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Competitiveness of Superpowers: Impact of Education and Innovations

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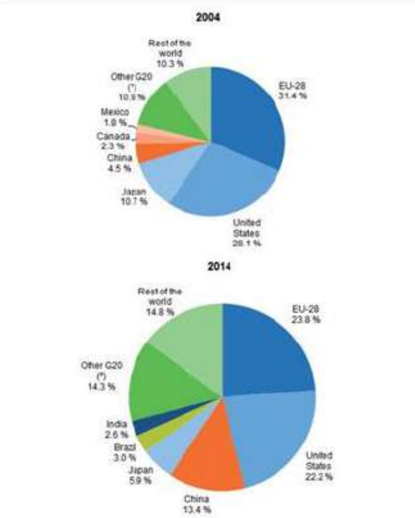
ABSTRACT

The impact of knowledge determinants on global competitiveness based on multiple criteria assessment methodology and their empirical expert assessment was evaluated taking the comparative expert data of the U.S., Japan, China, and India for a case study. The complex evaluations were determined with an account of the education, knowledge and innovation parameters published in the international reports of the WEF, INSEAD a/o experts. As result of author evaluations was found that differences between the USA and Japan, on the one side, China and India, on other, by GTCI and GII levels are lower than their differences in GDP per capita (PPP). The correlation between GTCI scores and GDP per capita, also between national economic competitiveness and GTC indices is weaker than expected by an approach based on GTCI model. The deep difference in labor productivity per employee was determined by the technical retardation of India and China compared with USA and Japan. At the same time, the differences of superpowers in educating the employable skills are not so significant.

1. Introduction

Below the comparison of criteria systems for evaluation of the education and innovation determinants in the superpowers significantly determining world development is presented by using the multicriteria decision-making approach (more detailed it was presented in Buracas et al., 2012). The main evaluating criteria and determinants applied in international comparisons of world superpowers' potentials can be used as an effective analytical instrument for the global management of intellectual resources (knowledge and talents), also distributing the financial and manual resources, for stimulating investments into productive innovations. The practical evaluation of the comparisons in the global knowledge and innovation pillars for some selected countries revealed the appropriateness of the most analytical criteria used for evaluating their comparative growth determinants and importance to deepening the qualitative research of their competitiveness.

The international comparisons of selected development indices for main superpowers were based mostly on the data series of the WEF and INSEAD experts on the knowledge-based economy. First-of-all, *Global Innovation Index (GII), Network Readiness Index (NRI),* also *Global Information Technology Index (GITI)* were reviewed. Some of them are interconnected with *Global Talent Competitiveness Index (GTCI)*[1] The advantage of the determinants used in these indices is their wide international comparability and possibility to use in the analysis of integral competitiveness indicators. Sometimes their significances are unequal in various international reports published as result of different analytical tasks within expert evaluation but the main trends are similar (Evans et al., 2011; EIU, 2011; IMF, 2017; OECD, 2015; WEF, 2014; Guloglu & Tekin, 2012).



(1) Argentina, Australia, Brazil, India, Indonesia, Saudi Arabia, South Africa, South Korea and Turkey.
(2) Argentina, Australia, Canada, Indonesia, Mexico, Saudi Arabia, South Africa, South Korea, and Turkey.
Figure 1: Share of world GDP, 2004 and 2014
Source: Eurostat Statistics Explained, March 2016. Planned Update: June 2018.

The author used hybrid criteria for selection of the main superpower states: for the first group – combined economic and intellectual potential (USA, Japan) and for the second group – combined economic and manpower potential (China, India) with an account of their perspective development within nearest years. The EU was not included so as many published expert evaluations do not present the comparable aggregated data suitable for the selected purposes. The last decade changes in world GDP potentials are presented in the Figure 1.

Within this decade, part of China grew from 4.5 % to 13.4 % and part of the US diminished from 28.1 % to 22.2 %, Japan – from 10.7 % to 5.9 %, EU – from 31.4 % to 23.8 %. The innovations lead to much more intensive technical and economic growth: the differences between leading powers as the USA and Japan and quickly developing China and India by GTCI and GII levels, also UNDP Inequality in Education index are less than differences in their GDP per capita (PPP) (Table 1).

