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COMPARISON BETWEEN ROMANIA AND ISRAEL USING SPECIFIC ECONOMIC INDEXES

Abstract. *The state of the knowledge based economy in a country can be estimated by some specific indexes. They take into account the level of development of economy, innovation, education and IC technology (information and communication technologies). To illustrate these indexes, we used them for a comparative study of the state of knowledge based economy in Romania and Israel.*

Key words : *knowledge based economy, Knowledge Assessment methodology, Knowledge Indexes.*

JEL Classification: P 51

Introduction

The state of the knowledge economy (KE) can be described using some specific indexes. We shall apply these indexes to compare the economies of two different countries, Romania and Israel. In Romania, the economy became valid in 1990, when the knowledge based economy was already well installed in the world. Israel adopted this kind of economy very early and the results can be easily seen in his economic development, even it is a country with poor natural resources and an unfriendly geographic environment.

Indexes describing the knowledge based economy.

The World Bank Institute's Knowledge for Development Program has developed a **Knowledge Assessment methodology (KAM)** [1] as a tool for benchmarking a country's position vis-a-vis others in the global knowledge economy. The KAM Web-based tool on country knowledge assessments is a user-friendly tool designed to assist client countries to understand their strengths and weaknesses in terms of their ability to compete in the global knowledge economy. There are four pillars that are critical to the development of a knowledge economy (KE):

1. An *economic and institutional regime* that provides incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship
2. An *educated and skilled population* that can create, share, and use knowledge well.
3. A *dynamic information infrastructure* – that can facilitate the effective communication, dissemination, and processing of information.

4. An *efficient innovation system* of firms, research centers, universities, consultants and other organizations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology.

In the basic scorecard, three variables are used as proxies to describe each of the four Knowledge Economy (*KE*) pillars: *Economic Incentive and institutional Regime, Education, Innovation, and Information Communications & Technology*, plus two variables that describe economic and social performance. These variables are used to derive two overarching measures:

▪ The Knowledge Economy Index - **KEI (Knowledge Economy Index)** is the average of the performance scores of a country or region in all four KE pillars (Economic Incentive Regime, Education, Innovation and Information Communications & Technology).

▪ The Knowledge Index - **KI (Knowledge Index)** is the simple average of the performance of a region or country in three KE pillars (Education, Innovation and Information Communications & Technology). Each pillar score is derived by averaging the normalized scores of each pillar defining variables for which data is available. For both the KEI and the KI, the data is available for two points in time: 1995 and most recent.

Table. 1. The Knowledge Assessment Methodology – dimensions [2]

Issue	*Dimension*
Performance Indicators	Average annual GDP growth (%) (World Development Indicators) Human Development Index (Human Development Report, UNDP)
Economic Incentive and Institutional Regime	Tariff and non-tariff barriers (Heritage Foundation) Regulatory Quality (WBI) Rule of Law (WBI)
Education and Human Resources	Adult literacy rate (% age 15 and above) (Human Development Report, UNDP) Gross Secondary Enrollment Rate (World Development Indicators) Gross Tertiary Enrollment Rate (World Development Indicators)
Innovation System	Royalty Payments and Receipts (US$/pop.) Patent applications granted by the USPTO, per million population (USPTO) Scientific and technical journal articles, per million population (SIMA)
ITC	Telephones per 1,000 persons, (telephone mainlines + mobile phones) (International Telecommunication Union) Computers per 1,000 persons, (International Telecommunication Union) Internet users per 10,000 persons (International Telecommunication Union)

