COMMENTARY

Education's Role in China's Demographic Future

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The aim of this commentary is to illuminate for a wider audience the essential features of the analysis described in the paper on "China's low fertility may not hinder future prosperity" (1), to place the paper in the context of the programme of work on the role of education in demography at the Wittgenstein Centre, Vienna and evaluate its claims. Tables 1 to 4 provide an overview of the options for forecasting a country's demographic future used in the Wittgenstein programme. The paper's authors chose from the options set out. The tables provide an interpretation of their work, based on reading the paper and discussion with the authors. Table 1 characterises the model, its inputs and outputs. Table 2 provides details of alternative demographic models that might be used. In the Companion Paper (1), a microsimulation model based on a sample data is used with the sample numbers factored up to a larger population. The demographic assumptions of the model embed the key relationships between fertility, mortality, and migration by educational attainment. The model for China focusses on the national population with no role for internal migration. International migration into and out of China is very small in relation to its 1.4 billion 2020 population, so does not play much part in determining future populations, in contrast to Western countries where immigration is a vital contribution and to developing countries where emigration is important. Table 3 presents information on indicators of population ageing. The companion paper (1) shows that very different results are obtained when education and productivity are included in the dependency ratios. Table 4 reports the implications of the work for national policy in China. There are also pointers to improvements that might be introduced such as integrating recent estimates of educational quality (2), the skills and knowledge that pupils and students gain through education.

Population Projections with Added Education

The authors apply demographic methodology developed by Wolfgang Lutz and colleagues over more than two decades (3) at the International Institute for Applied Systems Analysis (IIASA), Vienna Institute of Demography and the Wittgenstein Centre (a collaboration of IIASA, VID and the Vienna

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University of Economics). Innovations include: the rationale for including education as a variable in world population projections (4), the use of education as a key population attribute in the projection model (5). Educational attainment is usually measured by years of attendance at educational system of schools, colleges, and universities. Education attainment develops over a person's early lifetime, and in most societies has largely been completed by age 25. The assumption that educational attainment is fixed from this age makes its estimation for countries feasible using commonly available statistics.

Educational attainment has important effects on fertility, mortality, and migration the drivers of population change. The higher a woman's educational level, the lower her fertility (6). Higher education levels mean longer life expectancy (7, 8). Higher education also means higher levels of migration activity (9).

The Cohort Replacement Process or "Demographic Metabolism"

The basic process in a population projection model is cohort survival. People enter the population at birth and then over time survive or die from one age to the next, taking fixed attributes (educational attainment at age 25) with them through the rest of life. This process steadily improves the educational profile of a population, a process termed "demographic metabolism" (10). Of course, other socio-economic indicators such as income or occupation or health also influence demographic component rates and flows. But these other attributes fluctuate over time for individuals and populations, tracking ups and downs of economies. They are more difficult to operationalise. The overall educational attainment of the population improves over time because of the steady replacement in each age band of older less educated cohort by younger more educated cohorts.

Multidimension Projections Combine Multistate and Prevalence Models

In Table 1 the overall model has been characterised as multidimension rather than multistate (11). A multistate model incorporates two-way flows of persons between attribute states, so that outcomes in one state are dependent on those in all other states. The original model used regions within a country between which people migrated (12). Data on migration between regions is widely available from periodic censuses or continuous population registers. Equivalent flows between educational grades are not as accessible, so a prevalence method was used. This links prevalence of a condition in a population by age and sex in a recent survey or census to the age and sex variables in a life table or a projection. What needs to be added is a separate model for projecting educational prevalence (13).

Measuring Population Dependency using Improved Ratios

One of the key challenges faced by nation states in the twenty-first century is population ageing. To measure this challenge demography uses dependency indexes, principally the ratio of older age groups to working age groups (Table 3). However, crude demographic ratios are misleading, so researchers have developed ratios that account for the economic contributions of the different age groups by measuring the degree of labor force participation (14) and labor force participation by education grade (15). But education and labor force participation are insufficient to measure the potential for the working population to support dependents. Productivity-weighted labor-force dependency ratios have been estimated using education and wages by education grade as productivity proxies (16). Most recently measures of educational quality using literacy data for countries of the world have been estimated and used to generate a "skills in literacy adjusted mean years of schooling" or SLAMYS (2).

