Can demographically caused cognitive decline in China and India be offset by investments in education?

/ Extended abstract /

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Introduction

China and India are key countries among the BRICS - large and growing economies and constituting the world's two largest populations, constituting more than a third of the world's 7 billion in 2010 (1.359 billion in China and 1.232 billion in India). They are also undergoing population ageing, with China being at much more advanced stage than India (UN 2011). There is considerable concern to how well these countries will age – will their health and productivity reduce due to growing shares of elderly in the population?

The implications of demographic changes will in part depend on cognitive health and cognitive functional level. Cognition is an important determinant of productivity and the length of the working life in modern knowledge-based economies. Cognitive abilities have been shown to be important for determining both productivity and work, but also health and general functioning (Gottfredson 2004; Bosse et al. 1987; Schmidt and Hunter 2004).

China is demographically older than India due to its lower mortality and fertility - and experiences more rapid ageing of the population – which, ceteris paribus, could lower the country's relative cognitive level. However, there are considerable differences in the age-specific cognitive functioning levels across the two countries. Future investments in education and health may potentially outweigh the adverse effects of population ageing and shrinking. Although a nations' population may age and shrink, greater human capital investments can possibly offset these effects. This study aims to project the net effects of both demographic change and investments in human capital.

Data & Method

Our study focuses on cognition – one of the components of human capital – including comparable measures of cognitive abilities. Cognitive function (as observed in standardized tests such as TIMSS or PISA scores) has been shown to be an important determinant of national productivity.

We use data from the WHO Study on Global Ageing and Adult Health (SAGE), wave 1 (2007-2010) in estimation of cognition profiles by age and sex in China and India. We focus on two comparable measures of cognitive abilities, which are relevant for both potential job performance and health (Alzheimer's disease international 2010; Brækhus, Øksengård, and Engedal 1998; Ardila et al. 2000):

- verbal fluency – a measure of vocabulary size, number of animals one can name within one minute;
- immediate recall – a measure of short term memory, 10 simple words are read out (in local language) and the respondent has one minute to recall as many of these words as possible.

In order to identify the amount of improvement necessary to alleviate or even increase cognition levels, in spite of the impact of a population with lower size and an older age distribution, we use our findings on cognition together with new demographic projections by age, sex and education made by the Wittgenstein Center for Demography and Global Human Capital (IIASA, VID and WU) /WiC/ for the period 2010-2060. In this extended abstract, we present only findings based on immediate recall scores.

Education and cognition

Brain functioning relies on health status, genetic potential, a range of social stimuli and experiences, where education can be one important factor. Recent evidence has improved our understanding of to which extent education is in fact causally affecting cognition. There are large differences across countries in terms of cognitive ageing, where some countries have a much better average functional level at a given age – although age variation tends to be similar (Skirbekk et al. 2012). Differential investment in education could be one cause of this. Longitudinal studies show that education and mental activity in youth and adult life is related to a greater cognitive performance, net of initial ability (Deary et al. 2007; Husén and Tuijnman 1991; Whalley and Deary 2001), particularly for academic track education (Becker et al. 2012). Evidence of extensions to school length suggests a positive causal relation between education and IQ levels (Cascio and Lewis 2006; Falch and Massih 2011; Brinch and Galloway 2012). Further, comparisons of the cognitive outcomes of monozygotic twins with different education levels suggest that schooling significantly improves cognitive functioning, even when genetic differences may be dominant for certain subjects (Haworth, Daleb, and Plomin 2008). Also MRI analyses identified changes in neurological structures, with a growth in language related brain areas (hippocampal volumes and cortical thickness) associated with improved skills following education (Mårtensson et al. 2012).

Demographic changes

Rapid demographic change in terms of ageing could affect cognitive levels, and more so in China than in India due to stronger age structure shifts (see Figures 1a and b, and Table 1). Figure 2 shows the baseline (2010) estimates of age and sex-variation in immediate recall for India and China.

