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Łukasz Bryl
Poznan University
of Economics and Business
Poznan, Poland
Lukasz.bryl@ue.poznan.pl
ORCID ID: 0000-0003-0565-6394

Long-term Development of National Human Capital. Evidence from China and Poland

ABSTRACT

Objective: The aim of this paper is to present the long-term development of the chosen human capital indices that uncovers and compares the outcome of the national efforts performed by the two culturally distant countries (China and Poland) over the decade. Additionally, paper indicates the areas of further HC progress in both nations.

Methodology: The study was based on measuring human capital with the help of deliberately chosen set of macroeconomic indices (28 items) referring to the nations' capability to create innovations. Analysis was performed for the 2007–2017 years.

Findings: Positive phenomena in the case of human capital development outperform the negative ones in both countries, however, the extent is more remarkable in the case of China. China managed to: improve greatly the pupil-teacher ratio (both in primary and secondary schools), increase secondary and tertiary education enrolment rate along with the rise of the no. of students from abroad. In Poland, the greatest increase was observed in the case of the number of researchers what consequently contributed to the improvement of number of scientific and technical articles and citable documents (h-index).

Value Added: To the best Author's knowledge this is the first paper that compares national human capital development in Poland and China with a set of indices focused on capability to create innovations and adopts longitudinal approach.

Recommendations: Policy-makers in the case of Poland should concentrate on: fostering university/industry research collaboration, improving rank in worldwide QS classification and performing more efforts to attract and retain talents. Moreover, the negative trends should be reversed with regard to: PISA scores and general quality of education system. In turn, Chinese authorities should facilitate better PISA scores and increase the presence of scientific and technical articles.

Key words: human capital, education, innovations, development model, longitudinal study

JEL codes: O14, O15, O57

Introduction

In the knowledge-based economy the most important assets are intangible (Edvinsson & Malone, 1997; Lev, 2001; Stewart, 1997) among which human assets, broadly described as human capital (HC) should be perceived as especially valuable resources and as a key factors for sustainable national competitive advantage (Guenther et al., 2003; Huselid, 1995; Pfeffer, 1994; Prahalad & Hamel, 1990; Wright, Dunford & Snell, 2001). Nowadays, competitive advantage is defined by the level of technology driven by innovations; hence, considering innovativeness as a crucial factor for the future growth, many

countries have adopted development strategies based on the transformation of economy into an innovation-driven one. This transformation is conditioned upon productivity and utilization of nations' HC (Ederer, Schuler, & Willms, 2007). The industrial upgrading concept which is based on the theory of the global value chain (Porter, 1985; Gurria, 2012) means change from a dominant exportation of low-value-added manufactures to the development of competitive exports of high-value-added products. It is only possible through accumulating technological innovation capabilities by absorbing highly educated labour force into the real economy (He, 2015). The most well-known example is that of South Korea, which, through investment in education and HC in the 70s and 80s, performed industrial upgrading and a successful transformation from economy based on low-value-added to high-value-added exports (Kim, 1997). Emphasis on education and HC is argued to be as one of the most important driving forces for South Korea's technological progress and economic development (Cui, 2010; Shin, 2012). Therefore, nations willing to transform their economies into innovation-driven ones have to link HC and innovation strategies in order to utilize HC as stimulus of innovation (Ederer et al., 2007). Most studies on advanced economies provide a direct positive link between innovations and exporting (Cieślik, Qu & Qu, 2018).

The focus of the paper are the country-level HC advancements that strictly refer to the creation of the innovation capabilities. Consequently, the paper aims to present the long-term development over the last decade of the chosen HC indices that uncovers and compares the outcome of the national efforts performed by the culturally distant, (advanced) emerging economies, which for the purposes of the study, were China and Poland. Moreover, with regard to the practical approach, paper indicates also areas for further HC national progress. Hence, there are two research questions:

RQ1: How has HC developed in China and Poland during the last decade?
RQ2: What are the fields of possible future improvements of HC in China and Poland?

Comparative analysis of the aggregate data has been adopted as a method for this study. Comparing is essential to basic scientific and philosophic inquiries and it has been done for a long time (Deutsch, 1987). There are numerous practical benefits deriving from comparative analysis with regard to the macroeconomic national policies, such as more effective policy making, better administrative arrangements and enhanced development prospect (Caiden, 1989). In the proposed study, HC indices were compared in nations that are politically and culturally different, however both experienced economic shift from the socialist into the market economies characterized by the export-driven orientation. China and Poland were due to numerous reasons. First, a large portion in international trade is shared by China, however, several Authors (e.g. Subramanian, 2011; Nolan, 2012) have already warned in the past that its lag in industrial upgrading is restrictive in terms of future growth. Moreover, Chinese firms, although rapidly growing due to domestic market (especially the large, state-owned enterprises), are not globally competitive and there are neither leading Chinese technologies nor brands present in international markets (with only few exceptions in IT and banking industry). Consequently, China's export is still dominated by low-value-added manufactures. Recent slowdowns (2017 and 2018) in the Chinese spectacular growth throughout the last two decades may suggest a need to transform and diversify the structure of exports (as the leading driver of GDP growth) into the more knowledge-intensive. Similar phenomenon, in terms of not fast as desired exports transformation into more innovative one, is observed in the case of Polish economy, thus in order stay on the sustainable path of development driven by exports Poland should put more efforts into fostering the domestic innovativeness. Therefore, both nations base their growth on exports. Second, according to the recent (2019) issue of Global Innovation index, in the Human capital & research pillar China ranked 25th, whereas Poland 40th what indicates that both nations HC capabilities to create innovations indicate a relatively similar potential to improve. Third, in the

last decades both countries transformed their economies from the closed, socialist system into the market-orientated one focused on foreign trade. Fourth, the existence of cultural differences between the both studied nations makes the proposed comparison additionally interesting and valuable. Without any doubts, culture affects the development of national HC. For example, in China guanxi, face saving and Confucian ethos remain important drivers of human behaviour what translates directly on, *inter alia,* the way the students react and are taught. To sum up, China and Poland, although distinct in many economical, societal and political issues, appear to be surprisingly similar in their way of pursuing national goals aimed at boosting HC capabilities. Hence, the proposed comparative analysis adds value by providing essential information about the outcomes of the national policies concerning HC advancements. Consequently, country-specific cultural factors may impact the final outcome of HC development what is the point of interest of the proposed paper.

