Urbanization in India and China: Interpreting the UN Projections

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Abstract

The United Nations provides the most comprehensive and widely used projections of urbanization at the national level, but does not identify the demographic conditions that would be necessary to produce these outcomes. Taking China and India as illustrations, we use a multi-state model to identify the trends in future rural-urban migration and changes in age structure that are implied by these projections. We find that the UN projection for China implies net rural-urban migration of just over 10 million per year for the next 20 years, followed by a substantial decline over the 2020s. It also implies a substantial aging of the rural population: the proportion age 65+ nearly triples over the period 2000-2030. We use these results and those pending for India to suggest general conditions under which UN urbanization projections are likely to imply plausible, or implausible, future migration or age structures.

Background

Urbanization projections serve as key components of many types of analyses in demography, economics, and environmental studies (National Research Council 2003). The principal source of national urbanization projections is the United Nations, which publishes a bi-annual series of projections extending to the year 2030. The UN projection methodology takes an extrapolative approach based on projecting the future evolution of the difference between urban and rural growth rates in a given country. This projection is based, in turn, on a regression model relating the urban-rural growth rate difference to the urbanization level; individual countries are assumed to steadily approach a single hypothetical relationship between these two variables. The U.N. method has the benefit of being relatively simple and transparent, requiring no detailed data to carry out, and being easy to apply to large numbers of countries. In addition, the approach is grounded in past experience in that it is based on an empirical regularity that can be observed in historical data between the level of urbanization and growth rate differences.

However the method has been criticized on grounds that it is unrealistic for countries near either the beginning or the end of the urbanization transition, that it implicitly assumes all countries will follow historical paths of urbanization, and that it can be inconsistent with current rates of urbanization in some countries (National Research Council 2003; Cohen 2004; Bocquier 2005). We highlight a number of additional shortcomings of the approach:

- It is unclear what combinations of time paths of fertility and mortality (in both urban and rural areas) and net rural-urban migration would lead to the projected urbanization outcome. As a result, it is difficult to judge the plausibility of any given scenario.

- It is unclear whether the projected level of urbanization is equally plausible regardless of the population scenario to which it is applied.
- It is difficult to define a plausible range of uncertainty using this method (i.e., to define urbanization paths that would be considered exceptionally slow or exceptionally fast for a given country).
- No separate urban and rural age structure is produced. Knowing the age structure implied by particular urbanization scenarios can be useful in applied research, and can also help judge the plausibility of a given scenario. For example, a scenario might imply implausibly drastic changes to rural age structure even if it does not appear to be implausible in terms of total rural population size.

To address these weaknesses, we explore the potential benefits of multi-state projections that explicitly model urban and rural populations. We develop multi-state population and urbanization projections for China and India and compare them to UN projections. Multi-state projections include explicit assumptions about fertility and mortality in urban and rural areas and rural-urban migration rates. Such projections also produce explicit age structures in both urban and rural areas, and allow clear distinctions to be made between the effects of natural increase and migration on urban (or rural) population. We perform a back-projection exercise that takes a UN urbanization, population, and components-of-change scenario for China or for India as input, and solves for the implied net rural-urban migration rate over time. It also produces rural and urban age structures over the period of the projection. This allows us to interpret the results of the UN projection methodology in a new way, by examining the migration and age structure changes necessary to produce the UN outcome. We test the sensitivity of results to assumptions about rural-urban fertility differences.

Preliminary results: Back-projections of UN urbanization for China

To understand the implications of the UN urbanization projection for rural-urban migration, we begin by taking as given the UN projection of urbanization in China to 2030 (United Nations 2002). We also take as given the national population, TFR, and life expectancy projections for China from the UN 2002 Revision (United Nations 2003) medium scenario, and the base-year age and sex profile of the population. The UN projections assume that fertility remains constant at about 1.85, life expectancy rises from 71 in 2000 to about 74 years in 2030, and that urbanization will increase from 35.8% to 59.5%, while total population will grow from 1.28 billion to 1.45 billion.