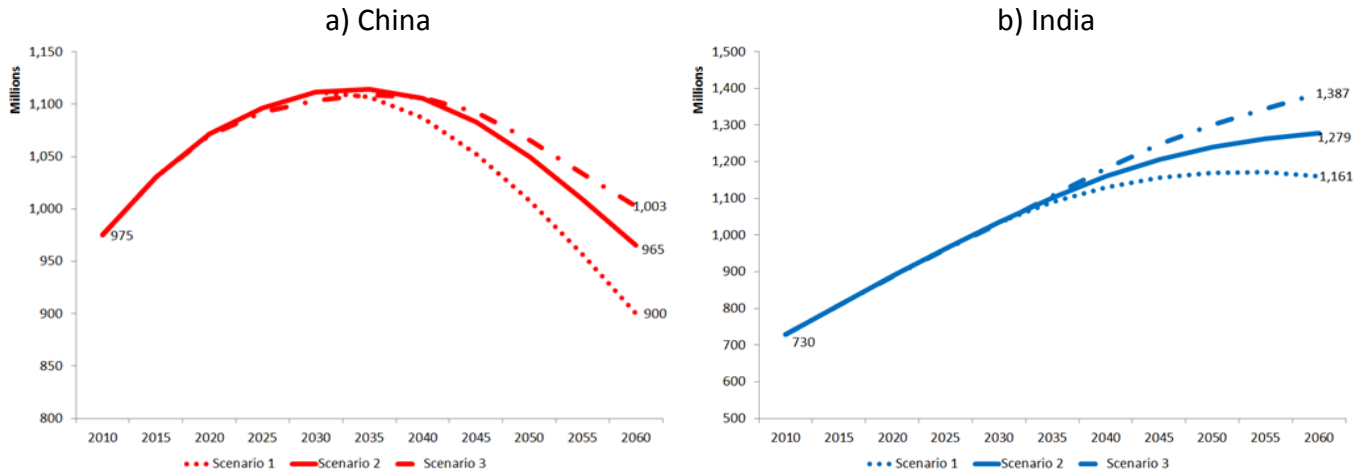
According to the population projections by the Wittgenstein Centre (medium SSP scenario –SSP2) India will overtake China in terms of population at age 20 and above. In China this age group will increase from 0.975 to 1.114 billion until 2035, but after this time period it will start decreasing. In 2060 there will be 0.965 billion

Chinese in this age group. Whereas, in India there will be an increase of population during the whole period under consideration – from 0.730 billion to 1.279 billion in 2060.

Moreover, China will face stronger population ageing than India. The share of population at age 50+ among 20+ will grow from 33.5% to almost 62% – in India from 26.7% to 48.4%, see Table 1. These findings suggest that from an age-structure perspective, India will be younger than China. India may potentially benefits from a greater relative share in typical working ages. Clearly, population size can have independent effects on economic outcomes, but these effects are not discussed here.

Reasons to believe that human capital may improve along cohort lines – continuation of current trends and foreseeable educational growth – suggest improved skills.

Figure 1 a) and b). Population size aged 20 and above in China and India in 2010-2060



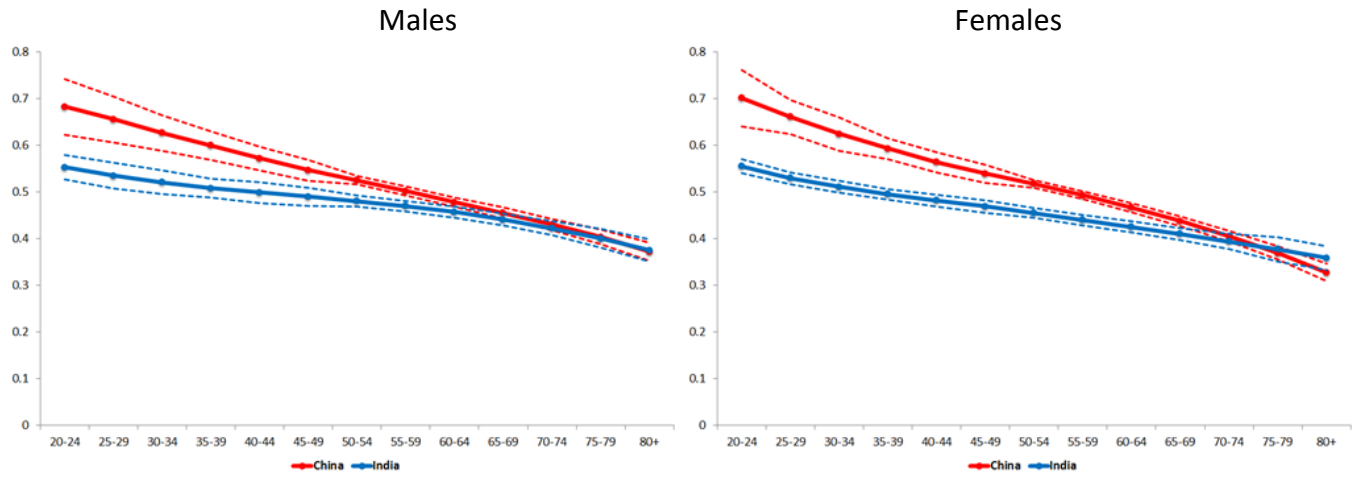
Source: SSP2 scenarios, (WiC, 2012)