There are two motivations for undertaking this topic. First, the importance of studying the longitudinal HC development in these countries is relatively underscored by research. Second, understanding how HC develops, especially in the context of (advanced) emerging economies, which both China and Poland are classified as, is crucial for shaping the short and long-term development strategy pursuing to the shift to high-value-added and innovative exports-driven economy.

Therefore, potential contributions of this research are threefold. First, it presents a long-term historical development of original set of national HC measures in the context of (advanced) emerging economies. Second, it identifies specific areas of future improvement which serve as a valuable information for national policy-makers. Third, it performs a non-obvious comparative analysis of the countries from two different cultural backgrounds.

The structure of this paper is the following: Section 1 is introduction, Section 2, divided into the two subsections, provides literature review. Section 3 outlines the methodology, while Section 4 presents results of the study

which is followed by Section 5 pointing to conclusions, suggestions and implications of the paper along with the limitations of the study.

Literature review

HC, innovativeness and development

The term "human capital" was coined by T. W. Schultz and G. S. Becker. They defined it as a set of characteristics, natural talents, predispositions, attitudes, respected values, acquired abilities and knowledge of people (Dorożyński & Dorożyńska, 2011). HC is embodied in skills, knowledge, and expertise that people possess; therefore it serves as an important source of competitive advantage to individuals, organizations and societies (Coleman, 1988; Gimeno et al., 1997). An individual's HC can be defined by knowledge and skills created by schooling, higher education, vocational training and work experiences (De la Fuente & Ciccone, 2002). Undoubtedly, HC and innovations are mutually linked (Marvel & Lumpkin, 2007; Alpkan et al., 2010; Kesting & Ulhøi, 2010), as together they create reinforcing loop of present and future value (Cabrilo & Grubic-Nesic, 2012). Investments in people result in improved individual performance increased organizational productivity and economic development as well as other societal benefits (Lynham & Cunningham, 2006). On the macro level, investment in learning and education leads to economic growth and significant positive outcomes on individual and societal levels (Schultz, 1961; Denison, 1962; Becker, 1976). It is argued that education may improve the level of HC, which is crucial for nations' productivity and innovativeness (Stokey, 1991; Mankiw, Romer, & Weil, 1992), consequently leading to industrial and economic development. Better education improves cognitive skills which foster innovation (Hanushek & Woessmann, 2008). Fundamental, early studies by Drucker (1969) proved that investment in HC is crucial for economic development, and leads to country's competitiveness through innovation. Education, measured either by the number of

years of education (Dakhli & de Clercq, 2004) or by the development of the education system on different levels (Vandenbussche, Aghion, & Meghir, 2006) is positively linked to country innovativeness. Recent studies on the role of HC in China and Poland provide essential and practical implications. For instance, Heckman & Yi (2012) argue that education will have significant positive impact on the development and innovativeness of China. Chi (2008) supports the evidence on the indirect role of HC in Chinese economic growth through physical capital investment. Author found that workers with college education play a more important role than those with primary or secondary educations. Weng, Li & Foo (2016) performed a longitudinal analysis of education in China and observed that the rates of returns on education in China have substantially increased during 1989–2011. These growths were mainly due to the effects of institutional reforms. He (2015) presents data relating to the current state of primary, secondary and tertiary education in China with the help of two indices: gross enrolment rate and pupil-teacher ratio. Derived conclusions provide interesting insight into the education system; however neither brings a full picture of Chinese education system nor HC. In addition, data refer to one year only, which is 2010. Study by Ardichvili, Zavyalova & Minina (2011) encompassed a two dimensional analysis of China (along with other BRICs nations) HC indices. First dimension, referred to the study of holistic measures, such as: KEI (Knowledge Economy index, provided by the World Bank) and HDI (Human Development Index) indices, whereas second referred to separate indices, which were: public spending on education, no. of researchers, no. of engineers and scientists, no. of research institutions, no. of students in higher education institutions and accessibility of education. Authors found that China's HDI grew annually at 1,37% on average over the 1980-2011, consequently China today is among countries with an average level of HDI. Data on separate indices refer only to 2006, hence do not show a long-term recent development trends.

With regard to the studies on Polish HC, research by Lin (2018) proved that HC is positively linked with GDP growth. Gugnin & Pliszka (2009) pointed

out that the important role in shaping national HC played such institutions as: catholic schools, hospitals and Polish Academy of Sciences. However, brief quantitative analysis of HC was narrowed only to: persons with doctoral and post-doctoral education and no. of pupils and students. Furthermore, the most recent year was 2006. Zdrojewski (2009) studied the level of education in Polish society with regard to the place of living. Similar to the previous studies, analysis related to 2006 only. Vast analysis of the current state of HC in Poland was performed by Czarnik et al. (2011) who studied among others: educational paths, competences, educational levels, trainings, female participation in workforce and educational institutions. Although the study presents plethora of quantitative data with various breakdowns (gender, occupation, place of living etc.), it does not provide historical data thus does not enable to catch the extent of actual HC long-term development.

A growing stream of research can be observed in terms of the impact of country innovation levels on exports. Concerning the outcome of the investments in HC in the form of the export growth driven by innovations the study by Cieślik, Qu & Qu (2018) found that innovations conducted by Chinese firms increase the export probability. Wei & An (2016) proved that innovation promoted export performance. Additionally, research by Huang, Hu & Liu (2015) revealed that in general innovations improve Chinese exports; however product innovations perform a stronger impact than process innovations. Studies on the link between innovations and export performance among Polish firms provide similar results confirming that innovations increase the probability of exporting (Brodzicki & Ciołek, 2016; Cieślik, Michałek & Szczygielski, 2016).

To sum up, previous studies employed various measures for HC, however certain shortcomings may be identified which are following: low no. of indices, quantitative nature of indices, lack of qualitative studies, low level of diversification of measures, lack of longitudinal studies on the same set of indices, lack of up-to-date data analysis, restrained comparisons with other nations, insufficient recommendations and limited relation of HC data to nations' innovativeness creation capabilities. Finally, to the best Author's

knowledge there is no paper that compares HC development in Poland and China. Proposed paper fills the gap in most of the above-mentioned fields.

