

Teach your children well: The dynamics of the distribution of educational attainment in Europe

Crespo Cuaresma, Jesus; Sauer, Petra

Published in:
Wirtschaftspolitische Blätter

Published: 01/01/2015

Document Version
Peer reviewed version

[Link to publication](#)

Citation for published version (APA):

Crespo Cuaresma, J., & Sauer, P. (2015). Teach your children well: The dynamics of the distribution of educational attainment in Europe. *Wirtschaftspolitische Blätter*, 3, 579 - 590.

Teach your children well: The dynamics of the distribution of educational attainment in Europe¹

Jesús Crespo Cuaresma (WU, WIC, IIASA, WIFO)

Petra Sauer (WU)

Abstract

The importance of human capital in the form of education as a determinant of economic development has been highlighted in the theoretical and empirical economic growth literature. Less attention has been paid to the distributional characteristics of educational attainment within and across age groups, as well as between males and females. Exploiting new age-structured data on educational attainment, we present an analysis of the degree of equality in the distribution of education in Europe over the last decades, both within and across generations. We highlight the differences existing across European regions and the changes experienced over time, as well as those implied by projected trajectories of educational attainment in the future.

Abstract (Deutsch)

Humankapital in der Form von Bildung nimmt in der theoretischen und empirischen Literatur über die Determinanten von Wirtschaftswachstum eine zentrale Stellung ein. Die Dimension der Verteilung des Bildungsniveaus – innerhalb und zwischen den Generationen sowie zwischen den Geschlechtern – wurde in diesem Zusammenhang nur selten berücksichtigt. Die demographische Struktur von neulich verfügbaren Bildungsdaten ermöglicht uns die Berechnung von alters- und geschlechtsspezifischen Verteilungsmaßen. Diese verwenden wir, um die Entwicklung der Bildungs(un)gleichheit in Europa zu analysieren. Hervorzuheben sind Unterschiede zwischen europäischen Regionen, sowohl hinsichtlich des Niveaus und der Dynamik in den letzten Jahrzehnten, als auch hinsichtlich der damit einhergehenden Ausrichtung der Bildungsexpansion und ihren Verteilungseffekten in der Zukunft.

JEL codes: I24, I25, O50

¹Corresponding author: Jesus Crespo Cuaresma, Department of Economics, Vienna University of Economics and Business (WU); World Population Program, International Institute of Applied Systems Analysis (IIASA); Wittgenstein Centre for Demography and Global Human Capital (WIC) and Austrian Institute for Economic Research (WIFO). Address: Augasse 2-6, 1090 Vienna (Austria). Email: jcrespo@wu.ac.at. The authors acknowledge funding from the European Community's Seventh Framework Programme FP7/2007-2013 under grant agreement 290647, "Welfare, Wealth and Work for Europe".

1. Introduction

The availability of new global data on educational attainment by age and sex (see KC et al., 2014) provides researchers and policy makers with new tools to understand the evolution of human capital and its effects on economic outcomes. Lutz et al. (2008), for instance, use age-structured data on educational attainment for most countries of the world to address the contribution of different age groups to economic growth. The results in Lutz et al. (2008) or Crespo Cuaresma and Mishra (2011) indicate that incorporating the age dimension to educational attainment data adds relevant information which significantly improves the predictive ability of econometric specifications aimed at modeling empirically economic growth differences across countries and over time.

Another line of research on the education-growth nexus enhances the literature as it incorporates the distributional dimension of human capital measures into the analysis. Earlier work in this line of research used the standard deviation of educational attainment in order to investigate its relation to income growth, income distribution and poverty reduction.² In the recent literature, the Gini coefficient of educational attainment, introduced by López, Thomas, and Wang (1998), is more widespread as a measure of educational inequality. In this regard, Checchi (2000) and Castelló-Climent and Doménech (2002) provide evidence on a strong direct negative relation between the education Gini coefficient and income growth, while Sauer and Zagler (2014) show countries that show greater education inequality to experience lower macroeconomic returns to education than more equal economies, on average.

The newly available age-structured information on educational attainment can be used to obtain measures of inequality which shed light on the distribution of education within and across different population subgroups. In this contribution we present an overview of the historical trends and potential future dynamics of the distribution of educational attainment in Europe. In particular, we concentrate on assessing the differential changes in educational attainment and its distribution across broad age groups. This allows us to address changes in the intergenerational persistence of educational attainment, which is at the same time an important measure of equality of opportunity in terms of human capital accumulation and one of the determinants of the future economic growth potential of the continent (see Crespo Cuaresma et al., 2013).