Table 1. Percentage of people at age 50 and above among population at age 20 and above

Country	2010	2060
China	33.5	61.9
India	26.7	48.4

Source: Own calculations based on WiC 2012

Figure 2. Average Immediate Recall Score by age and sex in China and India



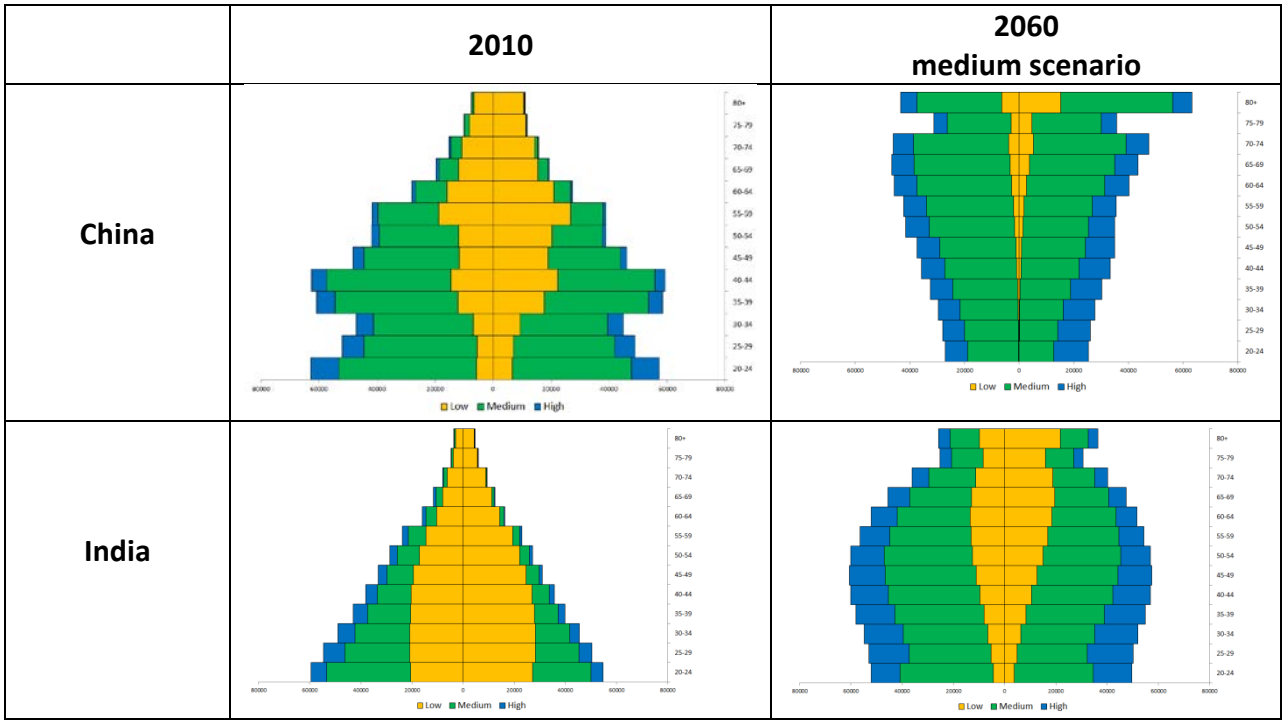
Source: Own estimates based on (WHO, 2010)

Educational distribution by age and sex

The population projection by age, sex and education suggests a significant development in education in China and India. In 2010 China had around 65% of population at age 20 and above with at least secondary education, whereas India only 41%. Despite more dynamic change in education in India in 2010-2060, China is expected to be better educated society than India in 2060. Only 7 % of the population will have education attainment on the level of primary completed or below – In India 23%. This means that from educational perspective China may have an advantage over India.