Cultural impact on HC development

Culture can be described as "transmitted and created content and patterns of values, ideas, and other symbolic-meaningful systems as factors in the shaping of human behavior and the artefacts produced through behavior" (Kroeber & Parsons, 1958). According to Rapport & Overing (2000) culture is composed of "beliefs, norms, assumptions, knowledge, values, or sets of practice that are shared and form a system". Hofstede (2001) points five dimensions of national culture: individualism versus collectivism, power distance, uncertainty avoidance, masculinity versus femininity, and long-term versus short-term orientation.

Culture affects significantly several national HC issues, such as: learning/teaching styles, students' collaboration (Kim & Bonk, 2002; Teng, 2007), motivation (Ramburuth & McCormick, 2001; Lim, 2004; Zhu et al., 2008) and participation (Agerup & Busser, 2004; Valiente, 2008), learning achievements (Pearse & Lin, 2007) and perception of new teaching tools, such as e-learning (Volman et al., 2005; Hannon & D'Netto, 2007).

With regard to the learning styles Kim & Bonk (2002) on the sample of on Finish and US students demonstrated that Finnish peers were more reflective and, usually, theoretically driven, in comparison to US students. They, in turn, appeared to be more pragmatic by performing more action and solution-oriented attitude in the process of learning. More social interaction of US students was also observed by Teng (2007) who compared the learning styles of US and Taiwanese students. US students developed closer relations with their classmates what improved a better sense of community and lead to an easier process of making the group decisions. They enjoyed working in groups, as it was a mean to better know their group members what simultaneously acted as a mutual support. Consequently, they experienced greater satisfaction from the

group performance. On the contrary, Taiwanese students were concentrated mostly in building relationships at the expense of working in teams. Hence, the significance of task completion was lower in the case of Taiwanese peers than US students. Different motivation levels can derive from the specific culture. Study by Ramburuth & McCormick (2001) indicated that Asian international students showed a significantly higher use of deep motivation, surface strategies, and achieving strategies, while Australian students demonstrated higher use of deep strategies and surface motivation only. Lim (2004) observed that online American students felt more accomplishment by a greater number of motivation types (course relevancy, course interest, reinforcement and self-efficacy) than Korean students. However, Korean students demonstrated significantly higher score only for learner control. Consequently, American students got more motivated after completing online lessons, possibility of sharing personal thoughts during the class and valued a sense of belonging by being enrolled in classes. With regard to Chinese students, Zhu et al. (2008) observed that Chinese students, with comparison to Flemish students, valued to a greater extent the type of learning that involves understanding, personal change, and development of social skills.

Cultural drivers of participation were studied by Agerup & Busser (2004) who found that the focus of US students was concentrated mainly on the specific deadlines and project requirements, whereas Japanese peers were more involved in the content research and writing papers in a hierarchical relation to a lecturer. Agerup & Busser (2004) studied also the mutual perception of the US and Japanese students. According to Japanese students, their US peers were fast, stressful, and unstructured, while the US students perceived the Japanese ones as conservative and unemotional. Valiente (2008) indicates that non-Western students' participation is fostered by the visual means, such as graphics, sensorial and rhetoric characters and associations. Hence, in the process of thinking and learning by Chinese students, who derive from the Confucian tradition, rehearsing and repeating is a necessary basic step.

Cultural factors, such as parental educational attainment, parental educational expectation, parental involvement and parenting style may also influence the learning achievements. Pearse & Lin (2007) found that academic achievement of Chinese Americans was equal or, in some cases surpassing the achievement of White Americans what justifies that cultural specific approach does impact the learning outcome. Considering the technology development and its implementation in education, Hannon & D'Netto (2007) argue that students from different cultures react differently to the organizational issues and arrangements which were implemented in the online learning technologies. Study by Volman et al. (2005) on Dutch students from two different ethnic backgrounds showed that pupils from an ethnic-minority environment appear to perceive themselves to be less familiar with ICT than peers from the majority population. As a result, the out of school usage of computers for all kinds of writing activities (papers, preparing talks, letters, reports, and e-mails) was lower for the ethnic-minority students. The utilization of computers at school was devoted merely for practicing at the cost of gathering information and preparing talks.

Methodology

China is the most populous nation worldwide. Its total population (1,379 billion inhabitants) exceeds almost 40k-fold total population of Poland. Therefore, due to enormous differences between China and Poland cross-country comparisons of absolute values do not make sense. However, there is a strong need to use relative measures. Employment of the relative indices (instead of the absolute ones) is a possible attempt to conduct a comparative analysis of two distinct economies; however it still possesses some generalization limitations. Nevertheless, for the purposes of providing a broad picture of HC development, the paper adopted the approach which is in line with the global practices of organizations issuing performance reports referring to various issues (e.g. Knowledge Economy Index, Global Innovation Index,

Network Readiness Index). Hence, bearing in mind the limitations, a set of relative measures was created.

Several indices can be adopted to capture HC, such as the level of education, the amount of vocational training, age and relevant management or industry experience (Hinz & Jungbauer-Gans, 1999; Kilkenny, Nalbarte, & Besser, 1999; Guzman & Santos, 2001). The choice of indices used to measure HC depends, *inter alia*, on the aim of the study. Since the paper attempts to analyse the long-term development of HC in terms of boosting the level of nations' innovativeness the combination of three groups of indicators was utilized covering the fields: general education (primary and secondary), universities and business. The research was based on quantitative and qualitative secondary data for the 2007–2017 years. The initial set of measures amounted to 38, however due to the lack of longitudinal data, some of them had to be excluded. The final sample of indicators consisted of 28 in total. Table 1 depicts the details on the methodology.