The inequality in education adjusted to income inequality shows the deep distance between rich and poor countries; according to the OECD approach, the efficiency of countries' skills strategy evaluates their developing, activating and using outcomes. But the differences in Human development index and Social progress index levels remain rather bright. Both these indices can be compared with a bridge between global social progress and economic competitiveness so as the access to knowledge, information and education is an important presumption of innovative society and smart sustainable economics.

What is important, in 2017 the share of world GDP (PPP, in US$) in China going to exceed the level of the USA. The evaluations presented by the IMF experts shown that until 2022 the comparative potential of superpowers in the world GDP (PPP) will change substantially: as expected, Japan compared to the USA will outrun it 1.12:1, China – 1.966:1 (Table 1).

Table 1: The potential of selected superpowers

Comparative macro data	USA	Japan	China	India
Share of World GDP, 2017 (PPP, US$), evaluations	15.3	4.28	18.3	7.49
Share of GDP compared to the USA, 2022 (PPP, US$), evaluations	1	1.12	1.966	3.866
GDP per capita (PPP, US$)	55,837	37,322	14,239	6,089
GDP (PPP, US$) as % of world total	19.31	5.4	15.4	5.83
NRI value	5.61	5.41	4.05	3.85
GTCI overall score	69.3	60.7	45.3	35.65
GTCI rank (out of 118)	4	22	54	92
GII overall score (out of 128)	61.4	54.5	50.6	33.6
Social progress index	84.62	86.54	62.10	53.92
Human development index (2015)	0.92	0.90	0.74	0.62
HDI Inequality in education %	5.6	19.8	…	39.4

Sources: IMF (2017); INSEAD (2016a, 2017); UNDP, 2016; Porter et al., 2016.

The suggestions are that structural changes in the renewed production functions, first, would be evaluated when comparing the potential of the superpowers, with an account of the productive contribution of the intellectual resources within different business sectors and regions. Second, it is necessary to integrate the more important estimates of professional competency determining the value of used resources, the innovative effect of talents and intellectual capital of the firms. Third, the strategic development insights concerning the intellectual potential are stimulating the alternative managerial decisions, contribute to general social and economic transformations and diminish the emerging risks of innovations. At the same time, the concept of intellectual production in those interconnected nets is mostly oriented to human capital or, more exactly, to knowledge skills measured by GII and NRI determinants. The quickly developing China and India have the much higher impetus for the economic growth than the USA and Japan (Table 2).

Table 2: Comparative development changes of selected states, 2016

Annual change, %	USA	Japan	China	India
GDP	1.7	0.5	6.5	7.4
Consumer prices	1.4	-0.1	2.0	5.1
Unemployment rate	4.9	3.1	4.1	4.9

Source: Eurostat (2016).

The components of professional abilities and competencies, talents, innovations, and network readiness are interdependent; talents are grown within some family a/o social traditions, cultivated by changing educational systems, and their social Significances depend on their successful contacts with entrepreneurship and best practices, also on network readiness. As a result, the global human potential and its competitiveness strongly depend on a partnership between skillful talented people, business, educational system and the government.

Most of the countries apply lifelong learning, many of them are promoting geographical mobility of innovative competencies, services, and products what in some cases influence substantially their global national significance. The distribution between branches and sectors of economic activity is also one of the actual directions of social policy when aiming to ameliorate the impact of talents and innovations on economic competitiveness. The adequate structure of creative potential can be developed mostly by big advanced economies, and the smaller countries need to cooperate when developing and retaining the necessary availability of highly skilled workers and talent pool. Under accelerated progress in the world creative potential and modern intellectual technologies, the part of world inhabitants below the poverty line diminished even with accelerated growth of population in less developed countries (from 52 % in 1981 up to 22 % in 2008: INSEAD, 2015).

The framework of World Bank's Knowledge Assessment Methodology (KAM) identifies four pillars to innovation processes: economic incentive and institutional regime (policies and institutions for the protection of intellectual property, the rule of law, the ease of starting a business, etc.), education (human capital), innovation (universities, firms, and research institutes), and ICT (physical capital). As revealed by the OECD evaluations, business investments in knowledge-based capital contributed up to 34% average labor productivity growth in the EU and the US. The Global Talent Competitiveness (GTC) approach was carefully audited by Joint Research Centre, the EC, also by some professionals from the World Bank Institute. Our approach is an effort to clarify some additional methodological aspects when applying the GTCI techniques for the comparative cases.