The measures presented in this study provide a set of instruments that can be used to evaluate and inform education policy. The importance of tracking the distributional characteristics of education expansions appears particularly important to assess the potential effects that human capital accumulation is expected to have on future economic growth in Europe.

This paper is organized as follows. Section 2 presents the measures of educational inequality that are used in the analysis and presents some evidence concerning the degree of inequality in the distribution of educational attainment within different age groups for Austria and Italy. Section 3 discusses historical dynamics of the age-specific education distribution and the aggregate mobility indicator in European economies. Thereafter, projections of educational attainment by age are used in order to evaluate potential future trends in the distributional characteristics of educational attainment. Section 4 concludes and draws some policy advice.

² See Birdsall and Londoño (1997), López, Thomas, and Wang (1998), Lam and Levison (1991) or Inter-American Development Bank (1999).

2. Distributional Aspects of Education in Europe: Age-Structured Gini Coefficients

Fan et al. (2001, 2002) use distributional measures based on educational attainment levels to assess the degree of inequality in the distribution of education over the full population. We refine these measures by constructing age and gender-specific indices of inequality in the distribution of education across individuals. The construction of such measures is possible thanks to the availability of reconstructed data on educational attainment by sex and age obtained using multistate back and forward projection. The method of reconstruction and population projection is described, for instance, in KC et al. (2010). We utilize information that spans the period 1960 to 2010, use four educational attainment definitions based on UNESCO's International Standard Classification of Education (ISCED) categories, i.e. no formal education, primary education, at least junior secondary education and tertiary education, combined with the formal duration it takes for completion from the UNESCO Institute for Statistics (UIS) in order to construct historical time series of Gini indices for all European countries, each 5-year age group of the population above 5 years of age, males and females. The education Gini coefficient ranges from zero to unity, with these extremes indicating a perfectly equal or unequal distribution of educational attainment respectively.

The cohort and gender-specific structures in the distribution of education are depicted in Figure 1 for Austria and Italy. Plotting gender-specific education Gini coefficients across age-groups reveals the distributional maturity of education expansion in Austria. With respect to years of schooling, education is almost perfectly equally distributed across all age-groups.³ Differences between males and females are small, with slight differences for persons aged 45 to 49 and 65 to 89 respectively. In Italy, on the other hand, the degree of education inequality is much larger for people aged 70 and above than for cohorts younger than 45. The largest drop in the education Gini took place when the majority of cohorts aged between 55 and 65 completed secondary education, while attaining not more than primary education was still common in their precedent generation. The transition was faster for males, resulting in a temporary gender gap with respect to the education Gini coefficient.

³ The higher education Gini coefficient of the 15-19 age group is mainly due to the majority of young individuals still going to school at this age.

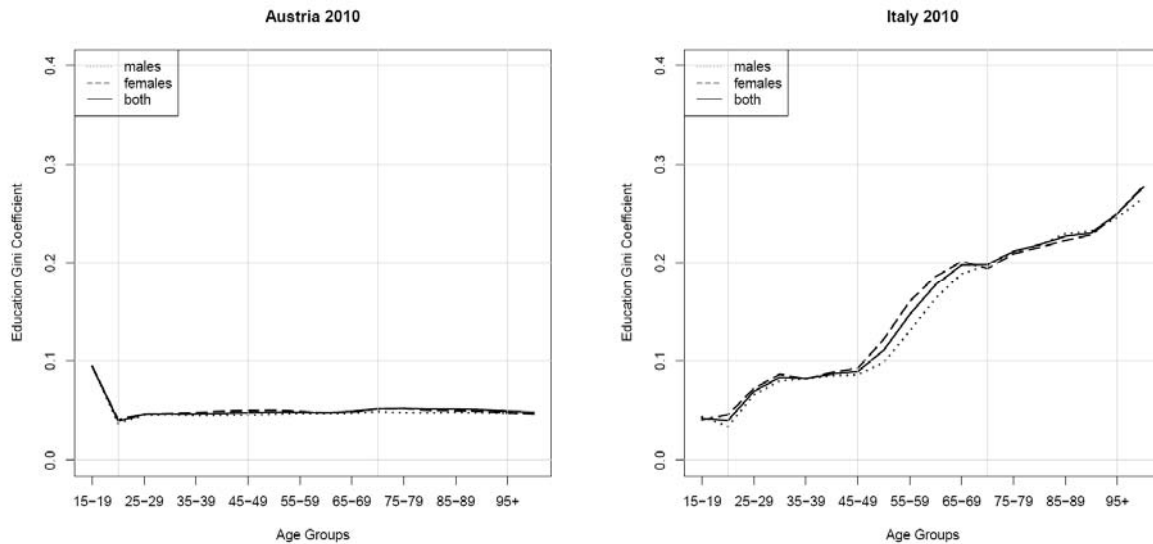


Figure 1: Education Inequality, Austria and Italy 2010.