To calculate implied rural-urban net migration in this scenario, we use a multi-state model with states defined by urban or rural residence. This model requires separate estimates of rural and urban age structure in the base year, age profiles of fertility and mortality in both regions, separate assumptions about TFR and life expectancy changes over time in both regions, and an assumed age- and sex-profile for rural-urban migration. We use 2000 census data to define age profiles of mortality and fertility in rural and urban areas, age profiles of migration for each sex, and the proportion of the national population that is urban by age and sex. These proportions urban are then used to define base-year age and sex profiles for urban and rural regions separately consistent with the national profiles from the UN.

The back projection is carried out by solving for the time path of total net rural-urban migration that minimizes differences between our projection and the UN outcomes for total population, proportion urban, and national level fertility. In this way, we produce a projection that closely replicates UN national level assumptions and outcomes, while also producing consistent migration paths and urban and rural age structures over time.

To do this, some assumption must be made about differences between rural and urban fertility. The UN projection assumes only a national TFR path, but differences in fertility

between rural and urban areas might have important effects on implied migration. For example, if fertility is much higher in rural areas than in urban areas over the course of the projection, rural population will have a large rate of natural increase (and urban areas a low rate of natural increase) requiring higher migration to match a given UN urbanization scenario.

We address this issue by producing a number of scenarios with different assumptions about rural-urban fertility differentials, in order to test the sensitivity of the results. In our base case, we do not specify the difference but treat it as a choice (control variable) in the optimization problem. We define the rural-urban fertility difference as a piece-wise linear function that begins in 2000, changes linearly to a value in 2015, and remains constant thereafter. The values in 2000 and 2015 are free parameters, chosen so that the best fit to the UN projection is produced. At the same time, the total migration path is also specified as a piece-wise linear function with free parameters representing total migration in 2000, 2010, 2020, and 2030. The optimization proceeds by finding values for all these parameters such that the best fit to the UN projection is produced.

Figure 1 shows the results for implied net migration. The UN projection implies that rural-urban migration must be 10-12 million per year until 2020, and then decline sharply to less than 4 million by 2030. Our multi-state projections reproduce very closely the UN outcomes for total population, urban proportion, and total fertility at the national level, but are produced with jointly modeled urban and rural populations. Our confidence that the optimization procedure is producing reasonable results is increased by the fact that the migration in 2000 (a free parameter) compares well with a separate estimate of average annual net migration over the period 1995-2000 of 9 million per year, based on 2000 census data (L. Jiang, personal communication).

The results are not sensitive to the assumed rural-urban fertility differences. In our base case scenario, the best fit to the UN projection occurs when the fertility difference begins at 0.76 in 2000, declines to 0.33 in 2015, and remains constant thereafter. We defined three additional scenarios in which the fertility difference is not treated as a choice but rather is assumed to be constant over the entire period at 0.76, 0.5, or 0.3, and results are shown in Figure 1. Cumulative migration over the 30-year period ranges from 279 to 301 million across the four scenarios, with our base case amounting to 291 million (at the center of the range). Differences in migration in any given year across these scenarios do not exceed 1 million.

Figure 2 shows results for urban and rural age structure in our base case scenario. Because of the distinctive age profile of rural-urban migration, migration has a strong effect on age structure. That effect is already present in the base year; the rural population has a noticeable deficit of people in their early 20s, and the urban population a noticeable surplus in the 20-40 year age group, due in part to the concentration of out-migration at these ages. By 2030, the rural population is smaller overall, has aged considerably, and the deficit in the age profile has now grown larger and shifted to those in their late 40s and early 50s, exacerbated by continuing out-migration (albeit at a lesser rate after people age beyond their mid-20s). The urban population grows at all ages over this period, particularly above age 40, due to the effect of sustained high in-migration.

Our conclusion then is that the back-projection indicates that the UN urbanization projection for China implies steady migration of 10-12 million per year for 20 years followed by a sharp decline. It also implies a substantial aging of the rural population – e.g., the proportion age 65+ increases from 0.07 to 0.20 over the period 2000-2030, a substantially larger shift than the increase from 0.06 to 0.13 that occurs in urban areas – and identifies distinctive characteristics of the age structures of urban and rural populations that would

result from this urbanization scenario, assuming that the age profile of migration remains constant.

Planned Work: Back-projections of UN urbanization for India

We plan to carry out an identical exercise for India, interpreting the UN projection in terms of implied migration and age structure outcomes. So far, we have completed the data analysis necessary to carry out the projections. We have used various data sources to define the year 2000 baseline population by age, sex, and urban/rural status, and to calculate fertility and mortality age profiles separately for rural and urban populations. We have also obtained data on urban-rural migration, and defined migration profiles to be used in the projection. This fall the back-projection of urbanization will be carried out and results analyzed.

