

The Evolving Global Talent Pool Lessons from the BRICS Countries



The **LEVIN** Institute

The State University
of New York

Executive Summary

In 2005, The Neil D. Levin Graduate Institute of International Relations and Commerce of the State University of New York, launched a research project to study the dynamics of global scientific and technical talent. Through the efforts of a global team of researchers, each with in-depth knowledge and understanding of the role of talent in driving economic growth, technological development, and innovation, the project has completed a series of comparative studies of talent pools in Brazil, Russia, India, China, and Singapore (BRICS for short). The team is especially grateful to the IBM Corporation for its vision and its assistance in supporting this very important and often complex collaborative initiative.

When examined as a whole, the data and analysis contained in this project has surfaced the following conclusions and recommendations.

1 Talent has become an increasingly key strategic asset for both nations and corporations. BRICS countries are at the forefront of expanded investments in education that are designed to increase the supply and improve the quality of high-end technical talent. More specifically, driven by the growing imperatives of innovation and competitiveness as well as sustainability concerns, each of these countries has come to the realization that possession of significant human resources in science and technology (HRST) is both a national economic priority and technological necessity. In the meantime, driven by a similar combination of strategic business needs, including the requirements for greater innovative capabilities, corporations around the world are seeking to identify and harness “brainpower” across the globe as they seek to deepen and expand their knowledge creation assets. While factors such as cost remain important drivers underlying the globalization of corporate activity, access to talent has become the new mantra for companies whose competitive success increasingly depends on the sustained creation and commercialization of new products and services.

2 While overall HRST figures suggest a relative fit between the supply and demand of talent, real-life circumstances suggest otherwise. Indeed, a talent shortage exists in the BRICS countries despite significant national efforts to increase the output of educational institutions in terms of science and engineering graduates. As the data in the five studies suggests, the prevailing mismatches between supply and demand are likely to become more severe within the next ten years.

- 3 In essence, the talent shortage is largely manifested in a shortage of qualified talent. Many of the HRST are not adequately educated for the jobs that are available; at the same time, many of those with degrees in science and engineering are not employable in the areas of their training.
- 4 The on-going talent shortage could become (and to some extent already has become) a significant obstacle to economic growth and the pursuit of innovation in emerging economies. And, as these talent deficits become more severe, they could serve to constrain the pace and thrust of global expansion among the world's leading multinational corporations (MNCs).
- 5 One of the major challenges associated with comparing the talent situation across the BRICS economies derives from the fact that talent definitions are different from country to country; this renders it difficult, if not impossible in some instances, to make direct comparisons across countries. Further work on talent definition, granularity, and especially quality should be undertaken, perhaps involving organizations like the World Bank, OECD, UNESCO and major international corporations, who would benefit from greater clarity.

In summary, by gathering a broad array of hard-to-find information, the Global Talent Pool project has achieved an important result in terms of yielding a detailed stocking of the technical talent present in the BRICS countries. It has produced a series of useful comparisons particularly with regard to some of the problematic trends in supply and demand of technical talent. Moreover, taken together, the studies have identified forward-looking trends that not only urge leadership in these countries to take action to meet their talent needs, but also can assist policy-makers in the U.S. and Western developed countries better appreciate their competitive challenges. Multinational corporations (MNCs) also should find the five studies useful individually and in aggregate in terms of designing and aligning their global strategies with current talent trends and conditions. It is clear from the studies that the “world is not yet flat” in talent terms—there is more heterogeneity than homogeneity—and despite obvious increases in cross border collaboration and travel, in reality, there is very limited talent mobility across borders.

The project represents a positive first step in terms of alerting academic leaders, corporate executives, and policy makers that new levels of intervention may be needed to address evolving talent gaps within and across countries. While almost every nation has targeted the improvement of its S&T resource as part of its overall economic development strategy, fundamental domestic education system reform may be required to respond to the significant misfits between talent demand and supply. More importantly, in particular, the business sector—both MNCs and local firms—shares a responsibility to invest both in their own employees and in the education systems of the countries in which they do business. At the end of the day, it is this talent which can turn innovative ideas into competitive products, and a dynamic economy.

Background

In June 2005, the occasion of The Evolving Global Talent Pool conference served as the inaugural event for the newly established Neil D. Levin Graduate Institute of International Relations and Commerce under the State University of New York. It also served as the platform for the announcement by Levin's President, Garrick Utley, and founding Provost, Dr. Denis Fred Simon, that the global talent issue would be a primary research focus of the Institute.

In his keynote speech, Nick Donofrio, then executive vice president for innovation and technology of IBM, pointed out:

Right now there is no comprehensive, accurate and reliable information source available for tracking skills on a global basis, or better yet, where those skills will be needed on a global basis. Levin and IBM are out to fix that through a tool we call The Levin Global Talent Index, a country-by-country guide focused exclusively on the skills supply and the macro forces that affect it. We are in pilot phase right now in the People's Republic of China, a most appropriate test bed, given all the attention on China's economic growth, revitalized university system, and its growing scientific and technological prowess. We are very excited to be working on this important initiative....

Immediately afterwards, the Levin Institute, with support from IBM, commenced a project to study China's talent pool, which subsequently became the pilot phase of a soon-to-follow, more ambitious Global Talent project.