The Table 1 shows that macroeconomic potential per capita of the U.S. measured by the GDP (PPP, in USD) is about 1.5 times higher than that of Japan, nearly four times higher than in China and nearly nine times higher, compared with India. However, as was mentioned, their GII and GTCI determinants vary less than their comparative GDP per capita revealing the trend to diverge their competitive potency-determining some perspective cultural and educational resources to global competitiveness (Figure 2).

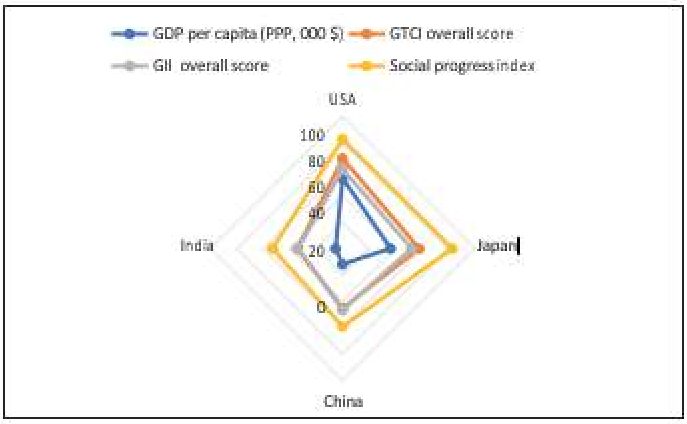


Figure 2: Some comparative levels of superpowers' macro indices
Source: Expert evaluations for the author's calculations were selected from IMF, 2017; INSEAD, 2016; Porter, 2016.

The measurement of the GTCI is based on the knowledge and practical experience (training etc.) to apply the necessary high-level skills, or global knowledge (GK) skills productively. It is substantial if these skills are linked to entrepreneurship, or leadership, and innovation of production and its products. Another most significant component of GTCI is the labor and vocational (LV) skills (necessary for employment) beside their formal training measured by labor productivity. Both these integrated indicators are substantially dependent on the dimensions of the social progress index as access to basic knowledge, access to advanced education, tolerance and inclusion determinants, also the satisfaction of basic human needs. Other world indicators of skills for employment (published in collaboration with the World Bank, ILO, and UNESCO) does not cover India and China. The conceptual framework is oriented to detail the range of factors driving LV skills from their industrial requirements to acquisition in education and training process matching to the level required by the labor market and as a result to economic and social outcomes (OECD, 2015).

The essential skills for innovation can be developed in the learning process; if necessary, the ICT a/o infrastructure is formed adequately. As a result, the developing of an innovation-friendly environment is a substantial presumption of talent competitiveness. Their efficiency and adequacy can be evaluated as a result of more detailed comparisons of real differences and similarities in such main characteristics as dimensions of social and economic policies, cultural and historical development, the size of economies, their GDP per capita, regional peculiarities, etc. For example, the brain drains of competent specialists (identified as talents) mostly goes from less developed countries to highly developed ones (especially the US), and this migration of potentially innovative resources is substantially slowing down the convergence of potential national innovation indices and GTCI of selected countries. The last decade state policy stimulating return of innovative brains in India and China helped to return this trend and somewhere equalize the outflows and inflows of the qualified labor force (INSEAD, 2016).

Some global indices characterizing the business-oriented learning and building of innovation infrastructure do not account specific differences of compound factors in selected countries connected with education traditions (p. ex., artes liberals in Western countries, or early development of child abilities in Eastern countries). The criteria used in popular international rating systems of university and professional institutes are based on international education standards (Program for the International Assessment of Adult Competencies, Program for International Student Assessment a/o: Carayannis, 2013) and partly accounted in the KAM, GTCI a/o systems dedicated to comparative evaluations of intellectual economy infrastructure and knowledge potential.