Table 1. Measures adopted in the study

Measure	Description / question	Source	Years
Education			
Quality of primary education	In your country, how do you assess the quality of primary education*	EOS**	2008–2017
Primary education enrollment rate	Ratio of children of official primary school age (as defined by the national education system) who are enrolled in primary school.	UNESCO Institute for Statistics	2007–2015
Secondary education enrollment rate	Ratio of total secondary enrollment, regardless of age, to the population of the age group that officially corresponds to the secondary education level.	UNESCO Institute for Statistics	2007–2014
Tertiary education enrollment rate	Ratio of total tertiary enrollment, regardless of age, to the population of the age group that officially corresponds to the tertiary education level.	UNESCO Institute for Statistics	2007–2017

Quality of education system	In your country, how well does the education system meet the needs of a competitive economy?*	EOS	2007–2017
Quality of math and science education	In your country, how do you assess the quality of math and science education?*	EOS	2007–2017
Expenditure on education, %	Government operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment, as a percentage of gross domestic product (GDP).	World Bank	2007–2015
PISA scales in reading, math & science	Programme for International Student Assessment (PISA) develops three-yearly surveys that examine 15-year-old students' performance in reading, mathematics, and science.	UNESCO Institute for Statistics	2009–2015
Pupil-teacher, ratio, primary	The number of pupils enrolled in primary school divided by the number of primary school teachers	UNESCO Institute for Statistics	2007–2016
Pupil-teacher, ratio, secondary	The number of pupils enrolled in secondary school divided by the number of secondary school teachers	UNESCO Institute for Statistics	2007–2016
Tertiary inbound mobility	The number of students from abroad studying in a given country, as a percentage of the total tertiary enrolment in that country.	UNESCO Institute for Statistics	2007–2016
Universities			
QS university ranking	Average score of the top three universities per country.	www.topuniversities. com	2012–2017
Quality of scientific research institutions	In your country, how do you assess the quality of scientific research institutions?*	EOS	2007–2017
Scientific & technical articles, billion PPP$	The number of scientific and engineering articles published. Article counts are from a set of journals covered by the Science Citation Index (SCI) and the Social Sciences Citation Index (SSCI). Articles are classified by year of publication and assigned to each country/economy on basis of the institutional address(es) listed in the article. The data are reported per billion PPP$ GDP.	Web of Science, Science Citation Index (SCI), Social Sciences Citation Index (SSCI)	2007–2017

Citable documents H-index	The H-index is tabulated from the number of citations received in subsequent years by articles published in a given year, divided by the number of articles published that year.	SCImago	2012–2017
University/industry research collaboration	In your country, to what extent do people collaborate and share ideas in between companies and universities/research institutions?*	EOS	2007–2017
Business			
Extent of staff training	In your country, to what extent do companies invest in training and employee development?*	EOS	2008–2017
Firms offering formal training, %	The percentage of firms offering formal training programs for their permanent, full-time employees.	World Bank	2008–2013
Knowledge-intensive jobs, %	Knowledge-intensive jobs correspond to the International Labour Organization (ILO) aggregate category "Managers, professionals, and technicians," as provided in the ILOSTAT Database.	International Labour Organization	2007–2017
Reliance on professional management	In your country, who holds senior management positions in companies?***	EOS	2007–2017
Company spending on Research and Development (R&D)	In your country, to what extent do companies invest in research and development (R&D)?*	EOS	2007–2017
Gross expenditure on R&D, %	Total domestic intramural expenditure on R&D during a given period as a percentage of GDP.	World Bank	2007–2017
Researchers	Researchers per million population, full-time equivalence. Postgraduate PhD students (ISCED97 level 6) engaged in R&D are included.	UNESCO Institute for Statistics	2008–2017
Brain drain****	To what extent does your country retain/attract talented people?*****	EOS	2007–2013
Country capacity to retain talent	To what extent does your country retain talented people?*****	EOS	2014–2017
Country capacity to attract talent	To what extent does your country attract talented people from abroad?*****	EOS	2014–2017

Availability of scientists and engineers	In your country, to what extent are scientists and engineers available?*	EOS	2007–2017
Female participation in the labor force	This measure is the percentage of women aged 15-64 participating in the labor force divided by the percentage of men aged 15–64 participating in the labor force.	UNESCO Institute for Statistics	2008–2017

Notes:

* [1 = extremely poor – among the worst in the world; 7 = excellent – among the best in the world]

** World Economic Forum Executive Opinion Survey (EOS) captures the opinions of 14 723 business executives in 141 economies. More about the methodology of WEF-EOS see: World Economic Forum (2016, pp. 77–87)

*** [1 = usually relatives or friends without regard to merit; 7 = mostly professional managers chosen for merit and qualifications]

**** Due to methodology change in 2014 category: Brain drain has been divided into the two separate categories: Country capacity to retain talent and Country capacity to attract talent

***** [1 = not at all – the best and brightest leave to pursue opportunities abroad; 7 = to a great extent – the best and brightest stay and pursue opportunities in the country]

Source: own work based on: WEF Executive Opinion Survey, World Bank database, International Labour Organization, UNESCO Institute for Statistics, Web of Science, Science Citation Index (SCI), Social Sciences Citation Index (SSCI) and SCImago.

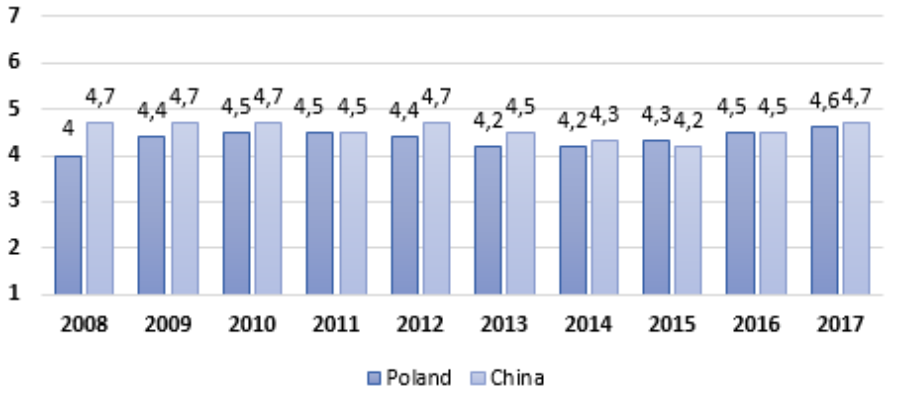
Results

Primary and secondary education

Primary education enrolment rate is high in both countries with the mean values during the 2007–2016 accounting for 95,9% in Poland and 99,5% in China respectively. In all studied years the enrolment rate was higher in China than in Poland – in Poland the lowest rate was 95,0% (2015), whereas in China 98,3% (2013). However, in 2014 the reported rate by the Chinese officials amounted to 100%, while in Poland during the studied period there