In fact, the evolution and framework for the project derived from several respected existing initiatives including the *World Competitiveness Report*, by IMD in Lausanne, Switzerland, in conjunction with the World Economic Forum. The research staff at The Levin Institute envisioned that the Global Talent project, based on analysis of systematically collected data related to talent across major countries, could become a compelling trusted and respected reference for those concerned with high-end human resources across the globe.

In particular, the project was designed to achieve the following goals:

- 1 Draw overall pictures of S&T talent (human resources in science and technology, or HRST);

- 2 Trace historical trends and developing forecasts of demand and supply of talent over 5–10 years; and
- 3 Assess quality, utilization patterns and specialization of talent.

The China talent pool study concluded in early 2007 and eventually led to the publication in 2009 by Cambridge University Press of *China's Emerging Technological Edge: Assessing the Role of High-End Talent* by Denis Fred Simon and Cong Cao, the two leading researchers involved in the China study at The Levin Institute.

With the China's talent pool study as the prototype, The Levin Institute, again with the support of IBM, proceeded with the second phase of the Global Talent project which involved a decision to focus initially on Brazil, Russia, India, and Singapore. These countries stood out not simply because of the sponsor's interests but also because these countries, plus China, or BRICS for short, a modification of BRIC, the famous Goldman Sachs acronym, represent the most dynamic emerging economies whose impacts have been and will continue to be felt globally.

The Levin Institute identified high-quality researchers in each country to study the "local" talent issue and its broader implications. The success of the Global Talent Index project, therefore, can be attributed to the participation of researchers from premier institutes in the four countries (Table 1).

Table 1: Research Teams

Country Studied	Institution	Location	Leaders
China	Neil D. Levin Graduate Institute of International Relations and Commerce, State University of New York	New York	Dr. Denis Fred Simon* Dr. Cong Cao
India	National Council of Applied Economic Research (NCAER)	New Delhi	Mr. R. Venkatesan Dr. Wilima Wadhwa
Singapore	National University of Singapore (NUS)	Singapore	Dr. Poh Kam Wong
Russia	Institute of Open Business Education	Moscow	Dr. Alex Bandurin**
Brazil	Brazilian School of Public and Business Administration (EBAPE), Getulio Vargas Foundation (FGV)	Rio de Janeiro	Dr. Paulo Negreiros Figueiredo

* Now with the School of International Affairs, Pennsylvania State University, State College, Pennsylvania.

** Now with the Moscow State Institute of Tourism Industry.

Overall Findings

When examined as a whole, the five country talent pool studies lead us to the following conclusions and recommendations (results of each individual country study are presented separately).

1 Talent has become an increasingly key strategic asset for both nations and corporations. BRICS countries are at the forefront of expanded investments in education that are designed to increase the supply and improve the quality of high-end technical talent. More specifically, driven by the growing imperatives of innovation and competitiveness as well as sustainability concerns, each of these countries has come to the realization that possession of significant human resources in science and technology (HRST) is both a national economic priority and technological necessity.

In the meantime, driven by a similar combination of strategic business needs, including the requirements for greater innovative capabilities, corporations around the world are seeking to identify and harness “brainpower” across the globe as they seek to deepen and expand their knowledge creation assets. While factors such as cost remain important drivers underlying the globalization of corporate activity, access to talent has become the new mantra for companies whose competitive success increasingly depends on the sustained creation and commercialization of new products and services.

The talent issue has taken on a highly strategic character among policymakers, business leaders and academics in all nations. The political leadership in the five countries appears to share a similar interest in nurturing talent as a competitive asset in economic and technological positioning and a similar drive to enhance innovation and new knowledge creation as a national resource. National policies for human resource development have been formulated, investment in human capital has been increased, and various measures have been adopted to nurture, better utilize, attract, and retain talent. Moreover, talent development will not recede in importance as the match between supply and demand, and the overall quality of talent move up on the public policy agenda.