Sensitivity analyses and generalization

Finally, we will carry out analyses of sensitivity of the results to assumptions about (1) the age profile of migration, and (2) the assumed baseline population scenario. Age structure implications of UN projections are likely to depend substantially on the evolution of the age structure of migration, and we plan to test this sensitivity using alternative migration profiles. Also, UN projections of urbanization are often used not only with the UN medium population projection, but also with the low or high projection. We will test the sensitivity of implied migration flows and resulting age structures to the assumed population projection that is paired with the U.N. urbanization projection. Finally, we plan to draw on the results of our two case studies to propose hypotheses about the generalizability of our findings to U.N. projections of urbanization in other countries, including the conditions under which these projections may safely be expected to imply plausible migration paths and age structures, and those in which they might produce implausible implications.

Conclusions

The UN urbanization projection for China implies a rural-urban migration path of just over 10 million per year for the next 20 years, followed by a substantial decline over the 2020s. Assuming the age profile of migration remains constant, this projection would result in substantial changes in the age structures of rural and urban populations, including a near tripling of the proportion of the rural population age 65 or above. These results do not suggest that the UN projection is implausible; to the contrary, the UN urbanization path represents a continuation of current levels of migration for two decades into the future. The utility of carrying out the multi-state back projection is that it allows this plausibility to be verified, it quantifies the specific nature of the migration scenario inherent in the UN projections, and it provides urban and rural age structures over time consistent with the UN urbanization outcome. We anticipate that results for India will provide insight into projections for that country that will be important in their own right, and will also provide a point of comparison that will assist in proposing hypotheses for the conditions under which UN urbanization projections are likely to imply plausible, or implausible, future migration or age structures.

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Figure 1: Net annual rural-urban migration implied by UN projection for China.

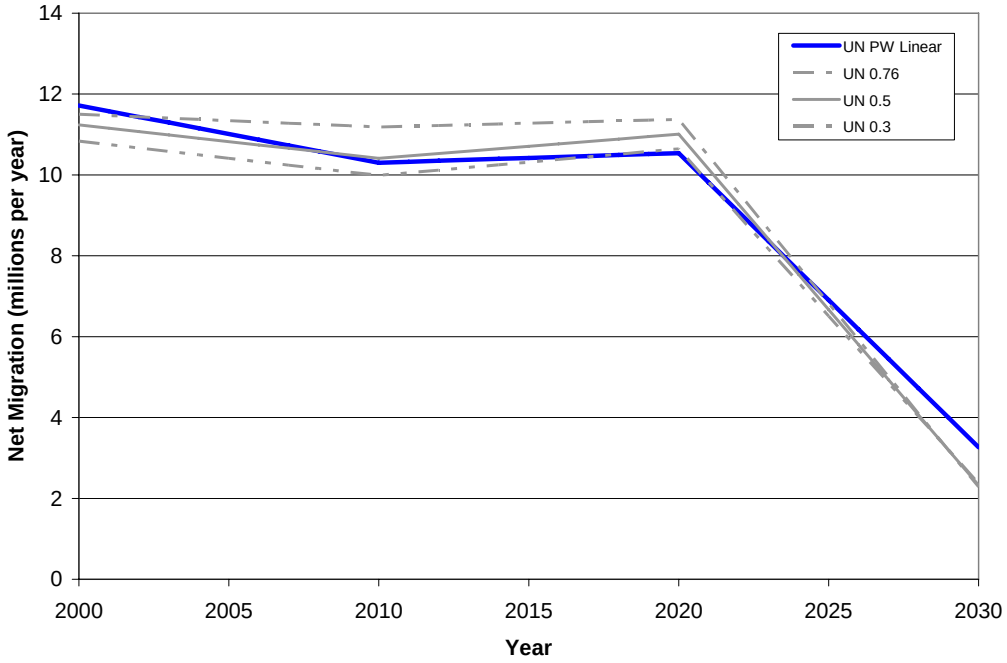

Figure 2: Urban and rural age structure for 2000 and 2030 in the base case projection consistent with the UN scenario.