Although the overall educational attainment level of the two countries is roughly comparable (mean years of schooling for the population above 15 years of age in 2010 was 9.9 for Italy and 11.8 for Austria), the differences in the distribution of education across persons by age and sex may be able to explain differentials in macroeconomic performance when it comes to the mechanisms through which human capital accumulation affects economic growth. In particular, technological progress and the intergenerational persistence of human capital have been shown to be intertwined in theoretical models (see for example Galor and Tsiddon, 1997).

3. Education Inequality and Mobility in Europe: 1960-2050

In this section we offer a more detailed analysis of the education inequality dynamics within Western Europe. In a global context, the distribution of education is relatively equal in European countries (see Crespo Cuaresma et al., 2013). However, there exists a non-negligible degree of heterogeneity within the continent which deserves to be studied in more detail. For our analysis we consider 19 countries and define 4 subregions: the Anglo-Saxon group (United Kingdom, Ireland), the Continental group (Austria, Belgium, France, Germany Luxembourg, Netherlands, Switzerland), the North-European group (Denmark, Finland, Iceland, Norway, Sweden) and the South-European group (Cyprus, Greece, Italy, Malta, Portugal, Spain).

In the left panel of Figure 2, we present the developments of the education Gini index for two broad age groups in these regions over the full 50-years sample period. While black lines depicts the education Gini for people aged 25 to 54, gray lines refers to cohorts older than 55. Processes of education expansion start out among the youth. Already in 1960, education is thus relatively equally distributed within younger cohorts in all subregions. Not before 1990 does the degree of education inequality of the elderly decrease to a similar level. We observe the highest level of education inequality in Southern European countries in 1960. In 2010, the degree of education inequality among young cohorts is practically equal to that in Anglo-Saxon countries, the latter being the only region with a slight increase in education inequality among the youth in the transition to tertiary education expansion in the 1970s. Nordic countries show the largest gap between young and old

cohorts in 1960, they experienced the sharpest decline in education inequality and report the lowest levels for the entire population as of 2010.

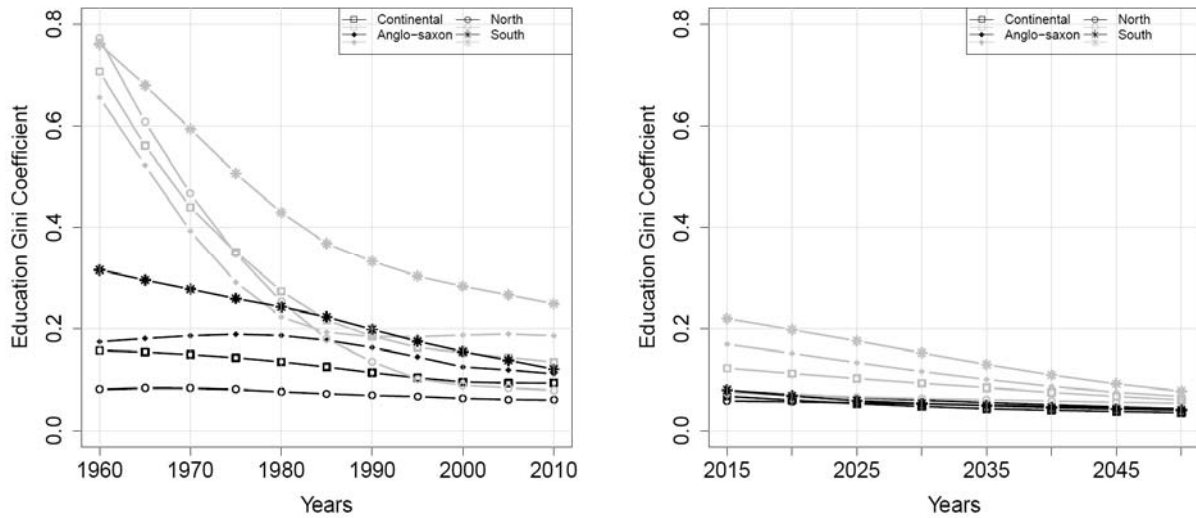


Figure 2: Education Inequality by European region, 1960 – 2050

(black: age group 25-54; gray: age group 55+)