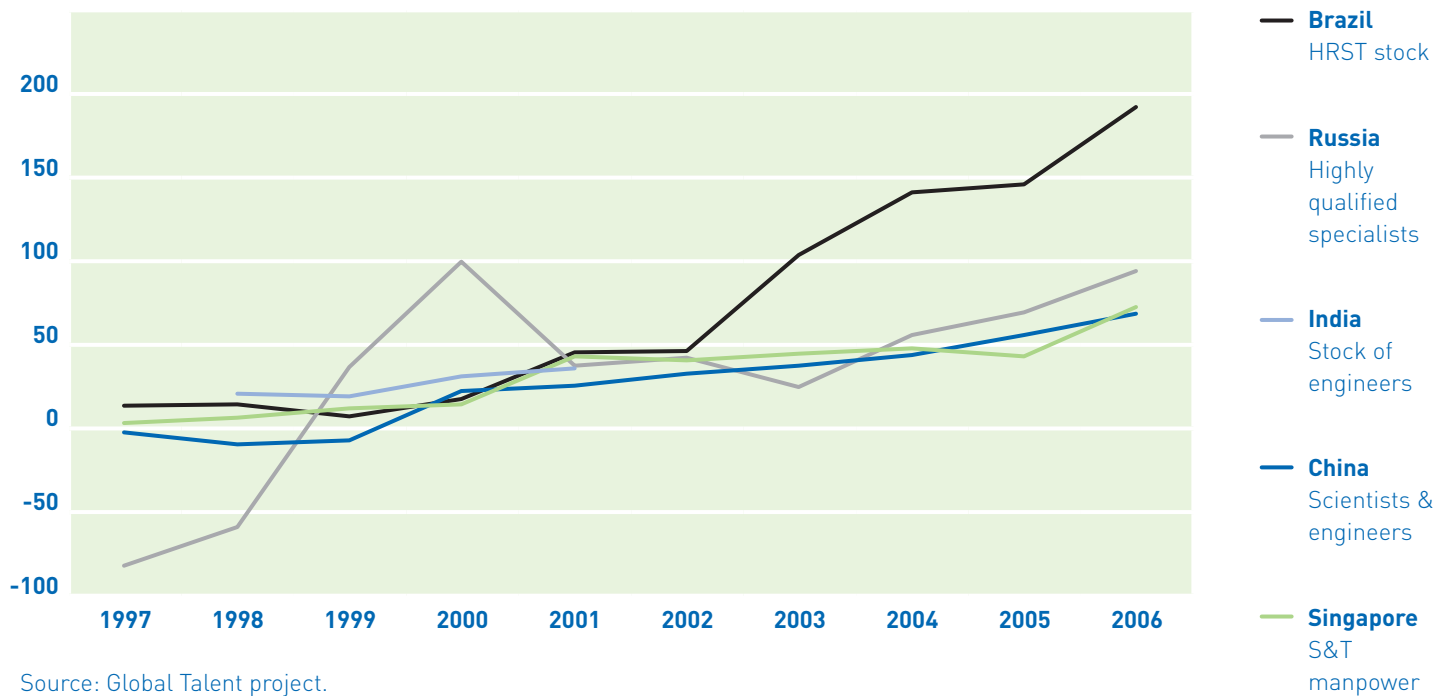
Even more urgent are the talent concerns of globally integrated corporations. And these issues of global talent are inextricably linked with a company’s market and product development plans. As demand has softened in the US and Europe, a company’s growth agenda in the emerging markets make talent issues in countries like China, India, and Brazil even more relevant today. For example, IBM officials noted that

the challenges and demands of global talent recruitment, deployment, and management have taken on even greater importance than when our project began in 2005.

Consequently, the HRST measures used in country studies have witnessed growth between 1996 and 2006 (Figure 1). Surprisingly, Brazil experienced the highest growth with its HRST stock almost tripled, followed by Russia (almost doubled), Singapore and China (both increased by two-thirds). In the meantime, BRICS countries all have experienced significant expansion of higher education in general and in science and technology in particular (Tables 2 and 3 and Figure 2).

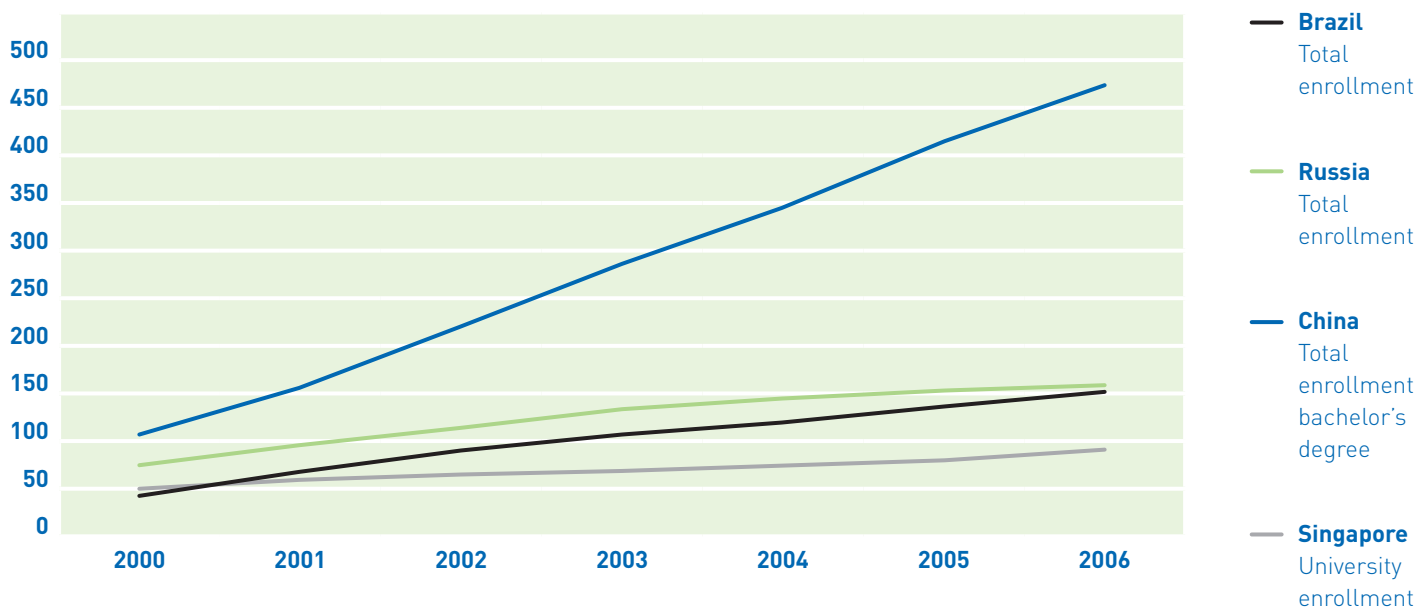
While data on total enrollment in higher education is unavailable for India, in terms of percentage change over the period of 1999 and 2006, total enrollment at the bachelor's degree in China increased most rapidly (476%), followed by total enrollment in Russia (162% increase), and in Brazil (151% increase). Singapore had seen the slowest growth in university enrollment (88%) of the four countries.