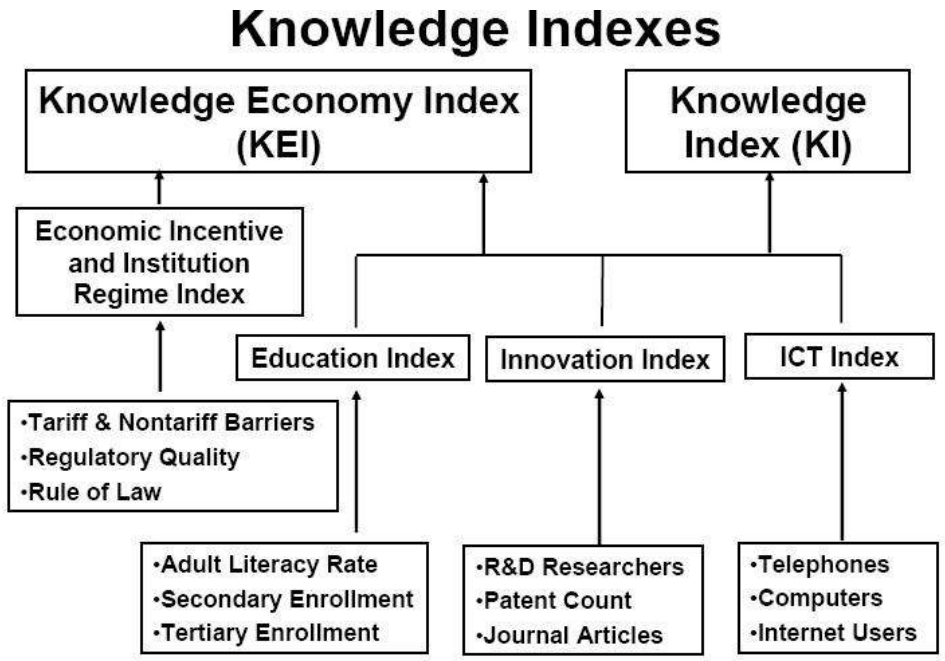

Figure 1 Structure of Knowledge Indexes [3]

The values of indexes are between 0 and 10. The highest the value, the best is the state of knowledge economy of the considered state, as presented in Tables 2 and 3.

Table 2. Knowledge Economy Index (variables weighted by population) for several countries [4]

rank	Country	KEI	KI	Economic Incentive Regime	Innovation	Education	ICT
1	Sweden	9.26	9.49	8.59	9.72	8.98	9.76
2	Denmark	9.22	9.30	8.97	9.43	9.22	9.25
	…						
22	Israel	8.16	8.40	7.47	9.32	6.83	9.04
	…						
48	Romania	5.86	5.89	5.77	5.69	5.91	6.09
	…						
136	Ethiopia	0.74	0.49	1.51	0.48	0.81	0.17
137	Sierra Leone	0.62	0.55	0.84	0.87	0.56	0.21

Economic Incentive and Institutional Regime Index

If we compare the Basic scoreboard's indicators [6] for Israel and Romania (table 3) we can see that Israel has better values for practically all indicators. The only exception is the average of Annual GDP Growth (%). But, if we consider the under development of Romania until 1990, the very high value found here is not astonishing.

Also, the Adult Literacy Rate (% age 15 and above), is slightly better in Romania, but we do not trust the values for Romania. If we took in consideration the rate of adults having university degrees (Romania, 7 % [7] , Israel 24 % [8]) the comparison is no more favorable to Romania. Or, for working in knowledge based economy, the simple literacy is not enough. This is proven by the values of other two indicators : Technical Journal Articles / Mil. People and Patents Granted by USPTO.

The Table 4 describe the Economic Regime for Romania and Israel. Again, the differences between the values of indicators are high. They are largest for Domestic credit to private sector (8.16 Israel and 2.87 Romania) and Intellectual Property Protection (8.24, respectively 3.03). So, in Romania is far more difficult lo launch a new business and, due to the state of intellectual protection, this business is not competitive.

In Table 5, Variables - Economic Performance for Israel and Romania, we find two very interesting indicators : Employment in Industry and Employment in Services. In industry, the score for Romania is double comparing to Israel, but in Services the situation is reversed. Or, one of main characteristics of knowledge based economy consists of predominance of services compared with the industrial activity. This can explain why the GDP per capita is much smaller in Romania compared with Israel.

