The Sandwich Generation: Demographic Determinants of Global Trends*

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Abstract

We evaluate the consequences of demographic change for care needs of families. We use demographic methods and microsimulation, calibrated with data from the UN WPP 2012 Revision, to estimate trends in the prevalence of the so-called 'sandwich generation' for all countries of the world. Longer and healthier life implies that the parents of people at childbearing age are less likely to be in need of support. Conversely, later childbearing increases generational length and implies that grandparents of young children are older and possibly more in need of care. Reduced fertility decreases the number of years that people spend looking after young children. Preliminary results indicate an expected global downward trend in 'sandwichness'. However, there are large differences across regions of world. If fertility decline in African countries stalls as projected by the UN, relatively high levels of 'sandwichness' will persist for a few decades in the continent.

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Introduction

The human life cycle is characterized by stages of dependency and periods of net production, which lead to inter-generational transfers of money and time (Lee and Mason 2011; Zagheni and Zannella 2013). Typically, individuals are net receivers of resources at the beginning of their life, when they are children, and at the end of their life, when they are frail and close to death.

At an aggregate level, several indices have been proposed to measure the ratio between dependency and production. The most commonly used index is the dependency ratio, a measure that typically has on the numerator the number of people younger than 15 and older that 64, and on the denominator those who are between 15 and 64 years old. The so-called young dependency ratio has on the numerator only those who are younger than 15 years old. The old dependency ratio has on the numerator only those who are older than 64 years old. One of the main drawbacks of dependency ratios is that they are based on fixed, arbitrary age groups that may not be related to the actual health status or level of dependency of individuals. An improved measure of dependency is the Prospective old-age dependency ratio (Sanderson and Scherbov 2010), an index that has on the numerator people who, based on life table calculations, are expected to die within a certain number of years.

Aggregate measures of dependency hide an important dimension: the timing of events over the life course. Transformations of the life course may lead to changes in the prevalence of simultaneous responsibilities towards elderly parents and young children. When analyzed using aggregate indexes like dependency ratios, situations where care responsibilities are smoothed across the life course may be undistinguishable from those where care responsibilities are concentrated during specific stages of the life course.

In this paper, we analyze how global demographic trends affect the overlap of generation. In particular, we use microsimulation, calibrated against data from the UN World Population Prospects, the 2012 Revision, to provide the first global picture of trends in 'sandwichness' between generations. We define a woman 'sandwiched' if she simultaneously has a young child (less than 5 years old) and her mother is within 5 years from death. Preliminary results indicate, among others, that the expected stall in fertility reduction in African countries may lead to high prevalence of 'sandwichness' in the continent for a prolonged period of time.

Demographic forces shaping trends in 'sandwichness' between generation

Three main demographic forces affect the probability of being 'sandwiched' between generations: the level of fertility, the timing of fertility, and the level of mortality. If fertility is high, women are more exposed to the risk of being sandwiched between young children and older parents because they spend a larger portion of their childbearing age with young children. Fertility postponement implies, all else held constant, that mothers and grandmothers are older when the children are born. Thus grandmothers are more likely to be close to death and thus unhealthy or frail. As a result, fertility postponement increases the probability of

maternal sandwichness. Mortality decline and improvements in life expectancy imply that grandmothers are more likely to be healthy when grandchildren are young. Thus mortality decline implies reduced maternal sandwichness.

Formally, given constant age-specific schedules of fertility and mortality rates, we can express the probability of maternal sandwichness at age a, $S(a)$, as:

$$S(a) = \underbrace{\sum_{x=1}^{5} f(a-x)}_{\substack{\text{fertility risk in the} \\ \text{5 years preceding age a}}} \times \underbrace{M_1(a)}_{\substack{\text{Prob. that mother of ego} \\ \text{is alive when ego is a years old}}} \times \underbrace{(1 - \frac{M_1(a+5)}{M_1(a)})}_{\substack{\text{Prob. that mother of ego} \\ \text{would die within 5 years}}} \quad (1)$$

where $M_1(a)$ is the probability of having a living mother at age a in a stable population. $M_1(a)$ can be approximated as (Keyfitz and Caswell 2005):

$$M_1(a) \approx \frac{l(\mu + a)}{l(\mu)}$$

Conditional on Ego's survival, $M_1(a)$ can be thought of as a survival probability in a life table: it has to be equal to 1 when a is equal to zero (the mother is alive when she gives birth) and goes monotonically to zero. It is the survival probability for the mother of Ego, conditional on the mother being alive when she gave birth.