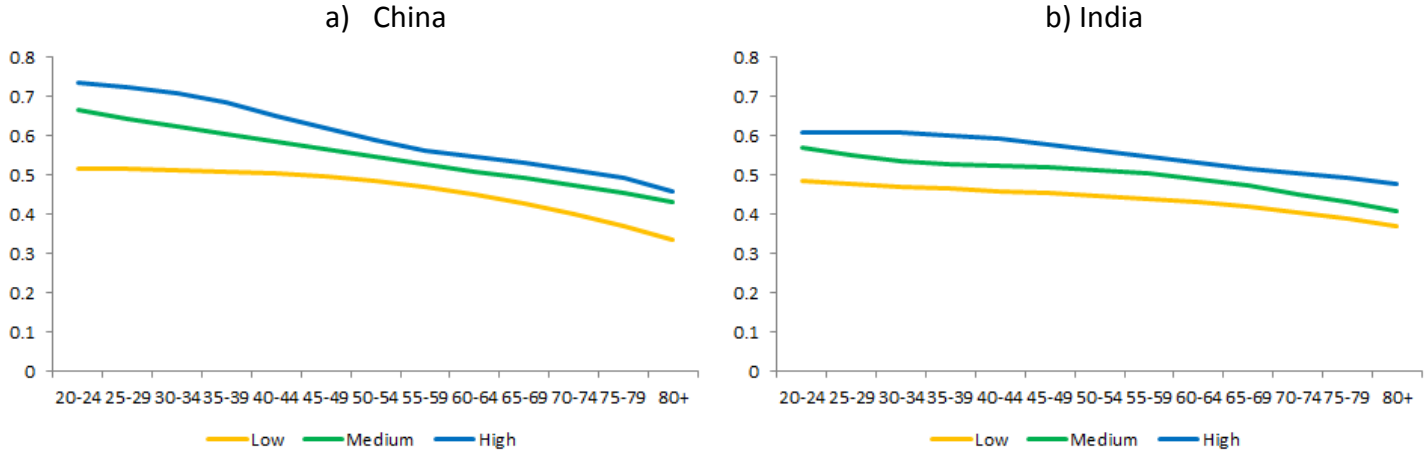
Figure 3 shows current and projected educational distributions by age and sex for China and India for 2010 and projections for 2060. Figure 4 and 5 show the distribution of cognition by education levels of the two countries by age and sex.

Figure 3. Education distributions in China and India in 2010 and 2060



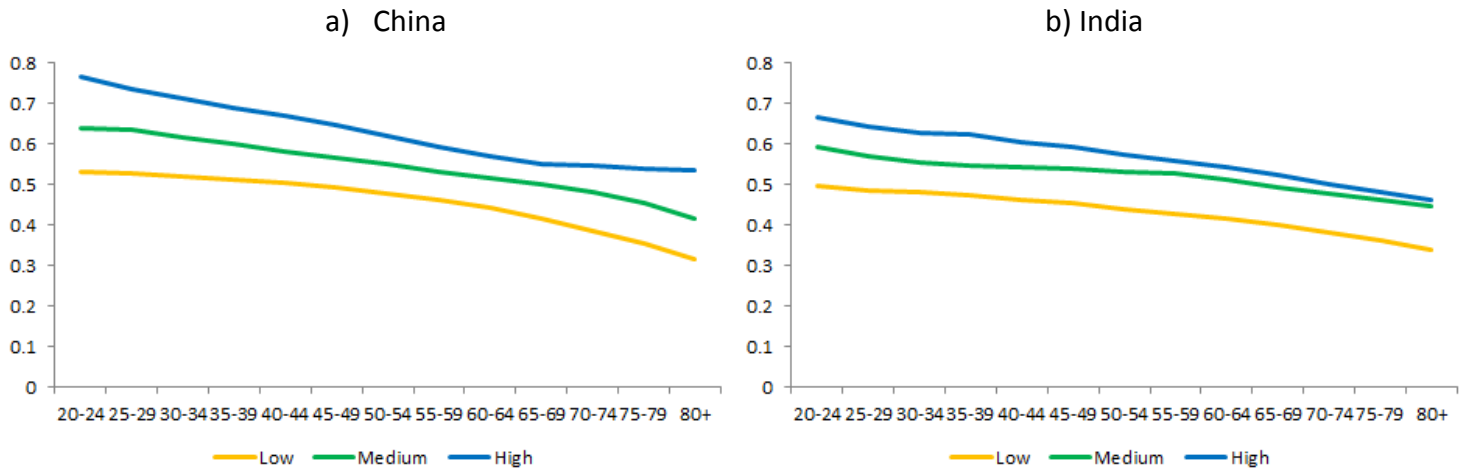
Source: (WiC, 2012)

Figure 4. Average Immediate Recall Scores by age and education among *males* in China and India



Source: Own estimates based on (WHO, 2010)

Figure 5. Average Immediate Recall Scores by age and education among *females* in China and India



Source: Own estimates based on (WHO, 2010)

Scenarios

Several scenarios of development of cognition are proposed:

- Scenario 1: Stable cognition profiles by age and sex from baseline year,
- Scenario 2: Fixed cognition profiles by age, sex and education from baseline year,
- Scenario 3: Development in cognition assuming fixed cohort effects which enable China and India by 2060 to reach the cognitive levels by age and sex of Denmark today (which has one of the highest observed cognitive performance levels by age and sex).