The demographic structure of the attainment dataset enables to compare the degree of within-age group inequality across different cohorts. Crespo Cuaresma et al. (2013) derive a measure of aggregate educational mobility as the ratio between the education Gini coefficients of the 25-54 and the 55+ age groups. This approach is based on the assumption that a more equal distribution of education among the youth than among the elderly implies that education has been mobile across generations. At a value equal to one, the distribution of the young generation over the four education categories resembles that of the older generation. The closer the ratio is to zero, the more equally is education distributed among the youth than among the elderly, with the reverse being true for a value above one.

The left panel of Figure 3 depicts this intergenerational education mobility index throughout the period 1960-2010. As opposed to the education Gini indices in Figure 2, the mobility index fluctuates strongly in the last decades. This feature emphasizes the importance of considering age-group specific developments in the education distribution to understand the dynamics of educational attainment in European societies. In the Anglo-Saxon cluster, the ratio of young-to-old education Gini coefficients increased until 1985, before consistently decreasing thereafter. This reflects the slight increase in education inequality among younger cohorts discussed above. The ratio of young-to-old education Gini coefficients increased from 0.27 in 1960 to 0.96 in 1985, before consistently decreasing to 0.48 in 2010. Also in Southern countries, education became increasingly mobile since the 1990s. On average, Northern Europe started out as a highly mobile region in terms of educational attainment in 1960 but was characterized by increasing persistency in the education structures over the last decades. Since 2000, the mobility index actually exceeds one, indicating a more unequal distribution among the youth than among the elderly. In Denmark, for example, the education Gini of the 55+ age group decreased from 0.43 to 0.02, while that of the 25-54 age group increased from practically zero to 0.03, resulting in a mobility index above unity since 1990. This is due to a relatively strong increase in the share of tertiary educated people in the population aged 25-54 from 9% in

1960 to 28% in 2010, compared to the population aged 55 and over, thereby widening the gap between the lower and the upper tails of the education distribution. On the other hand, Finland experienced a relatively *equal* transition to a higher educated society as the mobility index did not exceed 1.06 and the share of tertiary educated fluctuated around 40% in each of the two age groups since 2000. The increasing persistence in the education distribution across cohorts in Continental Europe, exemplified by Austria in Figure 1, is also reflected in an increasing aggregate mobility measure. These countries are characterized by a strong persistence of secondary education levels across generations.