was not observed such a high rate. The pupil-teacher ratio in primary school was lower (better) in Poland (mean value 10,2 during 2007–2016) than in China (mean – 14,5). However, in Poland the ratio did not show major improvements throughout the studied period (10,6 in 2007 and 10,8 in 2016), whereas in China the ratio tended to improve by decreasing from 17,7 in 2007 to 13,3 in 2016. Executives in the surveys in all studied years (except 2015) pointed out that the quality of primary education in China is slightly better than in Poland (mean evaluation 4,4 in Poland vs. 4,6 China – Figure 1).

Figure 1. Quality of primary education



Source: own work based on World Economic Forum Executive Opinion Survey.

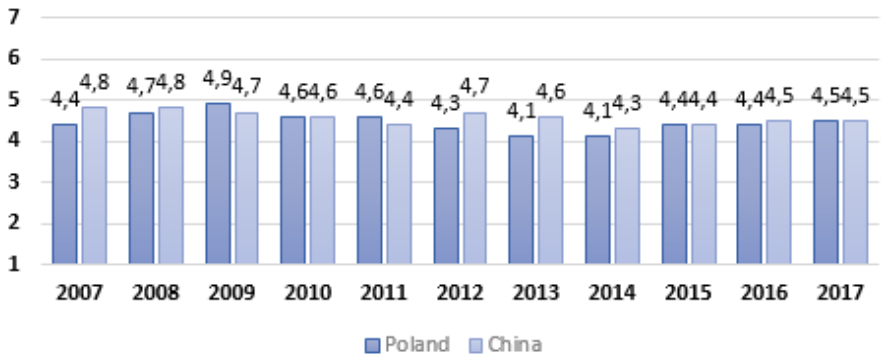
The lowest score for Poland was 4,0 (2008), while for China 4,2 (2015). In Poland the perception of the primary education has improved in 2017 with comparison to 2008 (+15%), while in China the executive opinion remain the same. In general executives evaluate the quality of primary education as good, however with the need to improve, what in terms of Poland is happening at a moderate pace, while in China not.

Secondary education enrolment rate showed major differences in Poland and China. In Poland the mean ratio was even higher than the primary education enrolment rate (99,9%), while in China the ratio average was 83,2%.

Moreover in Poland the indicator did not perform major differences during 2008-2016, while in China there was observed a strong improvement. In 2007 the secondary education enrolment rate was 77,3%, while in 2014 – 94,3%, what was the highest record in the studied period for China. However, highest China score was still below the lowest score in Poland.

The quality of primary and secondary education is partly reflected in the PISA scales in reading, math & science. Available data for 2009, 2012 and 2015 provide an insight into interesting phenomenon. In both nations there was observed an improvement in 2012 in comparison to 2009 (in Poland from 501,1 pts to 520,5 pts (+3,9%), in China from 576,8 to 587,5 (+1,9%)), however data for 2015 suggest a drop in PISA scores for both countries. A major decrease by 12,5% was observed for China, whereas for Poland it was 3,2%. Data prove that pupils from China perform better than the Polish ones. Education of math and science is one of the most important in the mental development of young people. Its evaluation by the surveyed executives has been shown in Figure 2.

Figure 2. Quality of math and science education



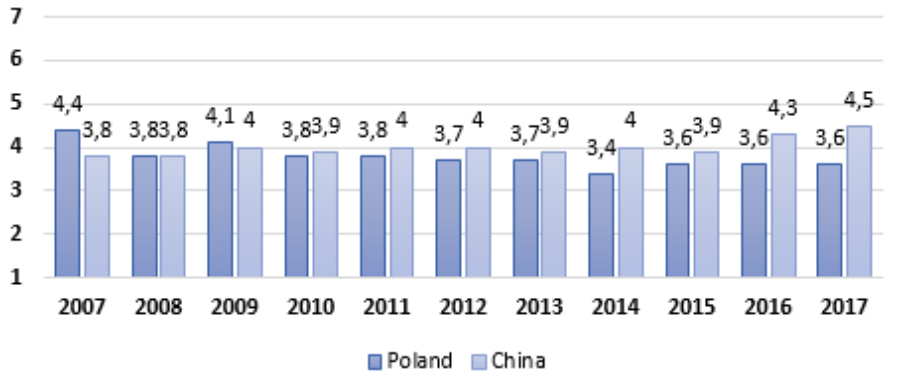
Source: own work based on World Economic Forum Executive Opinion Survey.

Executives perceive education of math and science as good in both countries but Chinese respondents seem to evaluate it slightly better. The mean

score for China was 4,6, while for Poland 4,5. However, in China the education quality perception has slightly worsened during the period 2007–2017 (by 6,3%), while in Poland there was almost the same score in 2007 and 2017 with only minor changes in the years between.

To some extent it may seem surprising that good evaluation of the primary education and education of math and science does not go in line with the general evaluation of education system (Figure 3).

Figure 3. Quality of education system



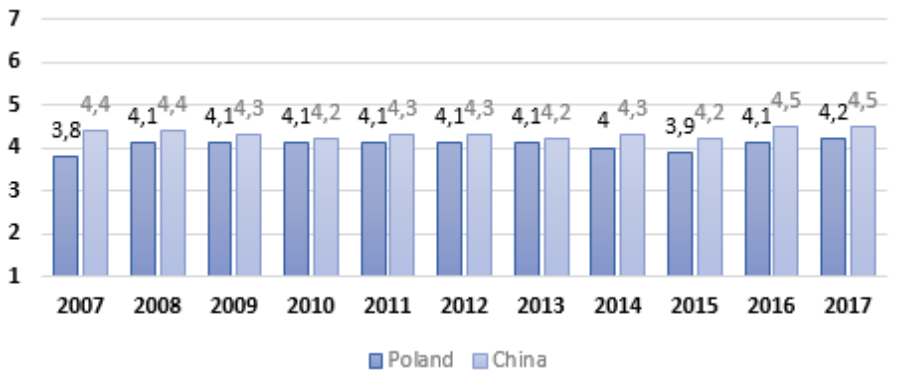
Source: own work based on World Economic Forum Executive Opinion Survey.

