Educational Systems of the BRICS countries: preliminary findings of a comparative, present and future time, adequacy analysis.

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Introduction

This paper advances some preliminary results of ongoing research concerning the educational systems of the BRICS countries, their past and present policies and programmes, their institutional designs and their adequacy in terms of the countries' social needs and market necessities. At this stage we have limited ourselves to assess the adequacy of the educational system's based on UNESCO's standardized and comparable data series with educational-related indicators. We also take a glance at some demographic forecasts from UNDESA. As will be revealed in the text, these databases lack crucial information required for a more in-depth analysis. Furthermore, we had no means to access and standardize the national data of the countries in order to possibly compensate for these gaps. Overall, this paper presents the administrative set ups upholding the educational systems of each country, the duration of their educational levels and whether they are mandatory or not. We look at nine educational indicators: expenditure (% of GDP and PPP $ per capita); gross enrolment ratios (since net ratios are not available); pupil-teacher ratios; repetition and literacy rates; net flow of internationally mobile students; Research and Development (R&D) allocated personnel and expenditure. We also hypothesize about future demands for each educational level in each country, as well as the time pressure facing education-led human capital accumulation as an auxiliary strategy to mitigate the fiscal challenges expected from a demographic transition.

Educational systems

Our overview of educational systems among the BRICS reveals that **Brazil** provides the longest period of mandatory education (14 years from primary to upper secondary), in which pre-primary and primary education are of municipal responsibility and secondary education is of regional state responsibility. The country has an interesting funding structure, in which subnational units are meant to contribute 2/3^{rds} of their revenue to a national fund (the remaining 1/3rd is provided by Central Government) which is then redistributed evenly among the municipalities and states. Tertiary education is provided and funded almost evenly by central and subnational units (although central and government tertiary education operates separately). Regular TVET (equivalent to secondary and tertiary education) is mostly of central government responsibility: it has been expanding its network, even so, the country still has a small supply of such services. Differently from all its BRICS peers, Brazil's extra-curricular TVET courses, offered by a myriad of institutions, are not validated by standard examinations. The government does however provide an online gateway where firms can source information concerning the quality of state-recognized TVET institutions issuing each certificate. Brazil has a flagship model of corporate responsibility for providing extra-curricular TVET institutions, the Sistema 'S'. It has a vast network throughout the country which provides good quality courses. They have recently been made accessible to the poor by means of large central government subsidy programmes inter-twined with other programmes such as Bolsa Familia (Cash Transfer) and PRONATEC (Inclusive Production)[2].

Russia provides the second longest period of mandatory education (11 years), encompassing primary to upper secondary. This is mostly provided and funded by regional governments (provinces), even though performance-oriented funds are provided by the Central government. There is parity between the supply of tertiary education by the centre and the provinces. Like Brazil, regular TVET is mostly

[2] UNESCO. (2014). BRICS: Building Education for the Future. Paris: Unesco.

provided by central government, which is fairly integrated into secondary education, but not so much into tertiary education[3].

India and China are the BRICS countries that provide the shortest period of time of mandatory education (8 years), which does not include upper secondary education (available but not mandatory). Primary and secondary education in India is provided by regional state government, but with growing funding and direct provisions from central government since this responsibility has ceased being restricted to regional governments. India is the country that depends the most on PPPs to provide public education at these levels of education. Tertiary education is mostly provided by regional state governments, although central supply is also significant. The country is undertaking massive efforts to expand regular TVET which, when available, is fairly integrated with secondary and tertiary formal education. The expansion however still has a long way to go[4].

In **China,** recent modifications have rendered an intermediate administrative unit, the county, responsible for providing pre-primary, primary and lower secondary education (mostly by means of its own funds, but also with some support from the centre). Upper secondary education is provided by the central government. Tertiary education is mostly of local responsibility. Regular TVET, which has high enrolment rates, is an integral part of most public upper secondary educational systems (which is not mandatory), and is fairly integrated with tertiary education as well[5].

South Africa provides 9 years of mandatory education, however it just goes up to lower secondary levels. Upper secondary is available but not mandatory. Basic education is provided and mostly funded by provincial-level government, and the country stands out for having substantial school-level managerial autonomy (with community participation). Tertiary education is mostly provided by central government. Regular TVET is similar to China (an integral part of most public upper secondary educational systems), however with lower enrolment rates[6].

Extra-curricular TVET (not equivalent to secondary or tertiary education) is stimulated by firm's mandatory contributions in China and South Africa. In China, the firms have to provide the training themselves, or outsource the training to specialized companies. South Africa gives the option for firms to provide training themselves or to pay the government, however the government fails to convert these contributions into the supply of adequate training. India funds public and PPP extra-curricular training opportunities, which face a sustainability challenge. The 12th FYP aims at mitigating this by introducing a mandatory corporate levy and by incorporating the production of TVET institutions into a business model[7].

Inclusive production provides the opportunity to stimulate learning by doing. In light of this, the BRICS inclusive production initiatives are concentrated among workfare programmes (like India's MGNREGA, South Africa's EPWP, and China's *Yigong-daizhen*) and programmes which provide access to credit to promote self-employment and entrepreneurship (like Brazil's Fies and PRONATEC, India's SJSRY and South Africa's NYDA)[8].

Related to these opportunities for learning-by-doing is **state and market support to informal innovation and production practices**. In Brazil, such practices are known as Social Technologies, and

[3] Ibid.
[4] Ibid.
[5] Ibid.
[6] Ibid.
[7] Ibid.
[8] OSÓRIO, Rafael; ARRUDA, Pedro. (2014). 'To BRICS or not to BRICS: The Dilemma of Youth Unemployment', in: IPC-IG Policy in Focus, No. 28. Brasilia: IPC-IG.

refer to identifying, funding and scaling up community practices, as well as to providing means for community inclusion in the operationalization of the country's many social programmes. Banco do Brasil, FINEP, Fiocruz and the MDS are some of the main state-actors promoting this agenda. The flagship civil society organization is the ASA (Articulação Semi-Árido Brasileiro): a federation of NGO's and social movements supporting social technologies such as cistern-distribution projects to fight water scarcity in semi-arid, Northeast Brazil. Russia has a fairly large formal labour-market compared to its BRICS peers. This may be the reason informal innovation in the country is more a complementary activity to formal work than a substitute for it, thus there is little public involvement or support for such initiatives[9].

India is the champion country in supporting such initiatives, known as Grassroots Innovation (GRI). They count on large civil society institutions and state infra-structure to actively search for informal innovators to create juridical means of accommodating such knowledge, funding it, and then engaging these innovators in a business model. Some of the Indian civil society institutions operating in this area, such as the HoneyBeeNetwork, have even evolved into global networks[10]. They have successfully advocated for the implementation of public institutions to support GRI, like the Gujarat Grassroots Innovation Augmentation Network (GIAN), the National Innovation Foundation (NIF), the Micro Venture Innovation Fund (MVIF) and the Grassroots Technological Innovation Acquisition Fund (GTIAF).

China has two main structures in place to accommodate informal innovators. First, folk innovation refers to popular initiatives without state intervention. The second, more recent structure, is indigenous innovation which gathers together public funds and universities to engage local communities in a business model similar to that of Indian initiatives[11]. Finally, South Africa promotes informal innovation and production by means of its Indigenous Knowledge System (IKS), which promotes active search, cataloguing, juridical and fiscal support for scaling up local knowledge, mostly of tribal origin. More recently, the IKS has played a central role in the country's long-term planning as well as in the institutional arrangements of the country's scientific institutions.

Present-time adequacy analysis

In an attempt to **assess the present-time adequacy of the education systems** described in the first part of this paper, we explore UNESCO indicators available for the BRICS, that serve as proxies of the following: the extent of state public investment (expenditure as percentage of GDP and as absolute per capita values), the system's coverage (gross enrolment); the availability of resources (pupil-teacher ratio); and the overall outputs and outcomes of these educational systems (repetition rates and literacy rates). There is also a brief overview of the profile of education-lead international migration (Net flow of internationally mobile students), and the R&D infra-structure of the countries,

[9] SOARES, F. V.; ARRUDA, P. L.. (2015). Social Technologies and Public Policies in Brazil. IPC Research Brief, v. 11. Brasilia: IPC-IG.