Findings

Figure 6 shows the projection findings for the four scenarios.

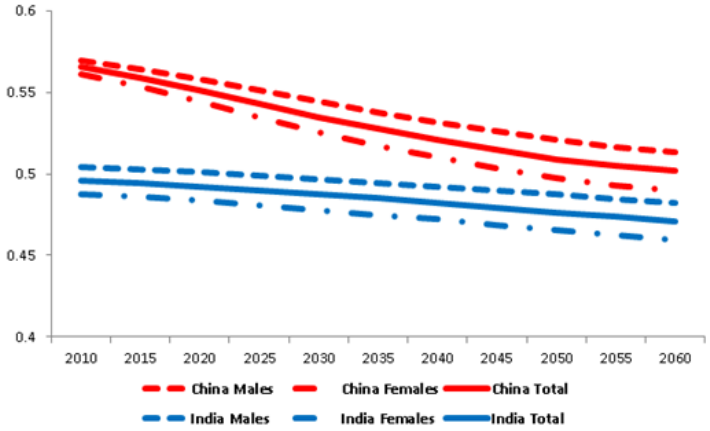
Scenario 1 shows that the average cognition of India and China will decrease over time. The more rapid ageing of the Chinese population imply a lower discrepancy between the two nations.

Findings from Scenario 2 show that the projected education increase may imply an increase in average recall scores for India in spite of ageing, while China sees a slight decline. Here the association between education and cognition is assumed to be constant by sex and age (as shown in Figure 4 and 5).

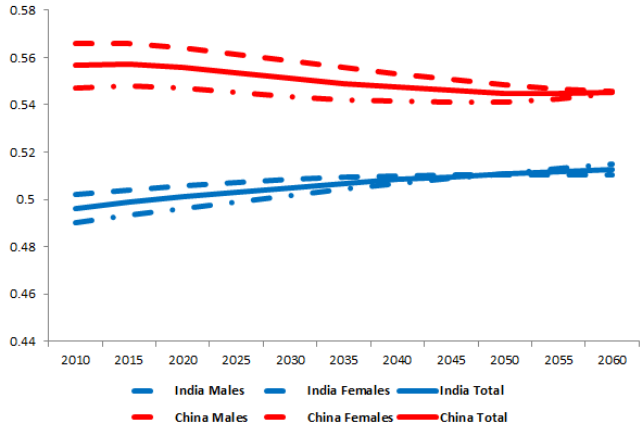
Scenario 3 shows the hypothetical case where both countries reach the level of Denmark by 2060. These results imply that India would overtake China in terms of cognitive performance due to its younger population.

Figure 6. Projected cognition per capita by gender in China and India in 2010-2060

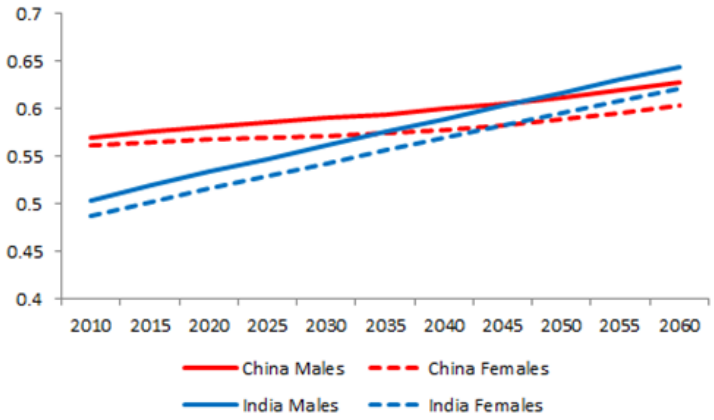
a) Scenario 1



b) Scenario 2



c) Scenario 3



Source: Own calculations

Conclusion

Unprecedented growth of the elderly population shares is experienced in China and India, and this study focuses on the implications for overall cognitive functioning development in these countries. Age-related decline in certain cognitive abilities can imply a decrease in overall cognition levels. Although the cognitive ability levels among the 50 plus are lower in India, China ages faster than India – leading to the average cognition levels to fall faster in China and reducing the differences between the two countries. Improvements in education levels, however, could potentially have an opposing effect. We estimate that projected educational increases could lead to a stabilization of our human capital measure for China and a slight increase for India, in spite of ageing.