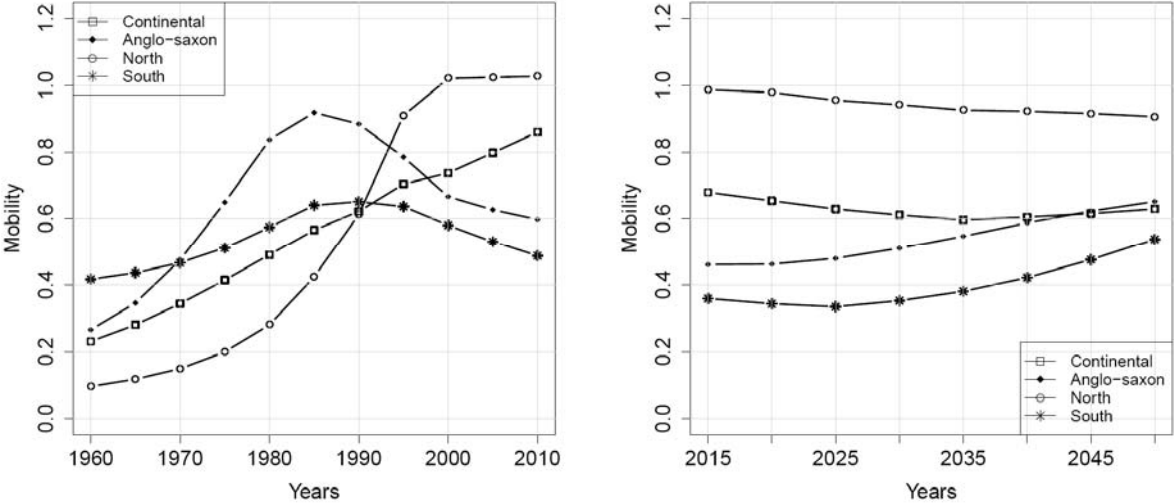


Figure 3: Education Mobility by European Region, 1960 - 2050

Using population projection methods, we can construct realistic scenarios about the future development of education inequality in Europe and the distribution of educational attainment across and within age groups. KC et al. (2010) provide a series of methods to obtain population projections by age, sex and level of education, which enables us to project the education distribution by age group and compute the corresponding education Gini coefficients up to 2050. We obtain the population projections using the so-called Global Education Trend (GET) scenario in KC et al. (2010). This scenario assumes that countries will continue their education expansion at the speed which corresponds to the attainment-specific estimates obtained using the historical experience of all countries of the world. To the extent that overall trend in educational attainment in the world over the last decades has been increasing, this scenario implies improvements in education for practically all economies. The speed of the educational expansion, however, is assumed to depend on the overall level of educational attainment already achieved. By basing the projection of further education expansion on estimates from the existing data, this scenario provides thus realistic population projections for the coming decades.

The age-specific education inequality and the education mobility indicator derived for the projection period 2015-2050 are depicted in the right panels of Figures 2 and 3 for the different European subregions. In general, these projections reveal the education Gini coefficient to level off slightly above zero. At the same time, European regions converge to a mobility index slightly below one. This is due to the fact that European economies are relatively mature with respect to their average level and the distribution of educational attainment. Since Southern and Anglo-Saxon economies started out with a relatively low mobility ratio of around 0.5, these countries are projected to gradually close

the gap in education inequality between young and old age groups. On the other hand, in Continental and Northern Europe, the degree of inequality in the education distribution is projected to slightly decrease among subsequent young cohorts. Notably, before mobility is projected to accelerate again, some Northern countries⁴ reported a mobility index above unity in 2010 while Continental economies remain below this threshold. The former region thus experiences a more *unequal* transition towards mass tertiary education, resulting in a relatively long period of persistent education structures. The change in the intergenerational education mobility index implied by the population projections is presented in Table 1 for Western European countries. In Galor and Tsiddon's (1997) theoretical framework, technological shocks are complementary to human capital, thus boost the returns to skills for everybody and accelerate intergenerational mobility. As technologies mature, returns to skills diminish and the existing labor composition persists until the next impulse. The observed and the predicted period together show an alternating pattern of intergenerational immobility followed by phases of accelerating mobility, which are fully in line with these theoretical predictions..

Country	Educ. Mobility 2010	Educ Mobility 2050	Change 2050-2010
Austria	0.94	0.85	-0.09
Belgium	0.36	0.53	0.17
France	0.49	0.39	-0.11
Germany	1.11	0.70	-0.41
Luxembourg	0.59	0.46	-0.13
Netherlands	0.57	0.56	-0.01
Switzerland	0.88	0.90	0.02
Denmark	1.22	1.07	-0.15
Finland	1.06	0.97	-0.09
Iceland	0.87	0.64	-0.24
Norway	1.62	1.10	-0.52
Sweden	0.32	0.76	0.44
Ireland	0.40	0.68	0.28
United Kingdom	0.57	0.62	0.05
Cyprus	0.34	0.54	0.20
Greece	0.49	0.40	-0.08
Italy	0.31	0.66	0.35
Malta	0.42	0.63	0.21
Portugal	0.39	0.47	0.09
Spain	0.53	0.52	-0.01

Table 1: Projected Changes in Education Mobility: 2010-2050 (GET scenario)

Crespo Cuaresma et al. (2013) estimate the growth effects of different education expansion trajectories. In general, they find a more equal distribution among young cohorts and higher intergenerational education mobility to significantly accelerate countries' growth rates. If we combine the economic growth elasticity implied by their panel regressions and the expected changes in the distribution of education across age groups from the projections, we can estimate the size of the contribution of distributional changes in educational attainment on future economic growth in Europe.

⁴ Denmark, Finland, Norway

4. Conclusions: What can we learn for policy?

The availability of information on the distribution of educational attainment across and within age groups enables us to analyze empirically the intergenerational transmission of education at the aggregate level in Europe. Theoretical and empirical results in the literature (see Crespo Cuaresma et al. 2013) indicate that achieving a more equal distribution in education across young cohorts of the population has significant beneficial effects for income growth that go beyond the standard aggregate returns to education. Education policy in advanced economies should thus incorporate measures aimed at achieving reductions in education inequality and monitor distributional measures such as those proposed above. Using some of the measures proposed in this study as an empirical background to their analysis, Altzinger et al. (2014) formulate a series of policy recommendations aimed at achieving lower persistence in the intergenerational transmission of education in Europe. These include, among others, increasing the universality and quality of child care and pre-school programs, later tracking and measures aimed at avoiding skill mismatch and facilitating technology development, as well as programs to foster the integration of migrants in the educational system.