[10] GUPTA, A.; SINHA, R., KORADIA, D.; PRAKASH, T.; VIVEKANANDAN, P. (2001) Building upon Grassroots' Innovations: Articulating Social and Ethical Capital, paper presented at the World Social Workshop, Brazil, January 25-30. Accessed at: http://www.hks.harvard.edu/sustsci/ists/TWAS_0202/gupta_250101.pdf [22.04.2015]

[11] GU, Shulin; LIU, Ju; LUNDVALL, Bengt-Åke; SCHWAAG SERGER, Sylvia. (2008). 'China's system and vision of innovation: analysis of the national medium- and long-term science and technology development plan (2006-2020)', presented at the GLOBELICS 6th International Conference 2008, 22-24 September, Mexico City, Mexico.

by means of indicators of expenditure and personnel in this area[12]. Naturally, these are just preliminary proxies, which ought to be better qualified and contextualized: a task we couldn't fully undertake at this point due to a lack of more comprehensive data. Such limitations are illustrated when we look at gross enrolment ratios to estimate coverage, even though this can inflate the perception of coverage due to repetition, age inadequacy and other phenomena which could have been controlled for if we had access, for instance, to net enrolment ratios. Both indicators of R&D (expenditure and personnel), which mostly focuses on formal R&D, are unable reflect important dimensions of knowledge production (innovation, production and learn by doing) among the BRICS countries, such as inclusive production programmes and Social Technologies/ Grassroots Innovations. The relationship between the indicators and the various aspects we explore are instrumental. Policymaking upon the hypothesis we suggest must rely on further in-depth research.

Therefore, the first relationship that emerges from our present-time adequacy analysis refers to the necessity of consolidating a BRICS data bank, in order for a full comparable data set to be realised to support more in-depth studies. A specific data set dedicated to the 5 countries would resolve methodological problems of data comparability more efficiently than other available data banks which include hundreds of countries, thereby providing little room for adjusting their standards according to the statistical needs of specific countries. A classic example of this is the lack of recent data of the age-specific population count for Brazil since 2006 (notably, enrolment ratios and school life expectancy). UNESCO and other global institutions have standardized procedures that make it a challenge to unravel inconsistencies like the current mismatch between UNDESA'S demographic forecasts and abrupt, unexpected population phenomena (such as Brazil's extremely sharp reduction in fertility rates). A BRICS specific data set could possibly facilitate discussion on alternative ways to overcome such challenges (for instance, estimating the absolute number of people at each age-specification out of inter-censitary national surveys, such as Brazil's PNAD). In many cases there is plenty of information at an individual, country level. What is lacking is a data set that standardizes such data in a comparable way – this demands uniform data indicators for all the countries, as opposed to different countries having similar indicators with certain differences.

Due to this data limitation, illustrating our argument for creating a BRICS data bank, there is little conclusive analysis for Brazil that can be made based on UNESCO's data. It is clear that **Brazil** has dedicated a substantial and growing budget to education in the past decade (both figures, as percentage of its GDP and as absolute per capita values, fare among the highest of the BRICS countries), however an objective analysis of the country's educational coverage would depend on updated enrolment ratio data that is not available. There is data on absolute enrolment numbers, which indicate an upward trend for the past decade. Conclusive data on the expansion of the age-groups meant to be enrolled is needed for a categorical evaluation of the country's educational system's coverage. Other indicator's (like the almost 100% literacy rate among the youth), as well as the set of new policies that have been undertaken in the last decades, suggest there has indeed been growth in coverage. The country has high pupil-teacher ratios when compared to its BRICS peers, although this might be a consequence of a possible expansion in the system's coverage. The repetition rate (the highest among the BRICS) is indicative of severe quality problems. Brazil is mostly a "sender" of students, as it has more national's studying abroad than it receives. The number of Brazilian's studying abroad as well as that of foreigners studying in Brazil is small in comparison to other BRICS countries. Both of Brazil's R&D indicators rate well in relation to the other BRICS. Despite a marginal

[12] UNESCO INSTITUTE FOR STATISTICS. UIS Data Center Website, <http://www.uis.unesco.org/Pages/default.aspx>, accessed 10/05/2015.

increase in the relative number of personnel involved in these activities in the past decade, the expenditure in such areas has increased sharply in the same period.

Russia's data on expenditure is outdated (the latest figures refer to 2008), but overall, they indicate intermediate expenditure in both the percentage of GDP and absolute per capita terms when compared to the other BRICS. Russia's capacity to transform its moderate investment into extraordinary results is impressive, suggesting a smart institutional design of its educational system. Its system relies on a national administrative arrangement considerably more efficient than those of Brazil, India and South Africa. Apart from primary education, the country performs very well in terms of all the observed indicators; particularly in terms of gross enrolment at tertiary education (where the country has almost 3 times better figures than its BRICS peers), pupil-teacher ratios (which are the smallest among the BRICS nations), among others. Russia and **China** differentiate themselves from the group by having almost null repetition rates. And despite all the BRICS (with available data) holding almost universal literacy rates, Russia and China are the only countries that show these figures for over a decade in the past: this indicates that the solidity of their educational systems come from a long tradition, while the other countries are all improving their more historically vulnerable educational systems. Since there is no available data on Chinese public expenditure on education, one cannot analyse its efficiency. Despite the positive indicators already presented, including coverage and pupil-teacher ratios for primary education, the country does display coverage and input gaps for the other educational levels. China sends more students abroad than it receives (it actually has the biggest number of national's studying abroad, compared to its BRICS peers), and despite the number of personnel in R&D being kept almost stable for past years, its expenditure on such activities has skyrocketed during the same period.

Possibly due to the large role allocated to private institutions in supplying primary and secondary education in **India**, the country has surprisingly low public expenditure (both, as a percentage of the GDP and in absolute per capita terms) if compared to its peers. It is indicated by the outputs and outcomes of this strategy, that the gap in state investment in education is not been adequately covered by the market, as enrolment ratios are low and repetition and pupil-teacher ratios are high (both, in absolute terms and in relation to the other BRICS countries). Worryingly, India is the only country which lacks recent data on literacy rates. This gap that must be remedied with urgency so that the country can make informed decisions about its educational policies. The data on India also reveals an imbalance in public expenditure among the different educational levels; wherein India's discrete budgetary improvements to education (as opposed to the sharper improvements among its BRICS peers) are disproportionally in favour of the tertiary education budget. In terms of student migration, India has a large flow of students to outside the country, possibly as a consequence of its large diaspora, rendering the number much higher than the number of foreign students in India.

South Africa's overall expenditure on education is high (amongst the highest of the BRICS), though its pre-primary and tertiary educational levels are more neglected. Absolute per capita expenditure on tertiary education even goes so far as to suggest South Africa has a high budget, but this impression is instead the outcome of the country's very limited number of public universities (less than 30). Gross enrolment rates corroborate this, however for other educational levels the figures are much better, suggesting intermediate to high coverage when compared to the other BRICS. The seemingly favourable coverage at primary and secondary levels has not been accompanied by a parallel increase in the number of teachers (since South Africa has the highest pupil-teacher ratios among the BRICS countries). The country has no data on repetition rates, however its latest 2003 figures, as well as its school life expectancy lasting longer than the regular time for primary and secondary levels of education, suggest there are severe quality gaps. Despite having almost universal literacy rates among

youth and adults, South Africa's low literacy rates among the old-age population (69% by 2012) is indicative of the vulnerabilities of the past educational systems. Overall, the country receives more foreign students than the number it sends to study abroad, and despite having a stable proportion of its population working on R&D (with figures comparable to India and China) it is the only country of the group that saw decreasing expenditure in the area since 2008.

Future-time adequacy analysis

In order to complement this present-time adequacy analysis with a **future-time adequacy analysis**, we hypothesised whether the demand and supply mismatch for education among these countries could be expected to be aggravated or reduced in the long-term, due to predicted demographic changes. For this exercise we look at the expected absolute sizes of age-groups which characterize the demand for each educational level, and based on that, we estimate whether the efforts needed to fully accommodate the present demand for education in the BRICS would have to be expanded or not. Related to this analysis, we also hypothesise how close each country is to its demographic transition crossing line (the point after which the percentage of Economically Active Population will start to reduce and the percentage of the Dependant Population will start to grow), which will subsequently pose a challenge to the countries' welfare financial sustainability if they don't increase their production by means of human capital accumulation, including increasing the educational levels of the population. The hypothesis deriving from one such analysis can add more or less pressure to the necessity of the BRICS countries to compensate for educational gaps of the past through means of TVET and learning-by-doing strategies, on top of the provision of regular education.