Executives suggest significant deterioration of the quality of education system in Poland during the period 2007–2017 (by 18,2%), while in China there was observed a contradictory trend (rise in the evaluation of the education system by 18,0%). Hence data show that education in Poland has changed its perception from good in 2007 to moderate in 2017, while in China from moderate in 2007 to good in 2017. What it is interesting, also in terms of the value of expenditures on education in relation to GDP – in Poland the ratio was higher and was 4,8% (2015), while in China 1,8% (2009, latest available data for China).

Universities

There can be observed significant differences between Poland and China in terms of the tertiary education enrolment rate which in Poland was 71,2% whereas in China 51,5% (both indicators refer to 2017). The average rate during 2007-2017 amounted to 69,9% in Poland and 33,2% in China. In both countries there was an increase of students enrolled in 2017 with comparison to 2007, however in China it was much greater (124,9% increase vs. 6,4% in Poland). Vast majority of students in both countries are nation's citizens, however the percentage of students from abroad (tertiary inbound mobility) is higher in Poland than in China (2% vs. 0,3%). In China the share of foreign students during the analysed period was relatively stable (0,2% to 0,36%), however in Poland since 2007 the ratio has increased from 0,6% to 3,42% in 2017. Executives asked about the scientific research institutions assess its quality as moderate/good in Poland and good in China (Figure 4).

Figure 4. Quality of scientific research institutions



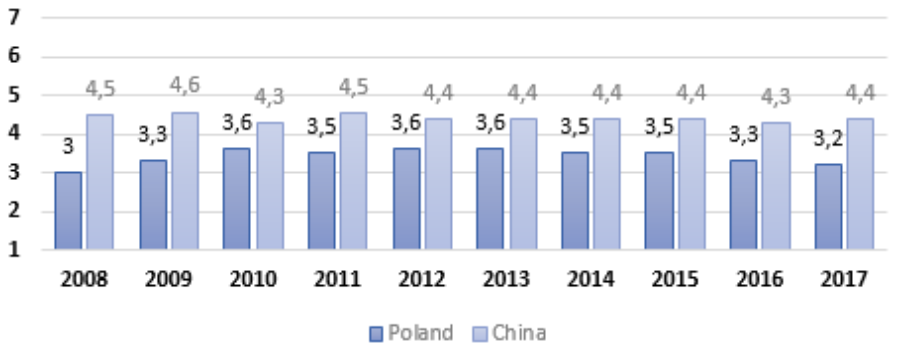
Source: own work based on World Economic Forum Executive Opinion Survey.

Mean scores for the period 2007–2017 were 4,1 in Poland and 4,3 in China. In Poland there was a 11,1% increase in 2017 in comparison to 2007, while in

China only 2,3%. The number of researchers per million population (full-time equivalence, 2017) is greater in Poland (2528,04) than in China (1234,78), however in both countries there has been observed different increase in terms of the relative number of researchers in 2017 in comparison to 2009 (in Poland 58,5%, in China 4,2%). The number of scientific and engineering articles in relation to 1 billion PPP$ GDP was also greater in Poland than in China (17,8 vs. 11,7), however the rising trend during the 2008–2017 years, observed in both countries, was much faster in Poland (66,4%) than in China (42,7%). Citable documents H-index performed a better value for China (674) in 2017 than for Poland (456), moreover since the introduction of the index and data availability (2012) both countries improved in that field (Poland by 62,4%, China by 90,9%). In 2017 QS ranking showing the quality of the top three universities in the country performed following values (the lower the better): 34 in China and 501 in Poland. Indicator (introduced in 2012) showed: improvement in China by 27 ranks and deterioration in Poland by 26 ranks.

The quality of scientific research institutions influences the extent to which universities collaborate with the enterprises in conducting common research projects. Results of the survey about the quality of that form of collaboration among the executives have been presented on Figure 5.

Figure 5. University/industry research collaboration



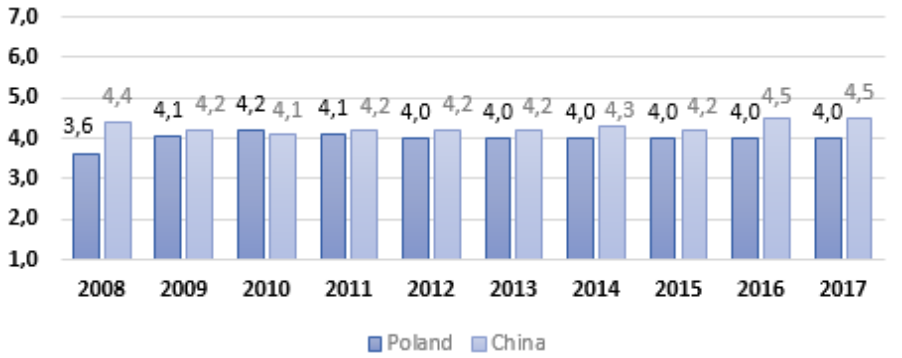
Source: own work based on World Economic Forum Executive Opinion Survey.

In Poland executives stated that quality of the university/industry research collaboration is moderate with the average score of 3,4 within the 2007–2017 years. At the same time Chinese executives evaluate that quality of the university/industry research collaboration in China higher as in Poland and perceive it as good with the average score of 4,4 within the same studied period. Although Poland has managed to improve its performance in that field by 6,7% (3,0 in 2008 and 3,2 in 2017), still its highest score was lower than China worst score (3,6 vs. 4,3).