The importance of policy interventions that affect early childhood development as an instrument to achieve intergenerational education mobility is highlighted in the modern human capital literature. Heckman and Cunha (2007), for instance, points out that earlier investment in education has benefits that go beyond the increase in schooling levels and income and spill over to improvements in health and reductions in criminal activity. Addressing the overall benefits of reductions in educational inequality should thus lead in the future to further assessments which will require the joint effort of economists, sociologists and education specialists.

References

- Altzinger, W./Crespo Cuaresma, J./Rumplmaier, B./Sauer, P./Schneebaum, A., Education and Social Mobility in Europe: Levelling the Playing Field for Europe's Children and Fuelling its Economy, WWWforEurope Working Paper no 80 (2015).
- Birdsall, N./Londono, J.L., Asset Inequality Matters: An Assessment of the World Bank's Approach to Poverty Reduction, *American Economic Review* 87 (1997), 32-37.
- Castello, A./Domenech, R., Human Capital Inequality and Economic Growth: Some New Evidence, *The Economic Journal* 1128 (2002), C187-C200.
- Castello-Climent, A., Channels Through Which Human Capital Inequality Influences Economic Growth, *Journal of Human Capital* (2011), 394 -450.
- Castello-Climent, A./Domenech, R., Human Capital Inequality, Life Expectancy and Economic Growth, *The Economic Journal* 118 (2008), 653-677.
- Castello-Climent, A./Domenech, R., Human Capital and Income Inequality: Some Facts and Some Puzzles, Working Paper 1228 (2012), BBVA, Economic Research Department.
- Cecchi, D., Does Educational Achievement Help to Explain Income Inequality? Working Paper 11 (2000), Università degli Studi di Milano.

Crespo Cuaresma, J./Sauer, P./KC, S., Age-Specific Education Inequality, Education Mobility and Income Growth, WWWforEurope Working Paper no. 6 (2013).

Crespo Cuaresma, J./Mishra, T., The Role of Age-Structured Education Data for Economic Growth Forecasts, *Journal of Forecasting* 30 (2011), 249-267.

Fan, X./Thomas, V./Wang, Y., A New Dataset on Inequality in Education: Gini and Theil Indices of Scholling for 140 Countries, 1960-2000, Mimeo, The World Bank (2002).

Fan, X./Thomas, V./Wang, Y., Measuring Education Inequality: Gini Coefficients of Education, World Bank Working Paper 2525 (2001).

Galor, O./Tsiddon, D., The Distribution of Human Capital and Economic Growth, *Journal of Economic Growth* 2 (1997), 93-124.

Heckman, J./Cunha, F., The Technology of Skill Formation, *American Economic Review* 97 (2007), 31-47.

Inter-American Development Bank, Facing up to Inequality in Latin America: Economic and Social Progress in Latin America, 1998-99 Report (1998), Johns Hopkins University Press.

KC, S./Lutz, W., The Human core of the Shared Socioeconomic Pathways: Population Scenarios by Age, Sex and Level of Education for All Countries to 2100, *Global Environmental Change* (2014), <http://dx.doi.org/10.1016/j.gloenvcha.2014.06.004>

KC, S./Barakat, B./Goujon, A./Skirbekk, V./Sanderson, W./Lutz, W., Projection of Populations by Level of Educational Attainment, Age, and Sex for 120 Countries for 2005-2050, *Demographic Research* 22 (2010), 383-472.

Lam, D./Levison, D., Declining Inequality in Schooling in Brazil and its Effects on Inequality in Earnings, *Journal of Development Economics* 32 (1991), 199-225.

López, R./Thomas, V./Wang, Y., Addressing the Education Puzzle: The Distribution of Education and Economic Reform, World Bank Working Paper 2031(1998).

Lutz, W./Crespo Cuaresma, J./Sanderson, W., The Demography of Educational Attainment and Economic Growth, *Science* 319 (2008), 1047-1048.

Sauer, P./Zagler, M, (In)equality in Education and Economic Development, *Review of Income and Wealth* 60 (2014), 353-379.