For both exercises, we look at demographic data from the UNDESA, Population Division estimated for the years of 2015, 2030 and 2050, all of them considering a medium fertility scenario[13]. The 2050 horizon is in-tandem with Goldman Sachs' seminal evaluation of the structural potentialities of the BRIC (originally without South Africa), which lead to the proposition that the countries' aggregate economy would overcome that of the G7 by 2050[14].

For the first of these exercises, our data analysis (also due to data scarcity) is limited to rough, imprecise approximations, as well as several methodological shortcomings. In this exercise, for instance, we do not count on age-specific forecasts that could be adjusted according to the age-groups of reference for each educational level of each BRICS country. Instead we estimate the increase in demand for each educational level based on forecasts for the UNDESA age-groups (0-4;5-9;10-14;15-19;20-25). This is notthe most compromising shortcoming of the exercise, considering UNDESA age-groups do contemplate the core of each country's own age-group of reference for each educational-level. What is more compromising is the fact that estimating demand from the age-group of reference for each educational level does not take into account that demand for education is also affected by phenomena like repetition and age-inadequacy, which do play a significant role in many of the BRICS countries, but which is not controlled in this exercise (since we don't even have access to net enrolment ratios). Finally, it must also be considered that we have adopted forecasts based on

[13] UNDESA, Population Division. Population Estimates and Projections Section, <http://esa.un.org/wpp/>, accessed 10/05/2015.

[14] O'Neill, J. (2001). 'Building Better Global Economic BRICs', Goldman Sachs Global Economics Paper, No. 66, 30 November. New York: Goldman Sachs.

medium fertility scenarios. Despite being the 'safest bet' collectively and without further auxiliary analysis, it might not accommodate Brazil (given its recent drop in fertility rates).

Such limitations preclude analysis based on marginal age-group absolute size variations. But in cases where there are radical variations, one can expect at least to a certain extent, that they illustrate whether the actual demand will grow, remain almost the same, or reduce. Naturally, the extent to which there will be a possible growth or reduction in the demand is far beyond the scope of this study, demanding more precise and methodologically consistent research.

Our exercise foresees a potential reduction in the demand for all levels of education (especially for secondary education) in Brazil by 2030 and, even more by 2050. A similar phenomena is less likely, though yet possible in India with respect to educational levels from pre-primary to upper secondary, but not between now and 2030 (only between now and 2050). The demand for tertiary education in India will possibly remain somewhat the same as it currently is by both, 2030 and 2050. Russia, China and South Africa's demand for upper secondary and tertiary education will possibly grow bigger than it currently is by 2030, though it will possibly get back to roughly what it currently is by 2050 in Russia and South Africa. China will possibly see an even bigger absolute reduction between 2030 and 2050 to below the 2015 current level. South Africa's demand for pre-primary and primary education will possibly reduce between now and 2030, mostly between now and 2050. A similar trend is possible for China and Russia, though the reduction from 2030 to 2050 will likely be less accentuated for China, whereas Russia will possibly see stabilization in this demand between 2030 and 2050. The African country can possibly see its demand for lower secondary education remaining somewhat stable between 2015 and 2030, while China and Russia will possibly see it grow in the same period. All the three countries will possibly have this demand further reduced to levels slightly below the current demand.

In none of the countries is the variation to such a large extent that it could not be rendered virtual or misleading due to our methodological shortcomings. Our hypothesis tends to be most pertinent to the countries where school abandonment, age inadequacy and repetition are more prevalent.

Finally, the second exercise reveals that Brazil will cross its demographic transition line gradually between now and 2030, and more sharply from there to 2050. In Russia and China this gradual transition started back in 2010, and will possibly move to a higher pace in Russia than in China by 2030, after which Russia will possibly carry on the transition at a slower pace than China. India's EAP will possibly keep growing (relative to the total population) until 2030 and stabilize from there to 2050, while the African country has the potential to reach 2050 with a still growing EAP (relative to the total population). Accordingly, Russia (despite its favourable indicators) and China (whose educational indicators reveal more gaps) are facing the greatest impetus to complement regular education with TVET and other educational structures capable of compensating for past gaps. This would increase productivity through education-lead human capital accumulation as a means of maintaining its welfare state's sustainability in an 'adverse' demographic context. The other countries have a bigger time-span to accumulate education-led human capital by means of regular education. This is except for Brazil whose first generation to confront the demographic challenge are current pupils older than 5 years-old, and mostly the youth (15-24 years-old) – who will all be the core of Brazil's EAP by 2030. Thus, Brazil must overcome its shortcuts in secondary and tertiary education to guarantee these cohorts of children and youth born before 2010 receive proper regular education. Despite being under less time-pressure than Russia and China, Brazil must also invest in TVET, which is capable of mitigating educational gaps of the past by means of work-oriented education and training targeted to the youth and young adults.

Conclusions

Our analysis reveals that Brazil, India and (to a certain extent) China have been seeking to improve their education by allowing for greater participation of the central government in the funding and operation of basic education, which has traditionally and to a large extent, been of subnational responsibility. Brazil does so by means of a centrally controlled participatory fund for education, whereas India has altered its Constitution to designate education as a shared responsibility between the centre and subnational units. China has shifted such responsibilities from its most capitalized administrative units to an intermediate level between the township and the centre: the province. This centralization movement is not universal among the BRICS, as Russia and South Africa maintain a more decentralized management and funding structure for their educational system. The South African model has been achieving good results in terms of coverage expansion, however several qualitative challenges remain. Russia, shows success in both coverage and quality provision. It is also a flagship case of resource rationalization among the BRICS as it achieves such results with moderate budgets compared to its BRICS peers.

When it comes to TVET, tertiary and non-mandatory education (as is the case for India, China and South Africa), the central government plays a bigger, more direct role in all the BRICS countries: being responsible for a network of institutions similar or bigger to that provided by subnational governments. Overall, the BRICS countries seem to be building corporate responsibility based extra-curricular TVET networks similar to Brazil's Sistema 'S'.

Despite a vast amount of data existing at the national level, there is still a challenging lack of comparable data series on the BRICS (as exemplified by the lack of data on enrolment for Brazil, repetition for South Africa and literacy for India). This is a major barrier to cooperative policymaking at the inter-regional level. A solution could be to institute a BRICS data bank, different from UNESCO's and other international organizations, with standardised parameters more appropriate to the statistical challenges faced by each BRICS country. Developing cooperation between the countries - since only 5 countries would be monitored as opposed to hundreds, would also be beneficial.

Some of the main educational challenges of the BRICS include Brazil's high repetition rates, South Africa's extremely low coverage of tertiary education, the overall high pupil-teacher ratios and low coverage for pre-primary education. China shows a seemingly successful strategy to expand its primary education with relatively high quality, though the remaining educational levels do not show similar advances. Conversely, Russia has the best indicators of the BRICS countries overall, although its primary education level lags behind others in terms of its indicators. India is a separate case, as it depends largely on PPP to promote education. Despite the potentialities of this strategy, it has not yet succeeded in overcoming the low coverage, scarce resources and questionable quality that characterize the country's education. Naturally, there are several exceptions within this scenario, notably related to the centrally administered upper secondary schools as well as tertiary education.

When it comes to non-traditional channels for knowledge production and circulation, however, India is the leading country in terms of both civil society and government support for informal innovation and production (or GRI, as it is locally known). It also holds the biggest workforce programme, the MGNREGA, though this initiative might be more relevant for its income security effects than for its training and qualification outcomes. These outcomes are more likely due to proper training, capacitation and access to credit oriented programmes, which do exist in all the BRICS countries. Formal R&D shows an overall trend of stable rates of professionals in the area, except in Russia, where the number of R&D professionals is much higher than in the other countries, although it has been

decreasing in the past years. The allocated budget for such activities has increased substantially in all the countries, except South Africa (whose R&D expenditure has decreased). In terms of student international mobility, China, India and Brazil, respectively, send the most students abroad; while Russia and South Africa receive the most foreign students.

A glance at future population prospects for the BRICS countries suggests the possibility that the demand for pre-primary and primary education will reduce in most countries, while the demand for secondary and tertiary education might stabilize or increase. These projection are the outcome of, admittedly, methodologically weak forecasts, which ought to be further fine-tuned and controlled for other relevant factors. However, if the methodological shortcomings are not great enough to fully invalidate the hypothesis (for countries with the highest repetition and age-inadequacy rates this hypothesis tends to be more unlikely), they can be interpreted as pressing signals towards improving secondary and tertiary education among the BRICS countries.