2. Determinants of Education and Innovations

The resulting indices of education services and intellectual Economics, such as the talent competitiveness input, output and sub-indices of GTCI, are compared and analyzed both aggregated and by components (48 benchmarking indicators) for selected countries. In the study under review, the value of GTCI is calculated by experts as the average of the scores obtained on levels of those input and output pillars. The input sub-index is determined by institutional enablers for talent development and other means to attract, grow and retain talent; and the output sub-index evaluates GK and LV skills. As a total, the international comparative evaluation of the GTCI amounted 103 countries are producing about 97 % of the world's GDP.

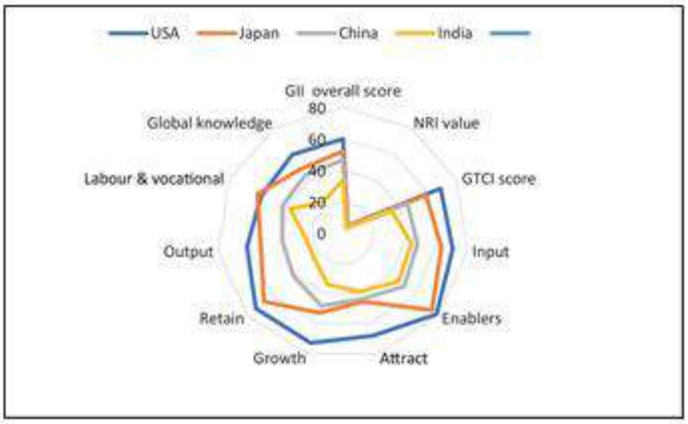


Figure 3: Comparative levels of GTCI Input and Output determinants on innovation
Notes: all sub-index rankings are between 0 and 100. In 2014 for U.S. input score was 73.28 (higher), output - 58.39 (lower). The author's construction based on expert evaluations taken from the source: INSEAD, 2016, 2016a.

The interactions between the GK and LV skills, on the one side, innovativeness and competitiveness of the economies, on the other, are mutual. So, the skills determining talents usually require of the innovative economy and strong education infrastructure; but higher levels of the GK and LV skills usually allow expecting the better possibility for growth of economic potential, more innovative and higher-quality education. For China, according to GTCI score, the most substantial achievement is in global knowledge level between upper middle-income group countries (in Asia and Oceania according to the WB classification), and for India the most substantial retardation – at retain level (within lower middle-income group), but it is much lower than in USA and Japan. For Japan, the retardation is in attract level (within a high-income group of countries, Figure 3).

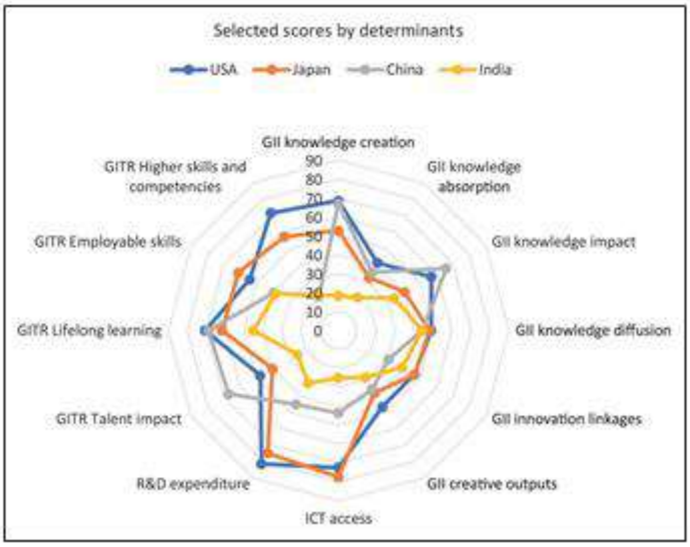


Figure 4: Comparison of GII & GITI determinants in selected superpowers

Notes: *Creative outputs: Intangible assets, creative goods, and services, online creativity. ** NRI (Network Readiness Index) – out of 144 states. The author's construction based on expert evaluations taken from the same sources.

The talent impact is the resulting measure determined by innovation output (GII) and new product entrepreneurial activity (% of entrepreneurs producing new products or services). As concerns innovation output, it is derived from aggregating knowledge and technology output (it covers knowledge creation, impact, and diffusion) and creative output (the last one includes creative intangibles, creative goods and services and online creativity). The knowledge creation itself is measured by such parameters of inventive and innovative activities, as patent applications and recognized (cited) scientific publications. The knowledge impact is measured by innovations impact on the real economy, such as increases in labor productivity, also by the entry of new firms, by certifications and international standardization (INSEAD, 2016a). The selected economies are more dependent on technology transfer than on R&D.