Table 3. Basic scoreboard's indicators for Israel and Romania

Variable (Group: All Countries)	**Israel**		**Romania**	
	actual	normalized	actual	normalized
Annual GDP Growth (%), avg 2001-2005	2.00	1.37	5.70	7.77
Human Development Index[a]	0.93	8.33	0.80	6.16
Tariff & Nontariff Barriers, 2007	75.20	7.26	74.00	6.81
Regulatory Quality[a]	0.89	7.43	0.17	5.71
Rule of Law[a]	0.76	7.71	-0.29	4.79
Royalty Payments and Receipts (US$/pop.)[a]	166.20	8.68	10.20	5.95
Technical Journal Articles / Mil.	1036.00	9.78	45.50	5.90

People, 2003				
Patents Granted by USPTO / Mil. People, avg 2001-05	163.81	9.50	0.34	5.21
Adult Literacy Rate (% age 15 and above), 2004	97.10	6.33	97.30	6.47
Gross Secondary Enrollment Rate[a]	92.70	6.35	85.10	4.89
Gross Tertiary Enrollment Rate[a]	56.50	7.80	40.20	6.36
Total Telephones per 1,000 People[a]	1544.50	9.21	820.30	6.00
Computers per 1,000 People [a]	741.00	9.62	113.00	5.83
Internet Users per 1,000 People[a]	470.30	8.29	207.50	6.43

[a]2005

Table 4. Variables - Economic Regime for Israel and Romania

Variable (Group: All Countries)	**Israel**		**Romania**	
	actual	normalized	actual	normalized
Gr. Capital Formation as % of GDP, 1995-2005	21.50	4.57	21.40	4.36
Trade as % of GDP[a]	97.20	6.04	76.50	4.46
Tariff & Nontariff Barriers, 2007	75.20	7.26	74.00	6.81
Intellectual Property Protection[b]	5.50	8.24	3.10	3.03
Soundness of Banks (1-7) [b]	6.30	7.48	5.20	3.45
Exports of Goods and Services as % of GDP[a]	45.90	6.01	33.00	3.77
Interest Rate Spread[a]	3.20	1.60	n/a	n/a
Intensity of Local Competition (1-7) [b]	5.50	7.80	4.90	4.75
Domestic Credit to Private Sector as % of GDP[a]	97.50	8.16	20.00	2.87

Cost to Register a Business as % of GNI Per Capita [b]	5.10	1.83	4.40	1.53
Days to Start a Business [b]	34.00	5.04	11.00	0.84
Cost to Enforce a Contract (% of Debt) [b]	22.10	6.79	10.70	1.45

[a]2005 ; [b]2006

Table 5. Variables - Economic Performance for Israel and Romania

Variable (Group: All Countries)	**Israel**		**Romania**	
	actual	normalized	actual	normalized
Annual GDP Growth (%) 2001-5	2.00	1.37	5.70	7.77
GDP per Capita (in/nal current $)[a]	25864.30	8.13	9059.90	5.90
GDP (current US$ bill) [a]	123.40	7.05	98.60	6.33
Human Development Index, 2004	0.93	8.33	0.80	6.16
Poverty Index, 2004	n/a	n/a	n/a	n/a
Composite Risk Rating[a]	71.25	4.38	71.00	4.05
Unemployment Rate 2004	10.70	6.83	8.00	4.33
Employment in Industry (%)[a]	21.70	4.82	30.30	8.68
Employment in Services (%)[a]	75.60	9.30	37.50	1.84

[a]2005

Innovation performance index

Innovation can be defined [9] as the development, deployment and economic utilization of new products, processes and services, at micro-economic and macro-economic levels. It enables firms to respond to more sophisticated consumer demand and stay ahead of their competitors, both domestically and internationally, and contributes to the growth of multifactor productivity. Beyond its contribution to economic growth and efficiency, innovation facilitates the fulfillment of other societal needs, such as improved health and environmental protection.

In constructing an index of innovation performance, the policy recommendations of the OECD Growth Project [10] were used as a framework for

selecting and placing indicators in three performance areas deemed most relevant for innovation in OECD countries:

i) the conduct of basic research and production of new knowledge,

ii) the existence of links between public and private research, and

iii) *iii*) high levels of industrial innovation. The three areas parallel the main policy recommendations of the OECD Growth Project regarding innovation: *i*) ensuring generation of new knowledge and making government funding more effective; *ii*) fostering science-industry links and enhancing knowledge diffusion; and *iii*) creating incentives for private sector innovation.

On this basis, the index consists of three core components that combine between three to five underlying variables, mostly derived from OECD databases.