Figure 1: Growth of HRST in BRICS countries % (baseline=1996)



Source: Global Talent project.

Figure 2: Growth of higher education in BRICS countries % (baseline=1999)



Source: Global Talent project.

Table 2: Statistics on higher education in BRICS countries (1,000 persons)

Year	Brazil	Russia	China	Singapore
	Total enrollment	Total enrollment	Enrollment at bachelor's degree	University enrollment
1990	806	2,825	1,320	
1991	871		1,320	
1992	943			
1993	1,021		1,417	
1994	1,109		1,517	
1995	1,205	2,791	1,638	34
1996	1,312		1,795	37
1997	1,397		1,986	40
1998	1,489		2,235	43
1999	1,588		2,724	48
2000	1,695	4,742	3,400	50
2001	1,900	5,427	4,244	53
2002	2,209	5,948	5,271	55
2003	2,484	6,456	6,292	56
2004	2,643	6,884	7,378	58
2005	2,824	7,064	8,488	60
2006	3,018	7,310	9,433	64

Source: Global Talent project.

Table 3: Enrollment of science and technology majors in higher education in BRICS countries (1,000 persons)

Year	Brazil			
	Science, mathematics & computing	Engineering, production & construction	Health & social welfare	Total
1986	166	72	105	343
1995	242	157	230	629
1996	252	172	251	674
1997	263	187	261	711
1998	288	198	290	776
1999	321	216	323	859
2000	234	235	323	791
2001	262	254	364	880
2002	300	280	424	1,004
2003	334	301	484	1,119
2004	347	326	504	1,177
2005	361	353	524	1,239
2006	376	382	546	1,304

Year	India					
	Science	Engineering/ technology	Medicine	Agriculture	Veterinary science	Total
1985	701	177	123	42	9	1,052
1995	1,289	322	224	72	20	1,927
1996	1,341	335	233	75	21	2,005
1997	1,423	356	247	80	22	2,128
1998	1,510	378	262	85	23	2,258
1999	1,538	403	282	89	24	2,336
2001	1,739	619	278	90	18	2,744
2002	1,884	714	314	57	19	2,988
2003	2,035	717	313	59	15	3,139

Table 3: Enrollment of science and technology majors in higher education in BRICS countries (1,000 persons) CONTINUED

Year	China					Singapore
	Science	Engineering	Medicine	Agriculture	Total	S&T courses
1995	310	1,167	256	110	1,843	18
1996	315	1,213	263	106	1,897	20
1997	332	1,263	271	112	1,978	22
1998	359	1,355	283	119	2,116	25
1999	421	1,613	329	142	2,506	24
2000	537	2,148	423	182	3,290	31
2001	716	2,491	529	186	3,923	33
2002	852	3,085	657	216	4,810	35
2003	1,005	3,693	815	250	5,762	36
2004	1,156	4,376	280	976	6,789	37
2005	968	5,477	308	1,132	7,885	37
2006	1,048	6,144	332	1,269	8,792	38

Source: Global Talent project.

2 While overall HRST figures suggest a relative fit between the supply and demand of talent, real-life circumstances suggest otherwise. Indeed, a talent shortage exists in the BRICS countries despite significant national efforts to increase the output of educational institutions in terms of science and engineering graduates. As the data in the five studies suggests, the prevailing mismatches between supply and demand are likely to become more severe within the next ten years.

BRICS have faced and will continue to face talent shortage in the coming years in matching supply with demand; but a more serious problem of the shortage is the lack of talent with adequate skills to handle the tasks assigned. This shortage has occurred despite government initiative to stimulate supply in all the countries under study, which has raised a serious question whether corporations, education system, and society understand the demand issue correctly.

This shortage will be exacerbated especially when a country faces serious demographic challenge, as in the cases of China and Russia.

3 In essence, the talent shortage is largely manifested in a shortage of qualified talent. Many of the HRST are not adequately educated for the jobs that are available; at the same time, many of those with degrees in science and engineering are not employable in the areas of their training.

Although the talent shortage, projected based on statistical analysis, is in quantitative terms, a deeper problem is that a significant portion of the current talent does not possess appropriate quality for them to carry out assignments that require experience and skill sets beyond formal

training. This points to the problem of education system that does not provide opportunity in which students gain first-hand and hands-on experience at corporations.

Quality improvement is more difficult than quantity expansion. The expansion of higher education in countries such as China and India has been more likely at the low-end. For example, a significant portion of the Chinese and Indian college graduates have received an education only equivalent to that at community colleges in the United States. As a result, many of those employed as HRST are not educationally qualified. In the case of India, for example, that number reaches two-thirds.