References

Alzheimer's disease international. 2010. *World Alzheimer Report 2010 - The Global Economic Impact of Dementia*.

Ardila, Alfredo, Feggy Ostrosky-Solis, Mónica Rosselli, and César Gómez. 2000. "Age-Related Cognitive Decline During Normal Aging: The Complex Effect of Education." *Archives of Clinical Neuropsychology* 15 (6): 495–513. doi:10.1016/S0887-6177(99)00040-2.

Becker, Michael, Oliver Lüdtke, Ulrich Trautwein, Olaf Köller, and Jürgen Baumert. 2012. "The Differential Effects of School Tracking on Psychometric Intelligence: Do Academic-track Schools Make Students Smarter?" *Journal of Educational Psychology* 104 (3): 682–699. doi:10.1037/a0027608.

Bosse, R., C. M. Aldwin, M. R. Levenson, and D. J. Ekerdt. 1987. "Mental Health Differences Among Retirees and Workers: Findings from the Normative Aging Study." *Psychology and Aging* 2 (4): 383–89.

Brækhus, A., A. Øksengård, and K. Laake Engedal. 1998. "Subjective Worsening of Memory Predicts Dementia After Three Years." *Norwegian Journal of Epidemology* 8: 189–194.

Brinch, C., and T. Galloway. 2012. "Schooling in Adolescence Raises IQ Scores." *Proceedings of the National Academy of Science* 109 (2): 425–430.

Cascio, E.U., and E.G. Lewis. 2006. "Schooling and the Armed Forces Qualifying Test. Evidence from School-entry Laws." *J Hum Resour* 41: 294–318.

Deary, Ian J., S. Strand, P. Smith, and C. Fernandes. 2007. "Intelligence and Educational Achievement." *Intelligence 35 (2007) 13–21* 35: 13–21.

Falch, T., and S. Massih. 2011. "The Effect of Education on Cognitive Ability." *Econ Inquiry* 49: 838–856.

Gottfredson, L. S. 2004. "Intelligence: Is It the Epidemiologists' Elusive 'Fundamental Cause' of Social Class Inequalities in Health?" *Journal of Personality and Social Psychology* 86 (1): 174–99.

Haworth, C., P. Daleb, and R. Plomin. 2008. "A Twin Study into the Genetic and Environmental Influences on Academic Performance in Science in Nine Year Old Boys and Girls." *International Journal of Science Education* 30 (8): 1003–1025.

Husén, T., and A. Tuijnman. 1991. "The Contribution of Formal Schooling to the Increase in Intellectual Capital." *Educational Researcher* 20 (7): 17–25.

Mårtensson, Johan, Johan Eriksson, Nils Christian Bodammer, Magnus Lindgren, Mikael Johansson, Lars Nyberg, and Martin Lövdén. 2012. "Growth of Language-related Brain Areas After Foreign Language Learning." *NeuroImage* 63 (1): 240–244. doi:10.1016/j.neuroimage.2012.06.043.

Schmidt, F., and J. Hunter. 2004. "General Mental Ability in the World of Work: Occupational Attainment and Job Performance." *Journal of Personality and Social Psychology* 86 (162-173). doi:10.1037/0022-3514.86.1.162.

Skirbekk, Vegard, Elke Loichinger, and Daniela Weber. 2012. "Variation in Cognitive Functioning as a Refined Approach to Comparing Aging Across Countries." *Proceedings of the National Academy of Sciences* 109 (3): 770–774. doi:10.1073/pnas.1112173109.

UN. 2011. *World Population Prospects*. New York: United Nations Population Division.

Whalley, Lawrence J, and Ian J Deary. 2001. "Longitudinal Cohort Study of Childhood IQ and Survival up to Age 76." *BMJ* 322 (7290): 819. doi:10.1136/bmj.322.7290.819.

World Health Organization. *WHO Study on Global Ageing and Adult Health (SAGE) (WHO, Geneva)*. http://www.who.int/healthinfo/systems/sage/en/index.html.