The significance of GII knowledge impact and especially GITI talent impact levels for China are evaluated higher than for USA or Japan, and the level of GII knowledge creation for China and USA is about similar; GII creative outputs are at similar levels for Japan and China. At the same time, the biggest difference between both superpower groups concern the GITI levels of highest skills and competencies, also rather specific are significant differences between the selected countries by their GITI levels of vocational enrollment (Figure 4).

The detailing of GTCI enablers by their components for comparable countries revealed that Japan achieved highest levels by most of the indicators (except ease of redundancy and hiring, doing business where highest levels are in the USA). In this group of determinants, the especially deep differences between both groups of countries and most substantial retardation are in levels of R&D expenditures, ICT infrastructure, government effectiveness (Figure 5).

From the Figure 5 it is seen that venture capital deals, and ease of doing business in the U.S. is on substantially higher level than in other comparable countries and backwardness of India substantially depends not only on low economic potential (which can influence the differences in R&D expenditure: 19 scores for India and 92 – in Japan) but also of such bureaucratic breaks as ease of doing business (score 37 in India comparing with 53 in China and 90 in the US).

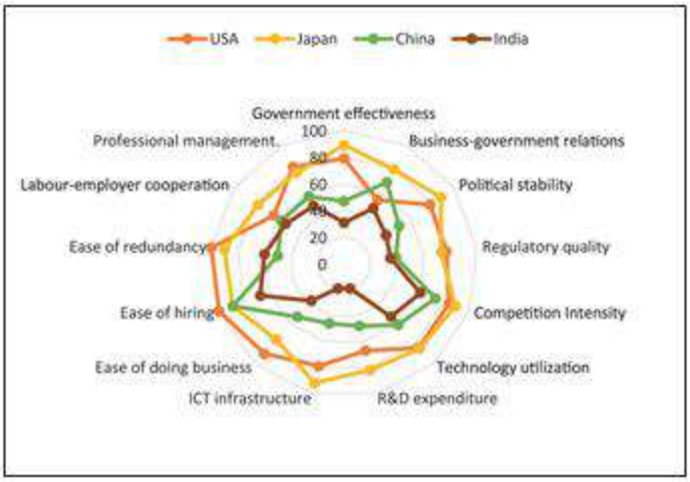


Figure 5: The enablers parameters for GTCI of superpowers

Note: The author's construction based on expert evaluations for multicriterial cobweb diagrams selected from INSEAD, 2016

When evaluating the differences in the GTCI attract components (Figure 6), the caste and feudal relics in India determines its biggest differences by gender earnings gap (female-to-male earnings ratio): 100 in the USA, and 25- in India, also the gap of female graduates and migrant stocks in the USA and all other Asian giant states. India does not also present data concerning the part of female graduates. It is interesting to mention the latest tendency of equalization of brain inflows (gain) and outflows (drain) in the USA, India, and China (Figure 6).

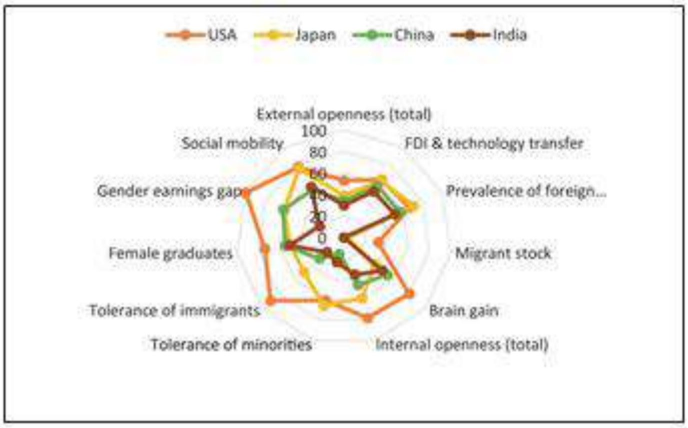


Figure 6: The attract components for GTCI of superpowers

Note: The author's construction based on expert evaluations for multicriterial cobweb diagrams are selected from the same sources (Fig. 3-5).