In terms of number, China and India are among the top countries in the world in the production of scientists and engineers. Given that these two countries also are the most populous in the world, however, the overall quality of workforce is still relatively low, measured by the average years of education completed and the percentage of employees with higher education, for instance.

Training is strategic in this regard, requiring domestic education system reform; more importantly, the business sector—both MNCs and local firms—shares the responsibility to invest both in their own employees and in the educational system of the country in which they do business. At the end of the day, it is this talent which turns innovative ideas into competitive products. Therefore, growing global attention to talent is in everyone's interest!

4 The on-going talent shortage could become (and to some extent already has become) a significant obstacle to economic growth and the pursuit of innovation in emerging economies. And, as these talent deficits become more severe, they could serve to constrain the pace and thrust of global expansion among the world's leading multinational corporations.

BRICS all have experienced and will continue to experience shortage of talent in growing their economies, competing internationally in terms of attracting high value-added foreign investment as well as raising the technological content of exports, and climbing the value chain to become innovation-oriented. In other words, talent shortage will make current economic development in these countries fragile and unsustainable.

5 One of the major challenges associated with comparing the talent situation across the BRICs economies derives from the fact that talent definitions are different from country to country; this renders it difficult, if not impossible in some instances, to make direct comparisons across countries. Further work on talent definition, granularity, and especially quality should be undertaken, perhaps involving organizations like the World Bank, OECD, UNESCO and major international corporations, who would benefit from greater clarity.

When the project started, it aimed at construct a Global Talent Index in the sense of becoming a “comprehensive, accurate and reliable information source available for tracking skills on a global basis,” rather than simply ranking global talent by an index. This is because measuring talent involves not only quantity, but increasingly important, quality. And the issue of talent quality itself is more complicated than ranking the

countries by economic indicators, which are more readily available, as studies such as World Economic Forum show. The quality differs across countries as a result of the differences in terms of curriculum, faculty members, facility access, exposure to cutting-edge knowledge at the international research frontier, legacy, and talent-nurturing environment, among others.

In counting talent, there is an international standard definition—human resources in science and technology (HRST)—as stipulated in the *Canberra Manual*, an OECD publication, and country studies did start with and tried to take HRST stocks (Table 4). More ready measures in quantifying scientific and engineering talent are in fact different (Table 5), with only China having a full range of data available (Table 6). The constraint of data availability has made cross country comparison difficult.

This fact itself points to the poor state of knowledge at national levels about supply and demand of talent. Because of the lack of accurate and reliable information on talent as well as the importance attached to talent, the authors recommend that governments, international organizations, and MNCs to work together to actively gather talent information and closely and continuously monitor the trends of nurturing, utilizing, and retaining talent on a global scale for future economic and social well-being.

Table 4: HRST in BRICS countries (1,000 persons)

Year	Brazil	India	China	Singapore
	HRST stock			S&T manpower
1991		18,500		
1996	723			176
1997	799			181
1998	808			187
1999	787		30,605	194
2000	848		30,602	202
2001	1,027		30,533	248
2002	1,048		30,893	244
2003	1,485		31,130	254
2004	1,739	42,800	31,531	259
2005	1,765		32,010	249
2006	2,071		32,568	295

Source: Global Talent project.

Table 5: HRST in BRICS countries used in quantitative analysis (1,000 persons)

Year	Brazil	Russia	India	China	Singapore
	HRST stock	Highly qualified specialists	Stock of engineers	Scientists and engineers	S&T professionals
1996	723	221	1,843	1,688	62.4
1997	799	46		1,668	68.6
1998	808	87	2,171	1,490	75.8
1999	787	297	2,159	1,595	83.5
2000	848	445	2,426	2,046	93.2
2001	1,027	290	2,556	2,072	135.1
2002	1,048	314		2,172	129.0
2003	1,485	287		2,255	140.7
2004	1,739	343		2,340	139.8
2005	1,765	375		2,561	128.6
2006	2,071	425		2,798	164.4

Source: Global Talent Index project.

Table 6: Various measures of China's HRST

Year	Persons with higher education	Persons w/ bachelor's degrees and up	Stock of HRST	Professionals	S&T personnel	Scientists & engineers in S&T activities	R&D personnel	Scientists & engineers in R&D activities
	million persons			1,000 persons			1,000 persons-year	
1991					2,286	1,321	671	
1992					2,270	1,372	674	472
1993					2,452	1,372	698	489
1994					2,576	1,539	783	552
1995					2,625	1,554	752	522
1996					2,903	1,688	804	548
1997					2,886	1,668	831	589
1998					2,815	1,490	755	486
1999				30,605	2,906	1,595	822	531
2000	31.5	10	25	30,602	3,224	2,046	922	695
2001	34	10.5	26	30,533	3,141	2,072	957	743
2002	38	11	28	30,893	3,222	2,172	1,035	811
2003	42	12	30	31,130	3,284	2,255	1,095	862
2004	48	13	32.5	31,531	3,482	2,252	1,153	926
2005	54	14.5	35	32,010	3,815	2,561	1,365	1,119
2006				32,568	4,132	2,798	1,502	1,224

Source: Denis Fred Simon and Cong Cao, *China's Emerging Technological Edge: Assessing the Role of High-End Talent* (Cambridge and New York: Cambridge University Press, 2009).