Business

In the knowledge-based economy substantial share of the workforce should perform knowledge-intensive jobs that drive the country competitiveness by offering innovative products and services of high quality. According to the Organization for Economic Cooperation and Development (OECD) in 2017 in Poland 39,0% of jobs available were classified as knowledge-intensive, whereas in China – 16,6%. In addition, in both countries this indicator throughout 2007–2017 has improved (by 6,3 pp. in Poland and 5,8 pp. in China). Knowledge-intensive jobs require constant development by internal or external trainings. The share of companies offering formal training differed significantly between Poland and China (34,6% vs. 79,2% of the total number of firms in 2013). Moreover, in both countries this indicator throughout 2008–2013 has fallen, in Poland by more than 43% (from 60,9% in 2008), whereas in China by 6% (from 84,8%). Share of companies offering formal training is a quantitative measure that should be analysed together with the qualitative data referring to the extent of training (Figure 6).

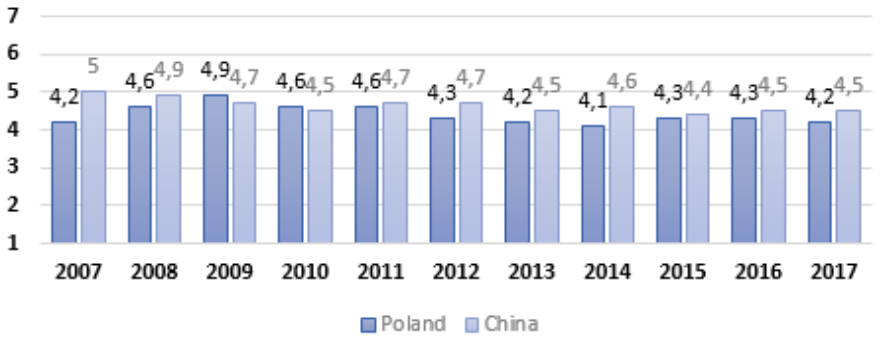
Figure 6. Extent of staff training



Source: own work based on World Economic Forum Executive Opinion Survey.

Executives perceive the extent of staff training in both countries as good, mean evaluation during 2008–2017 amounted to 4,0 in Poland and 4,23 in China. Although the share of firms offering formal training was much higher in China than in Poland, in terms of the quality of its training there was not observable such a large difference. Moreover significant decline in the number of companies offering formal training did not correspond with the fall of the training extent. In contrary, in Poland, although the share of enterprises with formal training declined, its perceived extent has actually risen by 10,2% (from 3,63 in 2008 to 4,0 in 2013). One of the aims of the staff training is the answer to the constant need to develop skills of the employees what will benefit the organization in the future by promoting specialists into the higher positions. On the Figure 7 there have been presented the results on survey concerning the fact to which extent senior management positions are hold by professionals chosen for merit and qualifications or by relatives or friends without regard to merit.

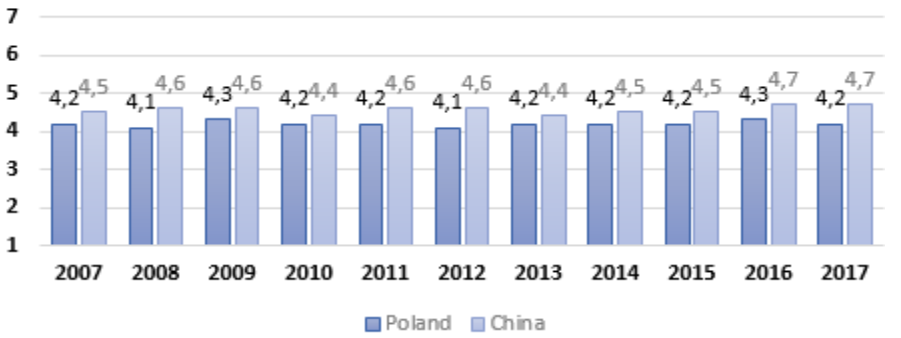
Figure 7. Reliance on professional management



Source: own work based on World Economic Forum Executive Opinion Survey.

Professionals holding management positions is being perceived more fair in China than in Poland (4,5 vs. 4,3), however the gap between the two countries has decreased throughout the 2007–2017 period, due to the improvement of situation in Poland (+7,1%), and deterioration in China (-10%). In China the score in 2007 was very good, whereas in Poland good. However, both countries still have to catch up and put more efforts to eliminate unfair nominations of unprofessional managers without merit and qualifications to hold senior positions. What is interesting, better score in China goes in line with better score in terms of the female participation in the workforce indicator. In China in 2017 the ratio of women to men employed was 0,83 (in 2008 – 0,91), while in Poland the ratio was lower (0,82 – without significant changes throughout the 2008–2017 period. As shown, at the example of scientists and engineers availability, executives perceive the situation as good in both countries (Figure 8).

Figure 8. Availability of scientists and engineers



Source: own work based on World Economic Forum Executive Opinion Survey.

Scientists and engineers are, in the opinion of the surveyed executives, more available in China than in Poland, however the difference is not significant (4,7 vs. 4,2 in 2017). In both countries availability of scientists and engineers does not seem to be a major obstacle, however executives might urge a possible improvement. In general in Poland and China the state of the availability of scientists and engineers is described as good. In China, there has been reported a slight improvement in 2017 with the comparison to 2007 (4,4%), while in Poland not. However, taking into account data concerning the problem of brain drain, Polish executives perceive the problem as insufficient, what shall be interpreted as best and brightest tend to leave the country to pursue opportunities abroad. However, the same indicator in China provides different results – Chinese executives evaluate the phenomenon of brain drain as good (Figure 9).

Figure 9. Brain drain

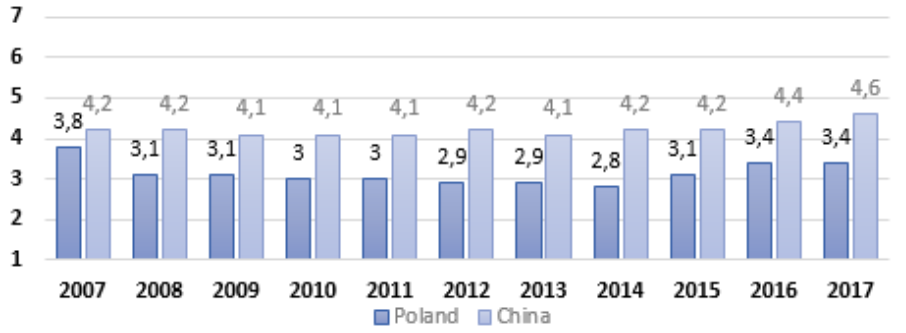
Source: own work based on World Economic Forum Executive Opinion Survey.