Finally, a related analysis suggests Russia (which holds the best indicators) and China (whose educational indicators have a lot to improve upon) specifically, have to heavily invest in TVET and other educational strategies in order to compensate for educational gaps of the past in a short time. In these countries, education-led human capital development must be pursued sooner as an auxiliary measure to maintain the welfare state's fiscal sustainability in 'adverse demographical contexts'. This fiscal imperative suggests Brazil, India and South Africa have more time to accumulate human capital. India and South Africa could even have cohorts of adults who will bear this fiscal responsibility fully completing their regular educational cycle by then, if coverage and quality gaps were to be immediately overcome. However, this does not mean that Brazil, India and South Africa should not seek TVET- like strategies for other equally pressing reasons, such as market adequacy of the labour-force and detrimental historical gaps which need to be compensated for as a matter of equity and social justice.

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APPENDIX 1 – UNESCO DATA ON EDUCATION (Source: UIS Website).

Indicator	Government expenditure on education as % of GDP (%)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	3.88	4.01	3.88	3.78		4.01	4.53	4.95	5.08	5.40	5.62	5.82			
Russian Federation		2.94	3.11	3.84	3.68	3.55	3.77	3.87		4.10					
India	4.34	4.25			3.55	3.29	3.13	3.09			3.21	3.32	3.85	3.79	
China	1.91														
South Africa	6.03	5.58	5.29	5.20	5.06	5.28	5.28	5.29	5.18	5.09	5.51	5.96	6.13	6.57	6.23

Indicator	Government expenditure on pre-primary education as % of GDP (%)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil	0.36	0.35	0.32	0.30		0.35	0.37	0.37	0.41	0.41	0.39	0.44		
India	0.04	0.04	0.06		0.05	0.04	0.04	0.04			0.04	0.04	0.05	0.05
China	0.03													
South Africa		0.07	0.19	0.19	0.01	0.02	0.03	0.03	0.03	0.03	0.05	0.06	0.08	0.09
Russian Federation		0.44	0.48	0.56	0.55	0.54	0.52	0.54		0.62				

Indicator	Government expenditure on primary education as % of GDP (%)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
South Africa	2.71	2.57	2.34	2.29	2.11	2.14	2.27	2.39	2.19	2.07	2.26	2.53	2.48	2.62
Brazil	1.32	1.24	1.17	1.07		1.32	1.54	1.59	1.64	1.72	1.82	1.82		
India	1.30	1.60	1.45		1.28	1.20	1.12	1.09			0.86	0.84	1.03	1.01
China	0.62													
Russian Federation														

Indicator	Government expenditure on secondary education as % of GDP (%)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
South Africa	2.03	1.75	1.65	1.62	1.78	1.88	1.72	1.65	1.74	1.58	1.70	1.87	2.02	1.99
India	1.64	1.70	1.61		1.48	1.37	1.34	1.31			1.12	1.23	1.46	1.45
Brazil	1.38	1.54	1.56	1.53		1.58	1.76	2.17	2.22	2.41	2.51	2.60		
China	0.71													
Russian Federation														

Indicator	Government expenditure on tertiary education as % of GDP (%)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
South Africa	0.92	0.81	0.77	0.76	0.71	0.70	0.80	0.68	0.68	0.66	0.69	0.71	0.72	0.78	0.77
Brazil	0.82	0.89	0.84	0.89		0.76	0.86	0.83	0.82	0.86	0.90	0.95			
India	0.76	0.86			0.71	0.66	0.61	0.63			1.17	1.20	1.29	1.26	
China	0.46														
Russian Federation		0.47	0.54	0.65	0.68	0.65	0.79	0.85		0.95					

Indicator	Government expenditure per primary student (constant PPP$)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil	1181	1200	1171	1118		1513	1852		2251	2520	2705	3011		
China														
India	282	367	346		301						289	307	418	
Russian Federation														
South Africa	1332	1300	1318	1331	1260	1313	1463	1650	1611	1598	1828	2041	2095	2315

Indicator	Government expenditure per secondary student (constant PPP$)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil				1158		1364	1585		2345	2650	2754	3082		
China	397													
India	586	626	604		538	516	516	538			518	578	720	
Russian Federation														
South Africa	1879	1660	1666	1645	1828	1943	1799	1786	1943	1853	2127	2298	2551	2567

Indicator	Government expenditure per lower secondary student (constant PPP$)												
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Brazil	1088	1159	1165	1141		1591	1867		2639	2979	3144	3387	
China	253												
India	457	369	339		285	275	287	306			295	309	420
Russian Federation													
South Africa													

Indicator	Government expenditure per upper secondary student (constant PPP$)												
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Brazil				1189		1014	1151		1879	2132	2144	2612	
China	748												
India	789	999	986		885	844	828	848			790	910	1081
Russian Federation													
South Africa													

Indicator	Government expenditure per tertiary student (constant PPP$)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	6240	6231	5317	5061		3858	4220		3859	3755	3813	4064			
China	3095														
India		2393			1862	1769	1786	1830			2957	2928	2702	2627	
Russian Federation		1457	1536	1758	1818	1860	2313	2619		3251					
South Africa															4841

Indicator	Pupil-teacher ratio in pre-primary education (headcount basis)													
Time	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil	19	19	19	23	18	18	18		20	19	18	18	17	17
China	27	27	26					23	22	22	23	24	23	23
India		35		40	40	41	41	40						
Russian Federation	7	7	7	7	7	7	7	7	7	8	8			9
South Africa														

Indicator	Pupil-teacher ratio in primary education (headcount basis)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	26	25	23	22	22	21	21		24	23	23	22	21	21	
China			22		21			18	18	18	17	17	17	18	
India	35	40	40	41	41								35		
Russian Federation	18	18	17	17	17		17	17	17	17	18			20	
South Africa	35	33	37	34	34	34	30	31	31	30	31	30	29	30	29

Indicator	Pupil-teacher ratio in secondary education (headcount basis)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil				19	17	16	15		19	17	17	17	16	16
China		17	19	19	19			18	16	16	16	15	15	15
India	34	34	33	32	32	33					25	25	26	
Russian Federation							10	9	9	9	8			9
South Africa	29	28	27	30	30	31	33	30	29	28	25			

Indicator	Pupil-teacher ratio in lower secondary education (headcount basis)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil	23	23	20	20	17	16	16		20	18	18	18	18	17
China	17	18	19	19	20			17	16	16	15	15	14	14
India		36	35	36		37					30	31	33	
Russian Federation														
South Africa														

Indicator	Pupil-teacher ratio in upper secondary education (headcount basis)													
Time	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil				18	17	16	15		17	16	15	15	15	15
China		16	20	20	17			18	16	16	16	16	16	15
India		31	31	28		28					21	21	21	
Russian Federation														
South Africa														

Indicator	Pupil-teacher ratio in tertiary education (headcount basis)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil	14	15	15	15	13	14	16		14	16	18	19	19	20
China	13	14	16	18	20	22	15	18	17	17	20	20	19	
India		24	24	25	26	22								
Russian Federation		12	13	14	15	14	14	14	14	14	14			14
South Africa														

Indicator	Gross enrolment ratio, pre-primary, both sexes (%)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	57.5	60.3	65.1	65.7	67.0	63.8	69.0								
China	36.1	38.6	39.4	37.6	39.8			47.3	49.7	51.2	53.1	56.0	62.0	69.9	
India	19.1	24.6	25.5	29.2	33.2	34.7	39.8	40.4	47.9	54.5	54.1	55.8	58.1		
Russian Federation	71.5	74.7	80.9	83.1	83.6	84.7	86.2	87.8	89.5	89.9	89.9		88.9	90.9	
South Africa	20.8	32.5	36.6	32.7	35.9	40.6	46.3	49.6	53.9	59.1	66.1	73.8	72.0	76.5	75.8

Indicator	Gross enrolment ratio, primary, both sexes (%)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	154.0	150.3	148.1	146.0	141.8	140.6	136.3								
China			105.3	108.4	111.8			118.8	123.5	127.7	129.5	128.9	127.9	127.9	
India	94.4	96.3	96.3	97.0	105.4				114.3	115.2	113.9	113.5	112.6		
Russian Federation	103.2	103.0	106.3	114.1	121.2		95.3	94.9	95.4	97.1	98.7		100.3	100.6	
South Africa	113.0	106.5	105.9	106.8	107.4	107.8	107.0	107.3	109.0	108.2	106.5	104.4	102.3	101.6	100.8