**Denis Fred Simon
and Cong Cao**

The Levin Institute

China Talent Pool

- 1** China is facing a talent shortage that could constrain its economic growth and innovation pursuit in the near-to-medium term and a rapid response is needed to moderate, if not ameliorate, any possible negative impact: first and foremost, the “fix” must be focused on closing the experience gap.
- 2** Four critical factors might impact the demand for China’s scientific and technical talent in the next 15 years: the increasing integration of China into the world economy, as measured by the level and structure of foreign direct investment (FDI) utilized; China’s commitment to become an innovative nation through indigenous efforts, as measured by domestic expenditure in science and technology; the technological sophistication of the Chinese society, as measured by the level and composition of high-tech exports; and the improved appreciation of the market of the S&T workforce, as measured by the relative wage for those involved in S&T-related occupations to the national average.
- 3** China had 2.25 million scientists and engineers (S&Es) in 2004. Its demands for S&Es are around 2.64 million in 2005 and 3.85 million in 2010. China’s future S&E demand will be 5.9 million in 2015 and 10 million in 2020. In the meantime, China should be able to supply 2.38 million S&Es in 2005 and 3.48 million S&Es in 2010. That is to say, China will face a quantitative S&T manpower shortage.
- 4** With the aging of China’s population, the college-ready group (between 18 and 22 years of age) will decline after 2010 and be surpassed by the age group of 55 to 60 years old (approaching retirement) around 2015. This demographic shift could be greatly disadvantageous to the growth of the talent pool beyond 2020. Therefore, China is at a critical juncture in terms of its talent policy as the nation is going to hit its peak in the quantitative supply of S&T manpower around 2020. Only by improving the quality of its S&T manpower will China be able to nurture the talent to become an S&T powerhouse in the world.
- 5** The quality of higher education is uneven not only between key and non-key institutions, but also within key institutions themselves. The problem itself arises from the lack of high-quality faculty members across departments and programs.
- 6** China lacks adequate talent (with respect to high quality) capable of leapfrogging in S&T, education, and the economy. The frustration is still present, even after the country has initiated various policy measures that favor talent enhancement.

Indian Talent in Science and Technology: An Assessment of Quantity and Quality

- 1** India faces a talent crunch in coming years. If the economy continues on its current pace, there is a predicted shortage of engineers (both degree and diploma holding) of 60,000 by 2010 and 2.45 million by 2020. The shortage is even more pronounced among degree-holding engineers. Under an optimistic scenario in which economy would generate such demand that the shortage of degree-holding engineers would be 150,000 by 2010 and 1.6 million in 2020. Such undersupply could be predicted to act as a brake on the economy, pushing its performance back toward more pessimistic outcomes.
- 2** Most demand for technical talent has been driven by the rapid growth of the service sector, in particular for business process outsourcing.
- 3** India's talent growth has been focused on information and communications technologies. While both biotech and nanotech are seen as critical, anticipated quantity and quality issues are very high according to industry interviews.
- 4** In 2004, 40.2 million Indians were qualified as HRST by education, 26.8 million by occupation, with 14.2 million being core as they possessed both education and occupational qualifications, which accounted for 3.9% of the workforce. However, only about 35% of those holding HRST jobs were educationally qualified for those jobs. This proportion has been falling since 1981 when 43% of those who were HRST with education qualification were employed in HRST jobs.
- 5** Total stock of scientists in 2001 is reported as 5.53 million, with additional 2.56 million engineers reported. Of the engineers, one-third are reported as degree holders, with 1,000 (0.04%) reported to have doctorates.
- 6** Total enrollment in higher education exceeded 10 million in 2004–05 academic year, of which some 35% are registered in science and engineering (including social sciences).
- 7** In 2006, India enrolled 885,000 new engineering students, of which 65.8% are in degree programs. Nevertheless, as India always enrolls more science majors than engineering majors, it is likely that the 2006 enrollment of science majors reached 2.6 million (see Table 3).
- 8** Quality measures are very unreliable, with estimates ranging from 15% to 50% of Indian engineers having the proper qualities for high-end knowledge work.
- 9** Over 90% of the population is employed in the informal sector, making accurate understanding of the talent pool very challenging.
- 10** Only 17% of Indians mid-twenties and older have secondary education.