National Homogeneity versus Subnational Heterogeneity

The China paper (1) considers the country as one homogenous territory. However, there is ample evidence of strong quality differences between schooling in rural and urban areas, through a collaborative project involving American and Chinese researchers (17). They have identified both the causative factors and solutions. However, in China the locality registration system or *Hukou* generates further inequality by denying the children of urban in-migrants to cities the same access to schooling and welfare benefits as holders of urban *Hukou.* If the model were re-run using either a rural/urban or rural Hukou/urban Hukou classifications or a combination, would the results for China be less favourable? We don't know. But a study of India which used Indian states, a rural/urban classification of settlements and educational grades for a set of fixed assumption projections found a close agreement between the results of a national and a triply classified projection (18). Sub-national inequality was closely linked to inequalities in educational attainment.

Policy Implications: Don't Panic

Table 4 points to policy implications of the China study (1) for the national government in planning for demographic ageing. Indicators of education combining time in school and quality of outcome should be used in projection models where possible. The main message is not to panic and impose draconian measures which affect family life, as happened under the one child fertility policy. China should invest in improving the educational quality of rural populations and of rural Hukou migrants in cities. National projections should be supplemented by sub-national capturing heterogeneity in population attributes to confirm the India result that inequality in education across the country largely accounts for differences between national and subnational projection outcomes. This might also resolve the conflict between top-down and bottom-up approaches to country projections. In top-down projections, the norm in national work, subnational projections are adjusted to agree with the national. In bottom-up projections, national projections are the sum of subnational results. This is approach of the Population Division of the United Nations in generating successive revisions of World Population Prospects.

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Table 1. Features of a population projection model including educational attainment

Model elements	Details
Inputs	Base year estimates plus forecasts of rates for demographic components and prevalence levels for education, labor force status and productivity
Design	Multidimension Population Projection Model (MDPM)
Outputs	Forecast populations, demographic components, and prevalence

Table 2. Model options, relationships and uses

Demographic model options	Relationships	Uses
Single region cohort survival (SRCS)	Fertility rates fall with increasing education Mortality rates fall with increasing education Migration rates increase with increasing education	Independent forecasts for a set of country or region or group populations
Multiregional cohort survival (MRCS)	Forecasts of prevalence levels for education are driven mainly by cohort replacement at ages 30 years and over, by educational investment at ages less than 30 years	Aligned forecasts for a set of regions or countries, linked through migration flows/rates
Biregional cohort survival (BRCS)	Forecasts of labor force status and productivity dependent on education forecasts	Reduced version of the MRCS model applied when region or country sets are large
Microsimulation model (MSM) based on microdata from large survey or census	Simulates changes in person and household attributes for individuals	Provides scaled up forecasts for the whole population

Table 3. Indicators derived from population forecasts

Derived indicators	Definitions	Forecast Changes
Old age dependency ratio (OADR)	Ratios of older populations to working age populations	Serious increase in ratios in future Shifts upwards in threshold ages for retirement
Labor force dependency ratio (LFDR)	Ratio of older retired population to employed population at all ages or ratio of inactive population to active population at all ages	Increase in ratios diminishes Older population needs support to continue working
Productivity weighted labor force dependency ratio (PWLFDR)	Ratio of inactive population (all ages) to active population (al ages), weighted by productivity for education grade	This measure remains relatively constant for 2020-2070 in China

Table 4. Implications for use of a multidimension model incorporating education

Indicator to use	Policy implications	Future model improvements
Use PWLFDR not LFDR or OADR to inform policy	Do not panic & introduce “forced measures” Invest in education and life-long learning, child health and support for disabled workers	Add indicators of educational quality beyond years of schooling Investigate other heterogeneity effects: sub-national regions, rural-urban settlement, the *Hukou* registration system in China

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