution ("constant group" of journals), but which limits short-term comparisons. For this reason, the indicators are smoothed on a three years basis (in the tables, the last year of information is used to date the indicator: 2004 for 2002 – 2004) where each year corresponds to the publication date of the articles.
At the same time, the OST, for indicator production, retains five specific types of documents of the Web of Science: articles, review articles, letters, notes and articles from meeting proceedings. The latter often appear as a selection in special issues. The proportion of meetings covered by the Web of Science is still relatively low.

▪ Gathering of journals within disciplines

The journals of the Web of Science are divided into eight major traditional academic disciplines, as defined from the subject category assigned to the journals by Thomson Scientific. The OST assigns each subject category to only one major discipline: for example immunology is filed in the "fundamental biology" discipline. Besides the eight disciplines a ninth field incorporates the "multidisciplinary" section, which is very heterogeneous but which includes some very prestigious general journals (*Nature, Science*…). This section is not isolated in the tables but contributes to the "all disciplines" totals.

This classification in these 8 major disciplines has the advantage of a good stability for the macro-indicators. Another disciplinary classification into 31 sub-disciplines is also used.

The journals can be attributed to different subject categories (up to 6). With fractional counts, the multi-attributed articles from the journals are fractioned among subject categories, whereas with integer distinct counts they are integrally counted in each category they belong to.

▪ The counting principle

The statistics by types of actors (country, region) are not calculated from the nationality of the authors but from the address of the laboratories and signing institutions. In other words, an Egyptian scientist working in UK will be counted as an UK scientist if he does not sign the address of his home institution.
The scientific articles are often co-signed by many acrors belonging to several laboratories and institutions. So several options of counting process can be chosen, in particular the fractional count and the integer count. In a logic of contribution to world science, the laboratories' contributions to each article are fractioned in order to get a total of 100% on the whole group of laboratories. This principle is also applied to the possible affectation of a scientific journal in several subject categories. This type of count, called "fractional", where

each article has a unitary weight, is additional in every scale and well adapted to macro-analysis. Extended to the relative impact indexes, this type of count is preferable for international visibility comparisons.
The other logic, the "participation" in world science, relies on "distinct integer" or "full integer" counts: each actor is credited with an unitary participation as long as he is present in a publication, and this logic is also extended to disciplinary affiliations of the journals. The summed data related to participations is necessarily superior to that of the contributions. For example, France can be present in 8% of the world publications but contributes to 5% when the fractional count is applied. Because of multiple counts, the integer count produces sums of actors' participations that are superior to 100% and the data vary with the scale changes. Despite this inconvenient, the "integer distinct count" is well adapted to micro-analysis and is easier to interpret for co-publications.
In order to produce more stable bibliometric indicators, The OST indicators are smoothed on a three years basis: the last year being used to date the indicator: 2004 for 2002 – 2004.
The following table presents the disciplinary repartition of the scientific publications registered in the Web of Science, for the three year averaged data, dated 1999 and 2004 and for the two types of countings.

Table M1: Disciplinary distribution of the OST publication database based on the Web of Science (1999, 2004)

	Fractional counts				Distinct integer counts			
	1999		2004		1999		2004	
Discipline	Number of publications	Disciplinary share (%)	Number of publications	Disciplinary share (%)	Number of publications	Disciplinary share (%)	Number of publications	Disciplinary share (%)
Fundamental biology	113 448	15,7	116 812	15,2	144 363	20,0	148 814	19,3
Medical research	222 535	30,9	229 672	29,9	247 212	34,3	255 695	33,2
Applied biology-ecology	50 756	7,0	51 199	6,7	65 442	9,1	64 240	8,3
Chemistry	100 497	14,0	111 893	14,5	123 066	17,1	139 159	18,1
Physics	83 398	11,6	88 762	11,5	97 641	13,6	106 489	13,8
Astro and Geo- sciences	42 253	5,9	48 940	6,4	49 772	6,9	57 427	7,5
Engineering	74 147	10,3	88 924	11,6	96 381	13,4	114 519	14,9
Mathematics	21 098	2,9	23 852	3,1	24 401	3,4	28 407	3,7
Total	**720 320**	**100,0**	**769 398**	**100,0**	**720 320**	**100,0**	**769 384**	**100,0**

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Important remark
In the leaflets, the most up to date indicators are proposed given that OST bibliometric database is updated once a year. When the leaflets were written, the most recent year for publications is the smoothed year 2004 (2002+2003+2004/3). At that time, the OST database was incomplete for those articles which were published in the year 2004.
Methodologically, this choice doesn't significatively impact on the value of the resulting indicators because they are calculated as a ratio between the country under study and the world (world share, impact index (share of citations divided by share of publications …) at the macro level (for countries and/or for large disciplines). It has been shown on a historical basis, that the indicators calculated with some missing data from last year are a very good approximation of those calculated with complete database.
When dealing with smaller entities (sub-disciplines for example), the indicators for 2004 must be considered as provisional and a note is written under the table to highlight that fact.