Science and Technology Talent Pool in Singapore: Trends, Issues and Implications

- 1** Demand for S&T professionals is expected to grow at 12.4% per annum under the most likely mid-range growth scenario with a GDP growth of 6.4% per annum between 2006–10. There will be demand for 98,000 additional S&T professionals between 2006–10. This represents a surge over actual recorded growth averaging 9.9% in the last 6 years.
- 2** Forecasts predict that Singapore's increasing demand for S&T professionals between 2006–10 cannot be fulfilled by the current talent pool or by the addition of new Singaporean S&T graduates (including foreign students graduating from local universities, some of whom are required to stay on to work for a number of years) to the labor force.
- 3** The forecasted supply is only 55.2% of demand, implying the need to employ over 44,000 foreign S&T professionals to cover the resulting manpower shortage. Actual foreign S&T employment between 2000 and 2006 was only 8,000. Under the optimistic scenario, the implied new foreign employment would be as high as 80,000.
- 4** In 2006, 164,000 were counted as S&T professionals and 23,000 as researchers.
- 5** Singapore has experienced rapid growth of R&D manpower, with a growth rate of 17% over 1999–2004; thus by 2004, Singapore ranked tenth in the world for R&D manpower per capita. The R&D component of S&T manpower has increased, from 6.5% in 1990 to 12.3% in 2006.
- 6** Between 2000 and 2006, foreigners accounted for 14–19% of the S&T professionals and higher among researchers (21.5% in 2006).
- 7** In 2006, more than three-quarters of the S&T professionals were degree holders, reflecting a much higher education level than the other nations studied.
- 8** Singapore has the highest share of graduates with S&T-related degrees (67% in 2004, up from 52.4% in 1998), therefore enjoying a substantial lead over the other countries. Its share of S&T graduates was higher than that of the 2nd highest ranked country, China, which reported 53% share of S&T (science, engineering, medicine, and agriculture) graduates with a bachelor's degree in 2006.

Highly Qualified Specialists (Having Higher Education) in Russia

- 1** Russia faces tremendous demographic challenges as a result of decreasing total birth rate per woman, a decline in women of child-bearing age, and heavy mortality of the employable population, especially men, due to low living standards and lack of healthy lifestyle.
- 2** The year of 2013 will be an inflection year as the employable population will be predominantly elderly thereafter.
- 3** Of the 20–24 year old group, the percentage with higher education increased from 3.94% in 1995 to 10.12% in 2006.

- 4 Higher education has been structurally imbalanced recently with increases mainly in such fields as humanities and economics. In the meantime, the demographic shift will lead to an overall reduction of students and graduates. Raising the bar for entrance and cost will become barriers for the development of higher education in Russia.
- 5 The demand for highly qualified specialists in the years to come will be constrained by decreases in population, in the economically active population, and in the economically active population with higher education.
- 6 The supply of highly qualified specialists is forecasted according to both the population of the 20–24 year old group and the population with higher education of the same age group. Based on these, there was an oversupply of 800,000 highly qualified specialists in 2007, with a slight shortage of 13,000 predicated in 2013. Afterwards, the shortage will increase to some 200,000 until 2024 when a balance is reached.
- 7 However, the structural imbalance will create deficits of highly qualified specialists in certain specialties and surpluses in others. For example, the deficit for highly qualified specialists in processing industries will be around 75,000 between now and 2025.
- 8 Both the number of and employment in R&D organizations have declined. In 1995, some 1.06 million R&D personnel were employed in 4,000 R&D organizations, which declined to 810,000 and 3,600 respectively by 2006. Similar is the case of those researchers with academic degrees. Nevertheless, the number of patents granted to domestic applicants has recovered in recent years after a decline between 1998 and 2001.

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Business Administration

The Global Talent Index Project: Brazil Chapter

- 1 There has been a significant increase in the number of entrants in higher education—10% annual growth between 2000 and 2006 as a whole, and about 8% in science and technology related specialties.
- 2 The intensification of growth of human resources in manufacturing shows a tendency that talent is more concentrated in occupations such as plant and machine operators and assemblers.
- 3 The nature of specific sectors and development stage capability are still in the process of evolving.
- 4 Despite a very interesting trend in the number of graduates, the great majority of these human resources do not seem to be allocated in formal R&D and engineering activities.
- 5 Engineers are lacking in certain industries, including IT, and there is a mismatch between the number and kind of HRST in industries and supply.
- 6 Brazil still needs a more effective alignment between the creation of knowledge and education of human resources in universities with the demand of professional expertise and technological bases for the formation of firms, and a clear use by companies of the university environments as a source for accumulation of technological capability.

Impact of Global Financial Crisis on the Demand for Talent

While moderating recently, the global financial crisis has contracted and will continue to contract the economic potential of the BRICS countries. Foreign direct investment (FDI) flows into these countries have slowed. China has exported fewer high-tech goods while India has seen less business in the BPO sector, which has translated into layoffs of those in S&T-related jobs and reduced employment in related sectors. These decreases are consistent with the low-growth projections of the Global Talent project country studies, since demand for talent is linked to economic growth (Table 7).

Table 7: Determinants for the demand of HRST in BRICS countries

Country	Brazil	Russia	India	China	Singapore
	HRST stock	Highly qualified specialists	Engineers (historical)	Scientists and engineers	S&T professionals
Determinants for the demand of HRST	GDP	GDP	Aggregate demand in the economy		GDP
	Investment in R&D		R&D expenditure	S&T expenditure	
	Investment in education		Education expenditure		
	Exports		Exports	High-tech exports	
			globalization	FDI utilized	
		Wages	Wage in manufacturing	Relative wage	
		Population			
		% of population with higher education			

Source: Global Talent project.