The components determining the innovation and economic growth are revealing the interstate differences dependent of cultural and education traditions (especially in use of virtual social networks, international students inflow, formal education and lifelong learning: Figure 7). The minor differences are revealed by comparing the quality of management schools in selected countries; the evaluations of India and Japan are on similar levels, that depend on traditional interconnections between metropolis G.B. and India. The differences in tertiary enrolment (USA – 80 and India - 19, China - 25) and international students' inflow are mostly dependent on inadequate economic & technical potential of the compared countries. The substantial differences are in use of virtual social networks between the USA and China (respectively 93 and 1%) what first-of-all shows the different social approaches to personal privacy.

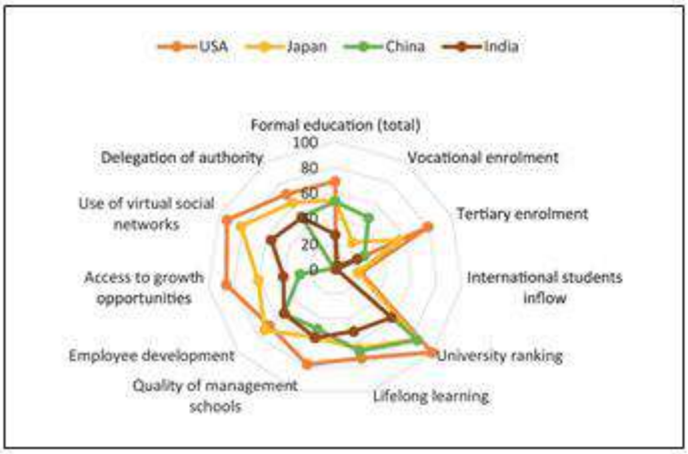


Figure 7: The growth components for GTCI of superpowers
Note: Expert evaluations for multicriterial cobweb diagrams are selected from the same source (Fig. 3-5).

The most substantial differences between retain components are in the coverage by pension systems – when they are evaluated at 95 scores in Japan and 92 scores in the USA, the comparative level in China achieved only 26 scores and about 10 - in India). Naturally, similar differences concern lifestyle comparisons (especially physician density, sanitation and environmental performance levels, see Figure 8).

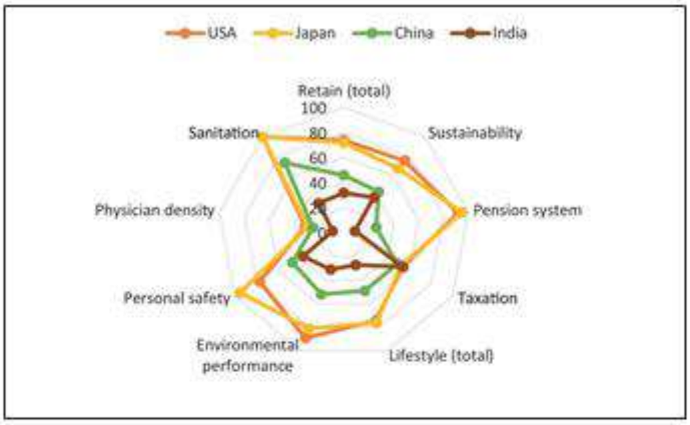


Figure 8: The retain components for GTCI of superpowers
Note: The author's construction based on expert evaluations for multicriterial cobweb diagrams are selected from the same sources (Fig. 3-5).

The vocational and labor skills (Figure 9) have a direct and substantial impact on the economic competitiveness of selected superpower potential. The deep difference in labor productivity per employee is one of the synthetic indices integrally determining the technical retardation of India (6 scores) and China (7 scores) from the USA (58). At the same time the differences in educating the labor and vocational skills as a total are not so significant (61 – for the USA, 46 – for Japan, 39 for China and 37 – for India). As a result, the employability of all selected superpowers is nearly to the same level (respectively 69-67-65-63). Some specific differences are in expert evaluations of the secondary-educated population: for USA 66 scores, for Japan – 56, China – 19 scores.