Equation 1 brings together the three main demographic quantities into one expression. Fertility levels enter the equation through fertility rates, which in turn affect the probability of having had a child during the past 5 years. Fertility timing enters the equation through both fertility rates and the mean age at childbearing μ. Mortality enters the equation through survival probabilities. We expect to generate comparative statics analyses of stable states for different combinations of mortality levels, fertility levels and timing of childbearing.

The Microsimulation approach

In the previous sections we offered an intuition of the demographic forces that shape trends in 'sandwichness'. To evaluate dynamics over time, we use demographic microsimualtion. In particular, we simulate populations for all countries using the kinship microsimulator SOCSIM, calibrated against estimates and projections of mortality and fertility rates published bt the United Nations (World Population Prospects, the 2012 Revision[1]).

In the simulation, each individual is an observation in a rectangular data file, with records of demographic characteristics for the individual, and identification numbers for key kinship members. SOCSIM is efficiently written in the programming language C and takes full advantage of arrays of linked lists to keep track of kinship relationships and to store information. The simulator takes as input population files and demographic rates. It returns updated population files as output.

[1]Data can be downloaded from `http://esa.un.org/wpp`

The individual is the unit of analysis of the simulator. Each person is subject to a set of rates, expressed as monthly probabilities of events, given certain demographic characteristics, like age and sex. Every month, each individual faces the risk of a number of events including childbirth, death and marriage . The selection of the event and the waiting time until the event occurs are determined stochastically, using a competing risk model. Some other constraints are included in the simulation program in order to draw events only for individuals that are eligible for the events (e.g. to allow for a minimum interval of time between births from the same mother, to avoid social taboos such as incest, etc.). Each event for which the individual is at risk is modeled as a piecewise exponential distribution. The waiting time until each event occurs is randomly generated according to the associated demographic rates. The individual's next event is the one with the shortest waiting time.

At the end of the simulation, population files that contain a list of everyone who has ever lived in the population are created. From these data, it is possible to determine the main demographic characteristics of the population and the kin network of any individual at any time. For each country, the results that we present in the next section are averages of output quantities of interest obtained from multiple runs of the simulator with the same values of demographic rates as input.

For more details about SOCSIM, its history, computer routines and applications, see Hammel et al. (1976), Wachter (1997), and the online documentation available at `lab.demog.berkeley.edu/socsim`.

Preliminary Results

Figure 1 shows the proportion of mothers 15-55 years old who are 'sandwiched' between young children and elderly mothers, by country, in 2010, relative to values of total fertility rate and life expectancy. The size of dots is proportional to the value of the proportion of mothers who are sandwiched. In absolute terms these values range from about 1%, mostly for countries in Europe, to about 5%, mostly for countries in Africa. In the African continent, the combination of lower life expectancy and higher fertility generates higher levels of 'sandwichness'.

Figure 2 shows the change in proportion of 'sandwiched' mothers relative to changes in total fertility rate and life expectancy, for the period 2010-2050. Figure 3 shows trends in the average proportion of 'sandwiched' mothers 15-55 years old, for countries grouped by continent. The two figures indicate that UN projections of demographic rates imply a decline in 'sandwichness' for most countries of the world. The reduction is mainly the result of projected lower fertility and improved longevity. In some European countries, however, we may observe a slight increase in 'sandwichness'. This trend is mainly driven by postponement of childbearing that more than counteracts increases in life expectancy.

Overall, the proportions of women who have, at the same time, children under 5 and mothers 5 years from death is quite low. However, situations of 'sandwichness' may be more complex, when we include in the definition siblings, spouses, parents-in-law and step-family. As family structure becomes more complex, so do care needs and responsibilities. The

prevalence of 'sandwichness' in a broader sense may be larger. As we develop our methods, we aim to generate measures that appropriately weigh care needs and responsibilities within the kinship network of the extended family.