Indicator	Gross enrolment ratio, secondary, both sexes (%)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil				109.6	101.9	105.6	105.5								
China	58.2	58.0	58.1	58.4	60.2			67.0	71.3	75.4	79.2	83.1	86.6	89.0	
India	44.2	46.1	46.3	48.2	50.7	52.5	55.1	56.1	58.7	61.9	61.3	65.1	68.5		
Russian Federation	92.3				91.7	85.5	83.2	83.0	83.2	83.3	84.9		91.9	95.3	
South Africa	87.5	84.3	85.3	86.4	87.6	90.0	91.0	93.6	94.4	92.3	93.8	95.4	98.5	101.9	110.8

Indicator	Gross enrolment ratio, lower secondary, both sexes (%)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	114.9	120.1	122.7	125.5	114.7	114.1	113.7								
China	76.0	75.5	77.0	78.5	82.0			90.0	92.0	94.0	96.7	99.8	102.7	103.5	
India	60.9	61.6	62.0	64.5	67.0	69.5	73.3	74.0	78.7	79.8	77.7	83.0	86.5		
Russian Federation	93.1	92.5	91.7	91.3	89.3	80.3	78.2	78.9	80.7	82.9	86.2		92.7	93.9	
South Africa	98.5	96.5	98.7	100.0	92.3	94.5	97.4	98.2	93.8	92.1	98.1	104.6	109.0	111.0	118.0

Indicator	Gross enrolment ratio, upper secondary, both sexes (%)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil				89.4	85.7	94.7	95.0								
China	37.1	36.7	35.3	35.2	37.0			47.6	54.0	59.9	64.5	69.1	73.0	76.6	
India	30.9	33.7	33.9	35.4	38.1	39.3	41.2	42.4	43.3	48.3	48.8	51.4	54.8		
Russian Federation	90.2				96.8	96.5	92.9	90.4	87.8	84.1	82.5		90.2	98.3	
South Africa	79.9	76.0	76.2	77.3	84.5	87.1	86.8	90.5	94.8	92.5	91.1	89.5	91.7	96.0	106.0

Indicator	Gross enrolment ratio, post-secondary non-tertiary, both sexes (%)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil															
China	2.9	2.6	1.9	1.7	1.4			0.4	0.4	0.4	0.4		0.4	0.3	
India	0.2	0.6	0.8	0.8	0.8	0.7	0.8	1.2	1.3				4.4		
Russian Federation				5.0	4.7	8.8	8.1	7.3	6.9	6.6	6.0		5.5	5.5	
South Africa	8.1	8.2	7.1	8.2	8.6	9.0	7.4				7.3	7.1	7.9	10.7	27.8

Indicator	Gross enrolment ratio, tertiary, both sexes (%)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil	14.5	16.0	17.7	20.0	22.2	23.7	25.5							
China	6.6	7.8	9.8	12.4	15.0	17.0	18.3	19.5	20.0	20.2	21.8	23.3	24.3	26.7
India		9.5	9.8	10.4	10.9	11.2	11.0	11.8	13.5	15.4	16.4	18.2	23.3	24.8
Russian Federation	51.4	55.4	61.2	66.6	70.5	70.5	72.6	72.9	74.1	75.0	75.5		76.5	76.1
South Africa														19.7

Indicator	School life expectancy, primary to tertiary, both sexes (years)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil				14.6	14.0	14.3	14.2							
China			9.3	9.6	10.0			10.9	11.4	11.8	12.1	12.4	12.6	13.1
India		8.5	8.5	8.7	9.4				10.5	10.8	10.8	11.1	11.7	
Russian Federation	12.1				13.5		13.6	13.6	13.7	13.8	14.0		14.5	14.7
South Africa														13.6

Indicator	School life expectancy, pre-primary, both sexes (years)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	1.7	1.8	2.0	2.0	2.0	1.9	2.1								
China	1.1	1.2	1.2	1.1	1.2			1.4	1.5	1.5	1.6	1.7	1.9	2.1	
India	0.6	0.7	0.8	0.9	1.0	1.0	1.2	1.2	1.4	1.6	1.6	1.7	1.7		
Russian Federation	2.9	3.0	3.2	3.3	3.3	3.4	3.4	3.5	3.6	3.5	3.6		3.5	3.6	
South Africa	0.2	0.3	0.4	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.7	0.7	0.7	0.8	0.8

Indicator	School life expectancy, primary, both sexes (years)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil	6.1	5.9	5.8	5.8	5.7	5.6	5.5								
China			5.3	5.4	5.6			5.9	6.1	6.3	6.3	6.3	6.3	6.4	
India	4.7	4.8	4.8	4.8	5.3				5.7	5.8	5.7	5.7	5.6		
Russian Federation	3.1	3.1	3.1	3.4	3.6		3.8	3.8	3.8	3.9	3.9		4.0	4.0	
South Africa	7.9	7.5	7.4	7.5	7.5	7.6	7.5	7.5	7.6	7.6	7.5	7.3	7.2	7.1	7.1

Indicator	School life expectancy, secondary, both sexes (years)														
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Brazil				7.7	7.1	7.3	7.3								
China	3.5	3.5	3.4	3.5	3.6			4.0	4.3	4.5	4.7	4.9	5.1	5.3	
India	3.1	3.2	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.3	4.3	4.5	4.8		
Russian Federation	6.5				6.3	6.2	6.1	6.1	6.1	6.1	6.2		6.6	6.8	
South Africa	4.4	4.3	4.3	4.4	4.4	4.5	4.6	4.7	4.7	4.6	4.7	4.8	4.9	5.1	5.5

Indicator	School life expectancy, tertiary, both sexes (years)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil	0.7	0.8	1.0	1.1	1.3	1.3	1.4							
China	0.3	0.4	0.5	0.6	0.7	0.9	0.9	1.0	1.0	1.0	1.1	1.2	1.2	1.3
India		0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.8	0.8	0.9	1.2	1.2
Russian Federation	2.6	2.8	3.1	3.3	3.5	3.5	3.6	3.6	3.7	3.8	3.8		3.8	3.8
South Africa														1.1

Indicator	Repetition rate in primary education (all grades), both sexes (%)												
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Brazil	24.14	20.95	20.25	19.48	20.20	18.35			11.70	10.61	9.14	8.54	
China			0.29	0.31				0.24	0.28	0.27	0.27	0.25	0.17
India	4.27	3.69	3.69	3.92					3.58			4.99	
Russian Federation	1.10	1.02	0.87	0.73			0.55	0.48	0.42	0.39			0.37
South Africa	8.25	9.32	7.45	5.22	7.93								

Indicator	Repetition rate in lower secondary general education (all grades), both sexes (%)												
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Brazil									18.64	17.94	16.21	15.82	
China									0.14	0.11	0.10	0.09	
India				5.09								3.42	
Russian Federation			0.95	0.82	0.75	0.72	0.63	0.49	0.43	0.41			0.37
South Africa	16.24		9.76	6.87	13.01								

Indicator	Youth literacy rate, population 15-24 years, both sexes (%)															
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Brazil		94.2				96.8		97.6	97.8	97.8	98.1	97.5	98.5	98.6			98.9
China		98.9										99.6					99.7
India			76.4					81.1									90.2
Russian Federation				99.7								99.7					99.7
South Africa									97.6		98.4	98.6	98.8	98.9			99.0

Indicator	Adult literacy rate, population 15+ years, both sexes (%)															
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Brazil		86.4				88.6		89.6	90.0	90.0	90.3	90.4	91.4	91.3			92.6
China		90.9										95.1					96.4
India			61.0					62.8									71.2
Russian Federation				99.4								99.7					99.7
South Africa									88.7		92.9	92.9	93.1	93.7			94.3