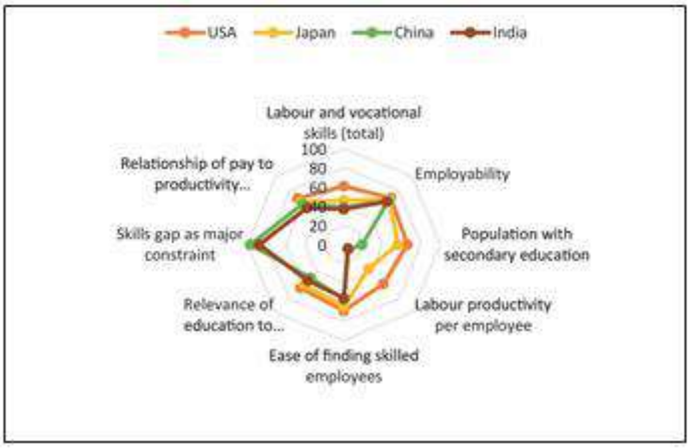


Figure 9: Comparison of GTCI vocational components by components for World superpowers
Note: The author's construction based on expert evaluations for multicriterial cobweb diagrams are selected from the same sources (Fig. 3-5).

The integral index of global knowledge summarizes the educational and entrepreneurial drive of selected superpowers: it is 2.5 times higher for the USA than for India, but the level of China (44 scores) is converging to Japan level (49 scores, see Figure 10). At the same time, talent impact of China was evaluated by experts (60 scores) higher than in the USA (51 scores) and Japan (33 scores) what was determined mostly by sophisticated exports and new product development (47 scores for USA and Japan, but 78 – China and 77 – India). These structural peculiarities of selected superpowers are better seen in web diagram characterizing their global knowledge component levels (Figure 10).

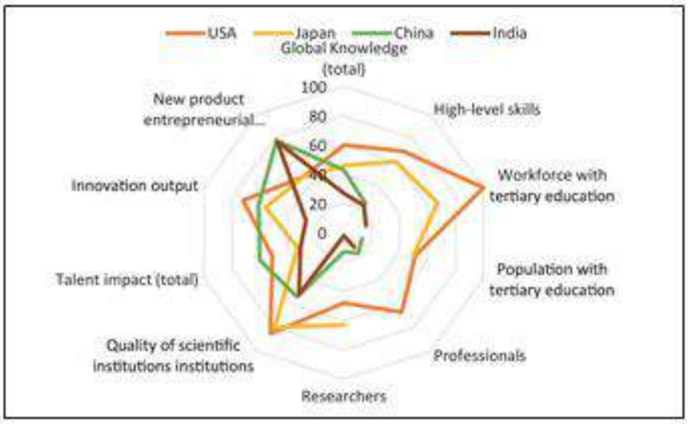


Figure 10: Comparison of GTCI global knowledge components for World superpowers
Note: The author's construction based on expert evaluations for multicriterial cobweb diagrams are selected from the same sources (Fig. 3-5).

For a summarizing review, main innovation and competency (or talents) determinants can be selected from parallel expert evaluation systems (mostly NRI and GCR) and their scores compared. So, China and India are lagging by intellectual property protection more than by the availability of latest technologies. Comparing totality of indicators, all the superpowers have lower scores for venture capital availability, and Japan has lowest between selected countries. The differences in quality of education systems and use of virtual social networks in selected superpowers are indecisive, but Japan is leading by its sophisticated system of primary education. Naturally, the country capacity to retain talented specialists is highest in the USA.

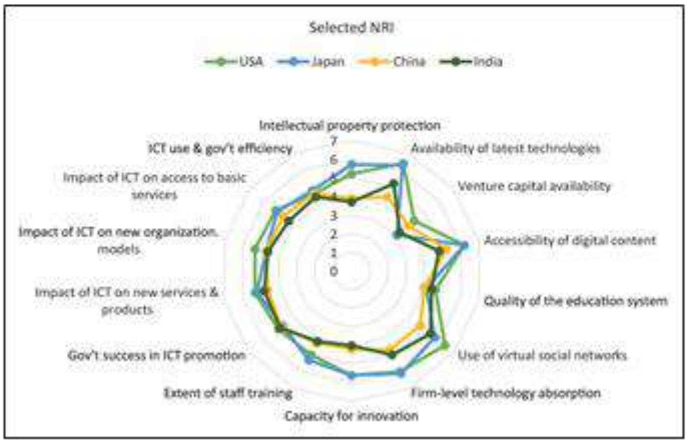


Figure 11: Comparison of NRI indicators determining innovations and talents competitiveness