However, the impact on demand for talent may not be as severe as expected. Employment impacts in the United States and other countries have been such that China, for instance, has taken advantage of the crisis to lure back talent from overseas. Delegations have been dispatched to the United States and other countries to recruit financial professionals. Most recently, the Department of Organization of the Chinese Communist Party Central Committee launched a Thousands Talent Program, pledging to attract some 2,000 high-end Chinese talent residing overseas in the next 5–10 years. Under the scheme, institutions

of learning, enterprises, and other organizations are encouraged to target those leaders who are able to make breakthroughs in key technologies, develop high-tech industries, and pioneer new discipline areas. Domestic companies and MNCs also have put on their agenda to nurture and secure a quality and adaptable workforce find and attract more qualified employees.

In India, in the most affected sectors such as BFSI (Banking, Financial Services and Insurance) there is a robust demand for high-end talent as the sectors continue to be bullish about their future prospects. Even in software services, the next wave of the impetus to the sector will come for public spending on e-governance programs where government departments are looking to spend about US\$6 billion on 30 projects under "Mission Mode Programs."

Although Singapore is expected to be most affected by the global recession due to its open economy and high reliance on international trade (net exports contribute 30% of Singapore GDP in 2007), there has been little capital flight as Singapore maintains a strong position in terms of accumulated reserves. The economy is expected to gradually recover towards the end of 2009 and to rebound strongly in 2010. As such, the expected impact on S&T talent will be relatively short-lived. Moreover, the policy emphasis on R&D and technological development has continued apace in this period of economic slowdown. While a situation of S&T unemployment is to be expected, especially for new university graduates, this will likely reverse by 2011. Additionally, while the manufacturing sector has been gravely affected by the current crisis, the impact has been far less severe on the services and other sectors that employ the majority of professionals in Singapore.

In Brazil, current employment in IBM alone has passed 17,000, more than tripling its headcount in 2005, which was 5,000. The company added 2,000 new hires in 2008 and 600 more in 2009. The country as a whole has a gap of 100,000 entry-level positions in IT alone.

As an unintended consequence of the global financial crisis, there has been an increasing return of those from countries that have been severely affected by the crisis. While some of the returnees were fresh out of schools so that they had no overseas professional experience, other job losers have knowledge and skill sets that are in great demand in countries such as China and India. Their return will boost the competitiveness of the countries and help transform their orientation toward innovation and may help change the global map of innovation.

Researcher Biographies

Alex Bandurin, formerly vice-rector of the Institute of Open Business Education (InOBE), is pro-rector of scientific work in the Moscow State Institute of Tourism Industry. His candidate degree is in economics, from the Russian Academy of Commerce, with concentration in statistical analysis methodology and his doctorate degree is also in economics, with concentration in corporate governance.

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Under the directorship of Dr. Figueiredo, the Research Programme on Technological Learning and Industrial Innovation in Brazil Studies at EBAPE has had active and fruitful interactions with international research groups in the United Kingdom, the United States, Finland, and such United Nations organizations as UNCTAD and UNIDO. And the research findings of these studies have been published widely in

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Dr. Figueiredo is the founder and editor-in-chief of the *International Journal of Technological Learning, Innovation and Development*, a journal published by Inderscience Publishers.

Denis Fred Simon is a professor at the School of International Affairs, the Pennsylvania State University. Previously, he was Levin Institute's Provost and Vice-President for Academic Affairs, Dean of the Lally School of Management and Technology at Rensselaer Polytechnic Institute and on the faculties of the Fletcher School at Tufts University and the Sloan School of Management at the Massachusetts Institute of Technology. He received his PhD in political science in 1980, from the University of California, Berkeley.

Dr. Simon is a member of the Council on Foreign Relations and the National Committee for U.S.–China Relations and a frequent advisor to global corporations and the U.S. government. He has been president of the Monitor Group (China) Ltd, director of the China Strategy Group and general manager for Anderson Consulting managing in Beijing, director of the Business Strategy and Innovation Center for Scient International in Singapore and the founder and former president of China Consulting Associates in Boston.

Dr. Simon has written and lectured widely regarding innovation, high-tech development, foreign investment and corporate strategy in the Pacific Rim and is frequently quoted in the Western and Asian business press regarding commercial and technology trends in China, HK and the Asia-Pacific region. He is the author of *China's Emerging Technological Edge: Assessing the Role of High-End Talent* (with Cong Cao, Cambridge and New York: Cambridge University Press, 2009).

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Dr. Wadhwa teaches statistics and econometrics at the University of California (Irvine), and the Indian Statistical Institute (New Delhi). She has also been a member of various government committees, including the Working Group for the Revision of Wholesale Price Index Numbers, Ministry of Commerce and Industry, Government of India.

Dr. Wadhwa has published extensively and her research interests include development economics and the economics of education. Apart from the study on Global Talent her work with NCAER includes work on the E-readiness reports since 2005. Her recent research focuses on the drivers of the Indian growth process and the role of the non-farm sector. She has also designed ASER—one of the largest surveys of learning in India—and looks after all the data and its analysis at ASER Centre.

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Prior to joining NUS in 1988, Dr. Wong was a co-founder of two IT companies and the founding managing director of a consulting firm in Malaysia. He has consulted widely for international agencies such as the World Bank, ADB and APEC, various government agencies in Singapore such as EDB, IDA and NSTB, as well as many high tech firms in Asia. Dr. Wong has published in numerous international journals on technology entrepreneurship and innovation strategy.

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