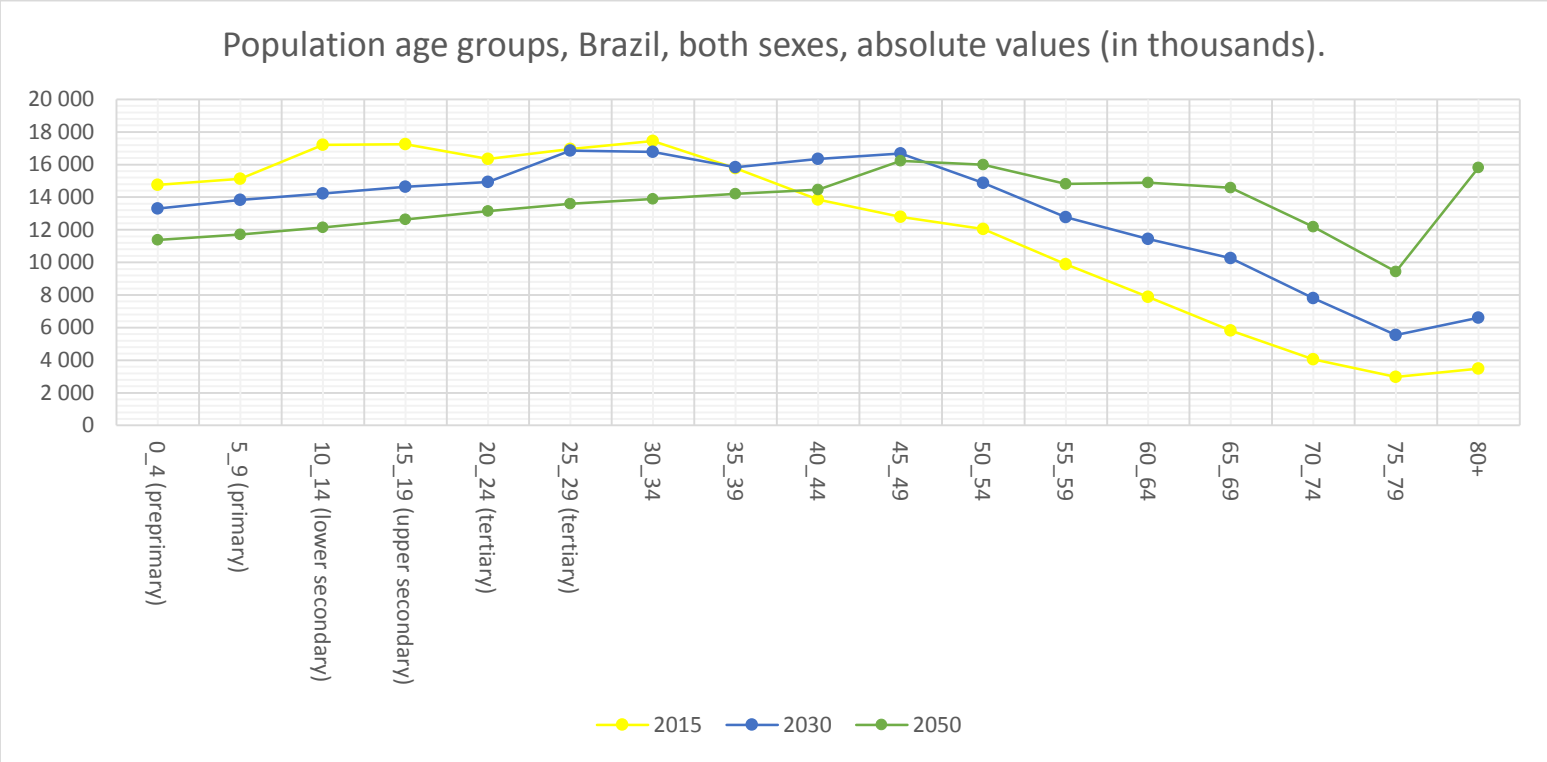
Indicator	Old-age literacy rate, population 65+ years, both sexes (%)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil		62.0				65.8		68.1	68.9	69.1	69.2	70.6	72.0	72.8
China												73.9		
India			35.6					35.2						
Russian Federation				97.6								99.2		
South Africa									56.4		67.9	67.2	67.7	69.1

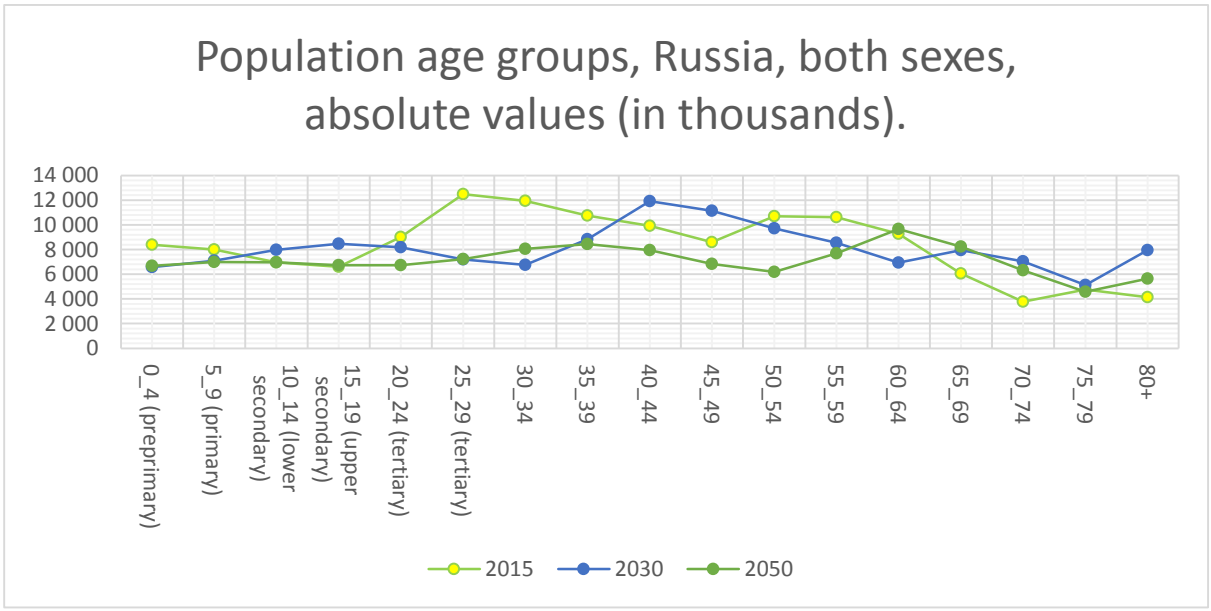
Indicator	Net flow of internationally mobile students (inbound - outbound), both sexes (number)													
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil				-18520	-19087	-18414					-10168	-13263	-15438	-15508
China								-370495	-387820	-408457	-455729	-496511	-570697	-605386
India		-55588	-66711	-92377	-111420	-126493	-134958	-133399					-176718	-161137
Russian Federation		12824	34271	36034	31625	38125	51192	35910	16984	92180	82158		114478	122456
South Africa	30062	39887	33948	40408	43725	45333	44556	47917	53282	58335	54365	59696	64152	35802

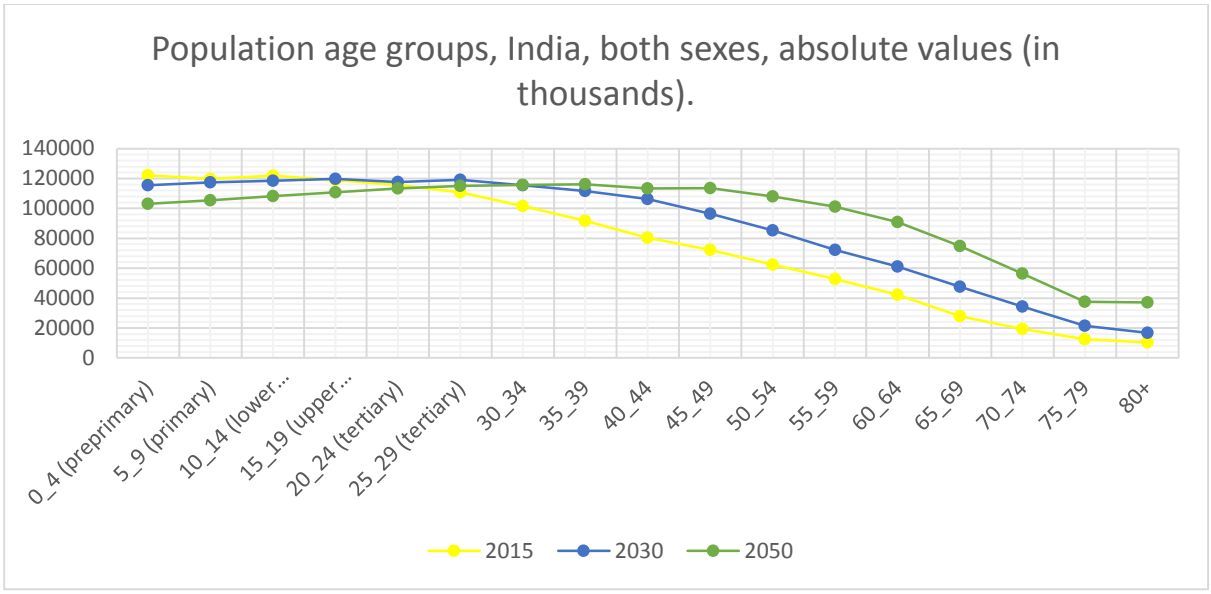
R&D per 1,000 adults	2000	2005	2010
Brazil	1.1	1.5	1.8
Russian Federation	8.4	7.5	6.9
India	0.5	0.5	0.5
China	0.4	0.5	0.9
South Africa		0.9	0.8