Notes: WEF Expert evaluations were selected from 144 countries. *For some countries – availability of scientists and engineers. For China and India, most problematic factors are access to financing, corruption tax regulations, and inadequate supply of infrastructure, for Japan – tax rates, restrictive labor regulations, insufficient capacity to innovate and government bureaucracy, for U.S. – tax rates and their regulation, also insufficient government bureaucracy, access to financing, etc.

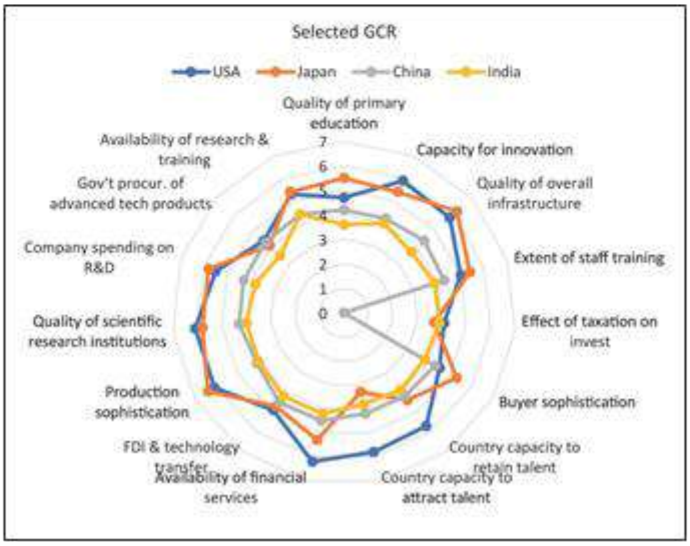


Figure 12: Comparison of GCR indicators determining innovation and talents competitiveness

Note: The author's construction based on expert evaluations for multicriterial cobweb diagrams are selected from the same sources (Fig. 3-5).

Main comparative similarities and differences of innovation and competency indicators determining the competitivity of the selected countries are graphically presented in Figure 11 and Figure 12.

The analysis was done in this section of our review also revealed the premises for a GTC approach to strategic programming of sustainable economic expansion so as it exposed the weaker and strong determinants or pillars in national innovation and talent competitiveness development.

Detailed comparisons of main activity chains <education- competencies, and skills-talents-innovations> also are anticipating some shortages in the employment of highly skilled labor esp. in fast-growth countries, and multicriteria evaluations of their sustainable development may serve as an indicator for necessary changes in national education systems.

3. Conclusion

1. The economies are more dependent on technology transfer than on their original R&D. The differences between the USA and Japan, on the one side, China and India, on other, by GTCI and GII levels are lower than their differences in GDP per capita (PPP). The GII knowledge creation and knowledge impact indices for China are high among the selected superpowers (GII knowledge creation for China and USA is about similar; GII creative outputs are on similar levels for Japan and China).

2. The competition in global knowledge skills development and levels of their implementation are substantially influenced by the brain drain of the talents which mostly goes from less developed countries to highly developed ones and that influence some deviations within main dependencies of the GTCI model. However, the state policy in India and China stimulating brain return helped about to equalize the outflows and inflows of the qualified labor force.

3. The correlation between GTCI scores and GDP per capita, also between national economic competitiveness and GTC indices is weaker than expected by the approach based on GTCI model. The deep difference in labor productivity per employee was determined by the technical retardation of India and China compared with USA and Japan. At the same time, the differences between both groups of superpowers in educating the employable skills are not so significant.

4. It is necessary to integrate of more important estimates of professional competency determining the value of intellectual resources, parameters determining their talents and intellectual capital of the firms into national social statistics. In general, GII and GTCI are useful measures for developing global innovation management, for better distributing the material and intellectual resources, also programming business innovative incentives and training employees. It also helps for anticipating some shortages of human capital especially some categories of highly skilled labor.

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