More detailed data on country international flows of talents (2014–2017) suggest low capacity (mean score: 2,7) to retain or attract talents in Poland (with slightly better evaluation of capacity to retain than to attract) and relatively high (mean score: 4,35) in China (with the same trend to score better in retaining than attracting talents).

Gross expenditure on R&D in Poland amounted in 2017 to 1% of GDP, whereas in China this ratio exceeded 2%. Since 2007 in both countries expenditures on R&D in absolute and relative measures have increased, however

the pace of growth was larger in Poland than in China (78% change, from 0,56% to 1% of GDP vs. 51% change, from 1,37% to 2,07% of GDP). Above mentioned macroeconomic hard data cover with the results collected from the questionnaires among executives concerning R&D expenditures on the microeconomic level (Figure 10).

Figure 10. Company spending on R&D



Source: own work based on World Economic Forum Executive Opinion Survey.

Respondents in Poland pointed out that the level of firms' investments in companies is moderate (lowest score: 2,8 in 2014, highest 3,8 in 2007 out of 7), whereas in China as good (lowest score: 4,1 in 2009, highest 4,4 in 2016 out of 7). The mean evaluation of R&D investments in Poland amounted to 3,1, whereas in China 4,2. Moreover, the perception of R&D investments was much stable in China than in Poland. Hard data suggest that in Poland total R&D expenditures have risen, however, according to the survey, employees state a 10,5% deterioration in R&D funding (3,8 in 2007 and 3,4 in 2017). In turn, in China the rise of R&D expenditures at the macroeconomic level is slightly observable in the surveyed executives' opinions (rise from 4,2 in 207 to 4,6 in 2017).

Conclusions

The Chinese economy is perceived as a special case in the literature of transition economies, showing huge differences in comparison to the nations of the former USSR and Eastern Europe (Salavrakos, 2010). Consequently, the aim of this paper was to compare the longitudinal development of national HC in China and Poland in order to indicate the differences and areas of further advancements in both culturally distant nations. A deliberately chosen set of macroeconomic indices referring to the nations' capability to create innovations was utilized in this research.

With regard to Poland, most indices that have improved during the last decade referred to the university level. No. of researchers was the one with the greatest increase what consequently contributed to the improvement of: no. of scientific & technical articles and citable documents (h-index) as well as tertiary education enrolment rate. Consequently scientific research institutions managed to improve its general quality in the view of surveyed executives. Interestingly, although no. of students from abroad (tertiary inbound mobility) has increased greatly, Poland is still not competitive enough in attracting and retaining talents (brain drain). However, in terms of attracting talents there is observed a stronger improving trend than in the case of retaining. Another two major shortcomings of Polish tertiary education system identified in this study were: university/industry research collaboration and drop in QS ranking. These phenomena should be a matter of greatest interest by the Polish authorities and/or policy-makers, since the above mentioned decreases were accompanied by already low rating/standing in these fields. In terms of university/industry research collaboration Poland not only recorded lowest score (and lower than China) but also decreased it throughout the studied period. Some concerns should arise also in terms of: worsening the scores in PISA exams and lowering the perception of the quality of education system in general. Relatively better picture can be drawn in the business field, where a positive trend in increasing R&D expenditures

was observed, accompanied with the increase of the share of knowledge-intensive jobs in total workforce and improvement of the perception of the extent of staff training provided by firms which as argued by Prais (1995) may foster country's productivity and economic growth.

Considering HC development in China, there may be identified the improvement of the same indices, as in the case of Poland. These were the assessments of quality of: primary education, math and science education, education system, scientific research institutions, extent of staff training and reliance on professional management. However, among major successes of Chinese educational system the following ones should be mentioned: lowering the pupil-teacher ratio (both in primary and secondary schools), increase of the secondary and tertiary education enrolment rate accompanied by the rise of the no. of students from abroad. Especially the total no. of students rose tremendously. This phenomenon is explained by e.g. Li et al. (2011) who argue that due to the transformation of higher education in China access to tertiary education has considerably improved for rural households. As a result, proportion of urban students in higher education admissions decreased, while the share of rural students increased (Gou, 2006; Li et al., 2011). Moreover, Chinese universities improved significantly their score in global QS ranking along with citable documents H-index. In relation to the negative trends observed in HC development there should be stressed PISA scales in reading, maths & science (which was the case in Poland as well) and decrease in the scientific & technical articles (per billion PPP$). With regard to business side China is transforming its economy towards more innovation-based what is reflected in the increase of proportion of knowledge-intensive jobs boosted by the greater share of R&D expenditures in GDP.

In general and with respect to the limitations of the data comparability possibilities there can be stated that, although the two analysed countries derive from different cultural background, the positive phenomena in the case of HC development outperform the negative ones in both nations. However the extent is more remarkable in the case of China. Nevertheless both China

and Poland should put more efforts to catch up in certain fields (relating to HC) in order to transform its economy towards more innovation-driven one. For China, these are: PISA scores and the presence of scientific & technical articles. Polish authorities should concentrate on: fostering university/industry research collaboration, improving the rank in worldwide QS classification and performing more efforts in attracting and retaining talents.

The study had its limitations, such as a relatively short time analysis and limited set of HC measures. However, in the case of some indicators it would not be possible to extent the time analysis, as these indicators has been introduced shortly or data is missing. Therefore, valuable contribution would provide a primary study based on questionnaire consisting of originally designed set of HC indices. Moreover, further research might also take into account more cross-country comparisons, as e. g. study by Ardichvili et al. (2012) and/or inter-industry insight to point possible shortcomings related to HC in the specific, given industries and not in the entire economy, what may potentially indicate a misleading picture. Especially, desired would be the analysis of the HC level of the export-oriented sectors. Additionally, the paper would significantly contribute by capturing the role of cultural distinctive features that may (not) affect the HC development.

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