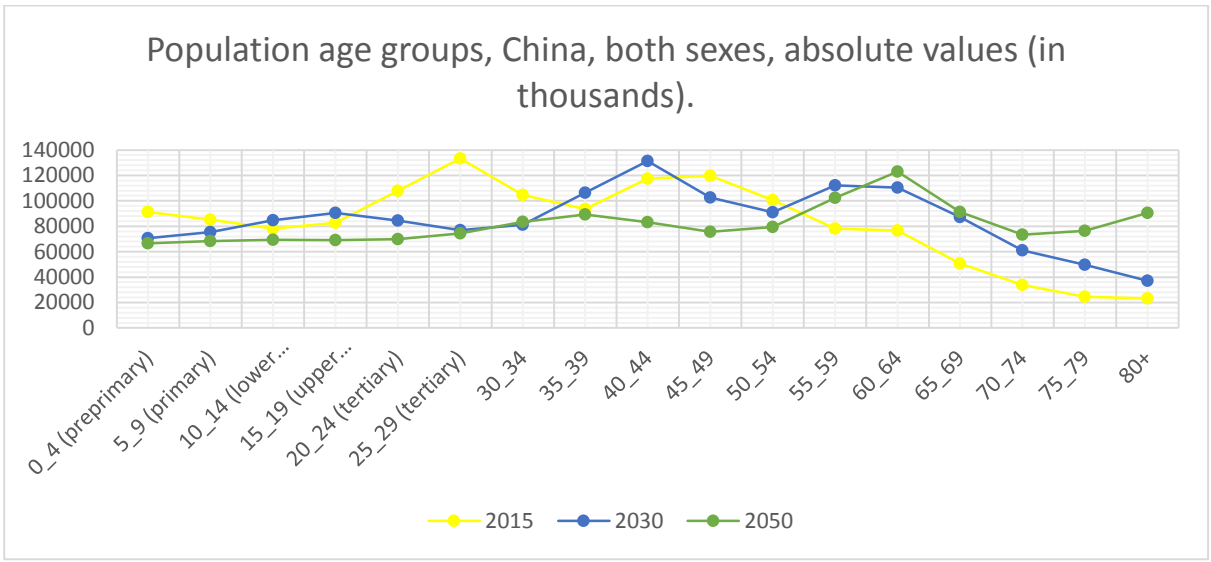
Indicator	GERD per capita (in current PPP$)																
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Brazil					71.7	75	72.8	72.1	72.7	82.6	90.9	106.5	115.1	119.9	128.7	139.3	
China	9.3	11.7	12.8	16.1	21.1	24.5	30.4	35.9	43.8	53.9	65.2	76.4	89.4	113.1	129.8	150.1	176.7
India	7.8	8.8	9.5	10.6	11.6	11.9	12.1	13	15	18.1	19.8	21.8	24.2	25.5	27.3	29.6	
Russian Federation	53.3	59.5	52.1	58.9	71.6	86.6	100	118.8	117.6	125.9	159.3	184.7	209.2	240.9	230.2	245.3	264.4
South Africa		37.1				50.7		58.8	66.6	75.8	84.4	89.1	93.8	85.8	77.5		

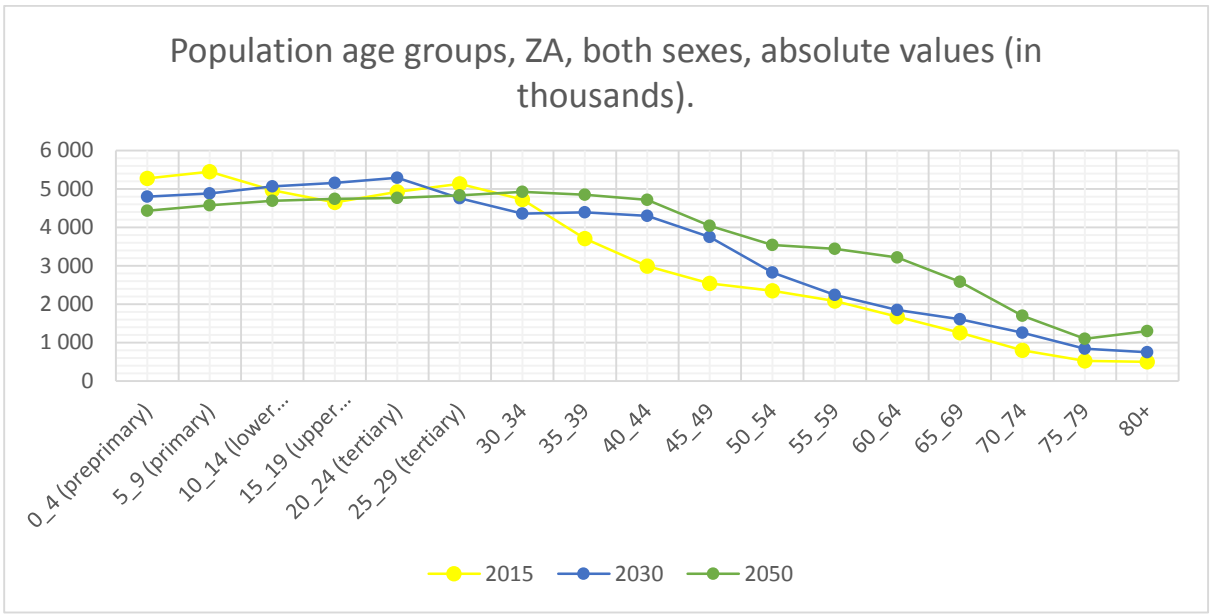
APPENDIX 2 – POPULATION FORECASTS, AGE-GOUPS, ABSOLUTE (Source: Author's elaboration based on data from UNDESA)