The first core component (*generation of new knowledge*) aggregates variables such as basic research as a percentage of GDP and non-business researchers as a share of the labour force.

The second core component (*industry/science linkages*) looks at public/private links through data relating to R&D, the scientific content of patents, and publications.

In the third component (*industrial innovation*), data on business research, patents and the introduction of new products and processes are used to measure private sector innovative performance.

The application of knowledge – as manifested in areas such as **entrepreneurship and innovation**, research and development, software and design, and in people's education and skills levels – is now recognized to be one of the key sources of growth in the global economy. Some countries have capitalized on this knowledge revolution to dramatically improve their competitiveness and welfare. To create and sustain an effective knowledge economy, countries must put in place appropriate arrangements to become more competitive and to increase welfare. Initially, this means understanding their strengths and weaknesses and then acting upon them to develop appropriate policies and investments to give direction to their ambitions and mechanisms to enable the policy makers and leaders to monitor progress against the goals set.

The analysis of data in table 6 shows a single variable where Romania has a value higher than Israel: Researchers in R&D, 2004. But, if the value for Romania is true that means that the yield of Romanian research is extremely low. On the other side, the highest differences are found for Availability of Venture Capital,(that means that the new technologies can not be applied in economy), Science Enrolment Ratio (so, no one is now interested to work in the field of research; probably, the average of researchers age in dangerous high) and University-Company Research Collaboration (again, the interest for introduction of innovation in economy is very low). Two other variables are interesting: Technical Journal Articles and Patents Granted by USPTO, just because here the differences are not high. Comparing with the other variables, we can conclude that these papers and

patents are not in direct relation with the needs of the economy, because they are not sustained by the industry and are not applied here.

Table 6. Innovation system performance for Israel and Romania [11]

Variable (Group: All Countries)	**Israel**		**Romania**	
	actual	normalized	actual	normalized
FDI Outflows as % of GDP, 2000-05	1.80	7.92	0.00	0.72
FDI Inflows as % of GDP, 2000-05	3.10	4.74	4.40	6.84
Royalty Payments and Receipts (US $mil.) [a]	1146.50	7.85	221.10	6.36
Royalty Payments and Receipts (US$/pop.) [a]	166.20	8.68	10.20	5.95
Science and Engineering Enrolment Ratio (%)[a]	27.90	7.93	25.00	6.90
Science Enrolment Ratio (%)[a]	9.60	5.23	4.70	0.91
Researchers in R&D, 2004	9161	4.48	21257.00	6.77
Researchers in R&D / Mil. People, 2004	1569.74	6.15	976.00	4.90
Total Expenditure for R&D as % of GDP, 2004	4.46	9.89	0.40	3.72
Manuf. Trade as % of GDP [a]	57.70	7.69	53.50	7.23
University-Company Research Collaboration (1-7), 2006	5.20	9.24	2.90	3.53
Technical Journal Articles, 2003	6941.00	8.63	988.00	6.91
Technical Journal Articles / Mil. People, 2003	1036.00	9.78	45.50	5.90
Availability of Venture Capital (1-7), 2006	5.50	9.83	3.00	3.61
Patents Granted by USPTO, avg 2001-05	1093.40	9.07	7.40	6.21

[a] 2005

Education Index

Table 7. Variables Education performance – Israel and Romania [12]

Variable	**Israel** (Group: All Countries)		**Romania** (Group: All Countries)	
	actual	normalized	actual	normalized
Adult Literacy Rate (% age 15 and above), 2004	97.10	6.33	97.30	6.47
Average Years of Schooling, 2000	9.60	8.60	9.51	8.50
Gross Secondary Enrollment Rate [a]	92.70	6.35	85.10	4.89
Gross Tertiary Enrollment Rate [a]	56.50	7.80	40.20	6.36
Life Expectancy at Birth [a]	79.70	9.07	71.70	5.00
Internet Access in Schools (1-7), 2006	5.80	8.40	3.60	4.54
Public Spending on Education as % of GDP [a]	7.30	8.95	3.60	2.66
Prof. and Tech. Workers as % of Labor Force, 2004	28.86	7.90	17.44	3.70
8th Grade Achievement in Mathematics, 2003	496.00	5.31	475.00	4.08
8th Grade Achievement in Science, 2003	488.00	4.69	470.00	3.67
Quality of Science and Math Education (1-7), 2006	5.30	8.40	5.50	8.91
Extent of Staff Training (1-7), 2006	5.10	8.07	3.30	3.03
Quality of Management Schools (1-7), 2006	5.60	8.82	3.90	3.87
Brain Drain (1-7), 2006	4.90	8.47	2.20	0.93