4. Indicators presented in the leaflet

One should be careful when interpreting indicators for small entities (small countries, small disciplines), which could be statistically sensitive, the variation of those indicators being potentially important.

4.1. Scientific production indicators

Scientific production indicators, also called scientific activity indicators, are calculated for all disciplines and for each of the eight standard scientific disciplines.

▪ World share of publications

The world share of publications is defined as the number of publications of an actor (a country, a region, an institution) divided by the number of worldwide publications, expressed as a percentage (%). It is the easiest comparable production indicator.

$$\text{Country world share (\%) in discipline "i"} = \frac{\text{Number of publications in discipline "i" of a country}}{\text{Total number of worldwide publications in discipline "i"}} \times 100$$

where discipline "i" is one the eight standard disciplines or all disciplines

The higher the value of this share (between 0 and 100 %), the more active is the country in world scientific production.

▪ Specialisation index

The specialisation index of an actor is the ratio of its world share in one particular discipline to its world share for all disciplines.

$$\text{Specialisation index in discipline "i"} = \frac{\text{Publication world share of the country in discipline "i"}}{\text{Publication world share of the country for all disciplines}}$$

A specialisation index of 1 in discipline "i" implies that the actor's world share for that discipline corresponds to his world share all disciplines combined. This is a neutral situation. When the specialisation index is greater than 1, the country is said to be specialised in disciplines"i", at the expense of those disciplines for which the index is less than one.

4.2. Visibity indicators

▪ World share of citations

The world share of citations is defined as the number of citations received by the publications of an actor (a country, a region, an institution) divided by the total number of citations received worldwide during a given period. Citations are received by an article for several years after the year of its publication. In the leaflets, the “citation window” used is two years, meaning that the indicators are calculated from the number of citations received for a period of two years following publication.

$$\text{Country world share (\%) of citations in discipline "i" for year N} = \frac{\text{Number of citations received by a country in discipline "i" during years N and N+1}}{\text{Number of citations received worldwide in discipline "i" during years N and N+1}} \times 100$$

The higher the value of the world share of citations for a country (comprised between 0 and 100%) the more visible that country is in world scientific production.

- **Relative impact index**

The relative impact index for an actor in a the world is defined as the ratio of the world share of citations for that actor to his world share of publications. The window used is that used for the calculation of the world share of citations.

$$\text{Relative impact index in discipline "i"} = \frac{\text{Citation world share of a country in discipline "i"}}{\text{Publication world share of a country in discipline "i"}}$$

A relative impact index of 1 in discipline "i" implies that the visibility of country's publications is equal to the average visibility of worldwide publications in that discipline. When the relative impact index is greater than 1, the country's visibility is better that world average. When the relative impact index is less than 1 the country's visibility hasn't reached world average visibility in disciplines "i".

4.3. Indicators of scientific cooperation

From a general point of view, the scientific community is strongly interconnected. A part of this cooperation takes the form of co-authored articles (co-publications).
The co-publication indicators are calculated in the leaflet using integer distinct counts, which is more "intuitive" regarding the notion of collaboration. Co-authoring an article means the existence of a "link" between the signing authors, independently of the other signing authors.

- **Level of internationalisation**

The level of internationalisation of a country is defined as the total number of international co-publications of that country divided by its total number of publications.

$$\text{Share of international co-publications (\%) in discipline "i"} = \frac{\text{Total number of international co-publications of the country in discipline "i"}}{\text{Total number of publications of the country in discipline "i"}} \times 100$$

The higher the share of international co-publications for a country (comprised between 0 and 100%) is, the more the country cooperates internationally.

- **International partnerships between countries:**

The share of co-publications of a country A, under study, with country B is defined as the number of co-publications between these two countries divided by the total number of international co-publications of country A under study. The indicator is expressed in percent, and in the leaflet the ten first scientific partners of country A are presented.

$$\text{Share of co-publicationsof country A with country B (\%)} = \frac{\text{Number of co-publications of country A with country B}}{\text{Total number of international co-publications of country A}} \times 100$$

The higher the share of co-publications of country A with country B (comprised between 0 and 100%) is, the more the country B can be considered as a scientific partner of country A.