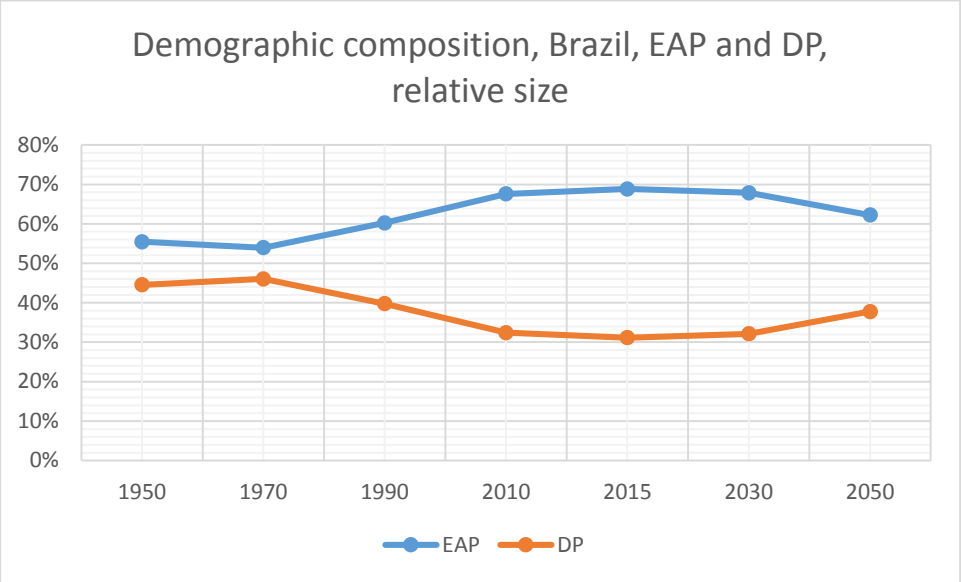


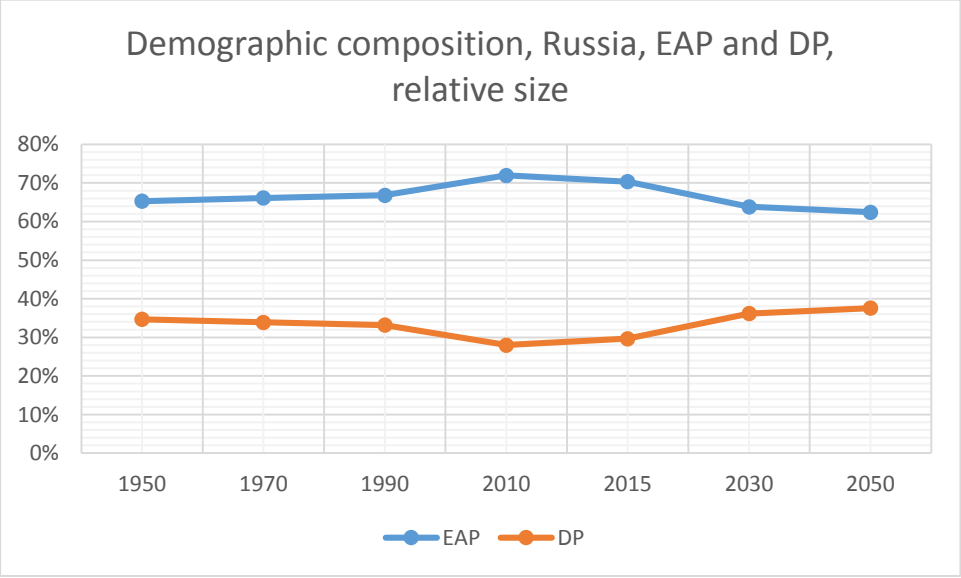

Population age groups, India, both sexes, absolute values (in thousands).
140000
120000
100000
80000
60000
40000
20000
0
0_4 (preprimary)
5_9 (primary)
10_14 (lower...
15_19 (upper...
20_24 (tertiary)
25_29 (tertiary)
30_34
35_39
40_44
45_49
50_54
55_59
60_64
65_69
70_74
75_79
80+
2015
2030
2050

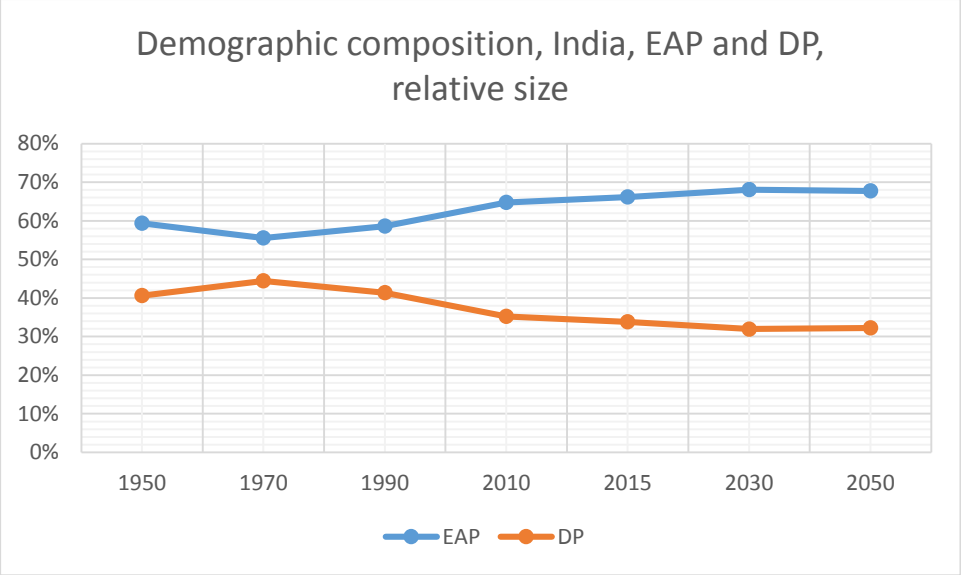

Population age groups, China, both sexes, absolute values (in thousands).
140000
120000
100000
80000
60000
40000
20000
0
0_4 (preprimary)
5_9 (primary)
10_14 (lower...
15_19 (upper...
20_24 (tertiary)
25_29 (tertiary)
30_34
35_39
40_44
45_49
50_54
55_59
60_64
65_69
70_74
75_79
80+
2015
2030
2050

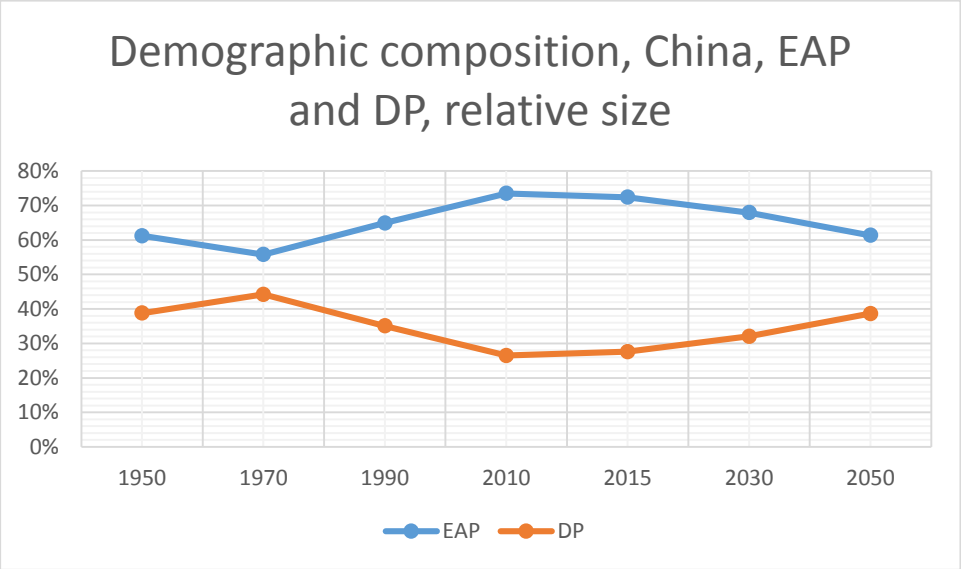

Population age groups, ZA, both sexes, absolute values (in thousands).
6 000
5 000
4 000
3 000
2 000
1 000
0
0_4 (preprimary)
5_9 (primary)
10_14 (lower...
15_19 (upper...
20_24 (tertiary)
25_29 (tertiary)
30_34
35_39
40_44
45_49
50_54
55_59
60_64
65_69
70_74
75_79
80+
2015
2030
2050

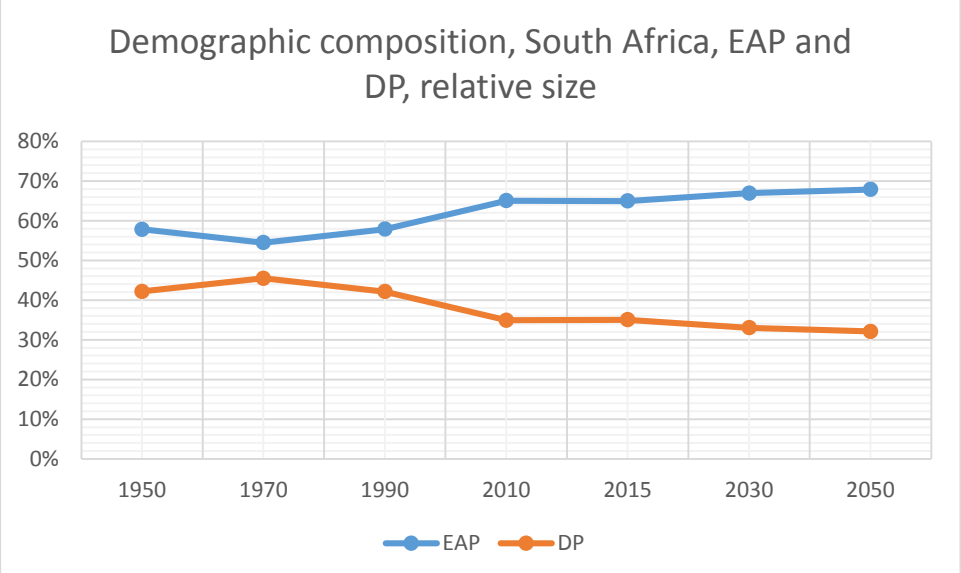
APPENDIX 3 – POPULATION FORECASTS, EAP x DP (Source: Author's elaboration based on data from UNDESA)






Demographic composition, India, EAP and DP, relative size
80%
70%
60%
50%
40%
30%
20%
10%
0%
1950
1970
1990
2010
2015
2030
2050
EAP
DP


Demographic composition, China, EAP and DP, relative size
80%
70%
60%
50%
40%
30%
20%
10%
0%
1950
1970
1990
2010
2015
2030
2050
EAP
DP


Demographic composition, South Africa, EAP and DP, relative size
80%
70%
60%
50%
40%
30%
20%
10%
0%
1950
1970
1990
2010
2015
2030
2050
EAP
DP