[a] 2005

The analysis of data contained in Table 7, concerning the education in Israel and Romania offers very interesting results. Romania is a poor country, which can be seen from the percentages of GDP given to education, of teachers, of internet access in schools, of extent of staff training. On the other part, we have good results in mathematics and sciences. It can explain why so much young Romanians are accepted in western universities and find good jobs there.
Other data can be explained on a historical basis. The good adult literacy rate is traditional in Romania. On the other side, fifty years of planned economy and lack of contact with the true economic science ca explain the quality of management schools.

ITC performance index

Table 8. Variables - ITC performance – Israel and Romania

Variable	**Israel** (Group: All Countries)		**Romania** (Group: All Countries)	
	actual	normalized	actual	normalized
Total Telephones per 1,000 People [a]	1544.50	9.21	820.30	6.00
Main Telephone Lines per 1000 People [a]	424.10	8.06	203.00	5.47
Mobile Phones per 1,000 People [a]	1120.40	9.57	617.30	6.43
Computers per 1,000 People [a]	741.00	9.62	113.00	5.83
Households with Television (%)[a]	92.60	6.09	93.70	6.67
Daily Newspapers per 1,000 People, 2000	n/a	n/a	n/a	n/a
International Internet Bandwidth (bits per person) [a]	2498.71	8.24	622.94	7.06
Internet Users per 1,000 People [a]	470.30	8.29	207.50	6.43
Price Basket for Internet (US$ per month) [a]	22.02	5.36	16.96	4.29
Availability of e-Government Services (1-7), 2006	5.00	7.83	3.47	4.35
Extent of Business Internet Use (1-7), 2006	5.40	8.73	3.40	3.22
ICT Expenditure as % of GDP [a]	8.30	8.27	3.60	1.73

[a] 2005

Finally, we shall compare the data concerning information and telecommunications industries (ITC). The main variables are presented in table 8. This time, Israel show better values at all variables, except the percentage of households with television where the values are similar. The values for Romania are not so bad if we consider tat, twenty years ago, practically there were no PCs in Romania. But other figures are more difficult to explain, such as the extent of business internet use or the availability of e-government services. On the other part, the majority of values of table 9 are from 2005. If we look at such figure in dynamics, we can see that, for Romania, they are improving every year (even if exact published data newer than 2005 are difficult to find).

Table 9. Comparison between KEI values for Romania and Israel [13] .

Country	KEI		Economic Incentive and Institutional Regime		Innovation		Education		ICT	
	2005	1995	2005	1995	2005	1995	2005	1995	2005	1995
Israel	8.16	8.21	7.47	8.18	9.32	9.13	6.83	7.24	9.04	8.29
Romania	5.86	5.33	5.77	5.25	5.69	4.89	5.91	6.01	6.09	5.17

This can be seen from data presented in Table 9 and Table 10. In ten years Romania has sensibly improved his KEI values, for all components. But not fast enough.

Table 10. Dynamics of KEI for several countries [5]

	Knowledge Economy Index		
Country	**2006**	**1995**	**Change**
Romania	5.86	5.33	0.53
Bulgaria	6.18	5.81	0.37
Israel	8.16	8.21	-0.05
Finland	9.07	9.36	-0.29
United States	8.8	9.19	-0.39

Conclusions

For all people, it is obvious that Israel is better situated than Romania in implementation of knowledge based economy. Romania lost considerable time during communist regime, adopting a non-concurrential economic regime and denying the role of informatics in industry and communications. As the world economy evolved exactly in this sense, the gap enlarged continuously. The KEI indexes show exactly how large this gap is, comparing Romania with a country who has an evolution in the right way, Israel. On the other part, the dynamic of KEI shows that we are in train to diminish the differences, but not fast enough.

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