Demographic Change and Poverty Reduction

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Abstract: This brief outline will begin by sketching the macroeconomic evidence of the relationship between demography and economic growth. It will then shift to a household level analysis of the poverty-demography trap, with a focus on one particular aspect of this trap, the use of low energy biomass fuel.

The nature of the relationship between demography and wealth has been debated for centuries. The Malthusian argument is a familiar one, where high and uncontrolled fertility rates lead to rapid population growth which brings down per capita consumption below subsistence levels. Poverty, in this scenario, is the only check on population growth. While Malthus' vision appears not to have been borne out, there are more modern versions of this perspective. The so-called "population pessimist" view holds that rapid population increase overwhelms the growth impacts of capital accumulation and technological change (Coale and Hoover 1958, Ehrlich 1968).
There is an opposing view, however, whereby the "population optimists" argue that population growth spurs innovation as societies are forced to keep up with growing consumption demands, and that larger populations allow for economies of scale (Boserup 1981, Simon 1981).

The issue is, of course, fundamentally an empirical one. Using cross country regression analysis economists attempted to determine which of these two schools of thought were actually correct. Surprisingly, most empirical research failed to uncover either a positive or a negative relationship (Kelley 1981). This led in the 1980s to a resurgence of what has come to be called the revisionist view, that there is no significant relationship between population growth and per capita income.

In more recent work, however, economists have pointed out that by simply looking at changes in the population growth rate, other important demographic effects may be ignored. Bloom and Williamson (1998) evaluate the impact of the demographic transition in Asia, focusing specifically on the lagged age structure effects of declining fertility. They find that a significant part of the East Asian economic miracle can be explained by the high ratio of working age to dependent population resulting from declining fertility rates in this region. When age structure effects are taken into account it is found that population growth rates are in fact negatively related with economic growth. Therefore policies that successfully bring down fertility can speed up the demographic transition and contribute to the economic growth process.

The linkage between demography and wealth is of course not unidirectional. The impact of increasing incomes has been shown to affect demography through its impact on health and education. Rising incomes will improve life expectancy and reduce infant mortality rates. This will in turn reduce fertility rates as couples can better plan for the desired number of surviving children. Similarly, education, especially for women, raises the opportunity cost of the time spent on child rearing, and by making children more expensive brings down fertility. The interlinkages between income, physical and human capital, and demography mean that improvements in each will interact with the other two and can set up a dynamic system feedback effects, creating a virtuous cycle of economic growth (Bloom Canning and Malaney, 1999).

The demographic transition is under way in almost all parts of the developing world, though in some regions the declines in mortality and fertility are significantly slower than in others. The speed of the transition is fundamental to determining the extent of the so called "demographic gift" of a reduced dependency ratio and higher growth rates, but demographic trends bode well for many low income countries in terms of economic growth at the national level. However, while economic growth is almost always a precursor to poverty alleviation, these macro relationships cannot answer the question of the impact of demographic trend changes on the poor.

Exploring demographic changes within countries shows that there remains a significant gradient across income classes in terms of mortality and fertility. Lack of sufficient access to health services amongst the poor keeps infant and child mortality rates higher. One of the most common findings across countries is that larger families tend to be poorer. The demographic transition is less of a reality for the poor than for middle and upper income groups. This is especially apparent in the discrepancy between rural and urban areas. Health indicators are consistently worse in rural areas which account for much of the world's poor. Similarly fertility rates are consistently higher.

Just as the links between demography, income and capital can set in motion an upward spiral of growth and development, so can a negative impact on the system lead to a poverty-demography trap. Many of the arguments linking income and fertility are well known. The poor, limited by a lack of collateral, generally cannot access financial markets. Children therefore act as a form of security for their old age, and there is a greater incentive to have large families. Similarly, rural settings with imperfect labor markets increase the need for large families as the social capital within families can smooth some of these imperfections. Poor access to health care translates into high infant mortality rates, which also encourage couples to have more children in order to correctly target the number of surviving children.

High fertility rates, through their effects on dependency ratios within families, can trap the poor into lower levels of consumption. There is evidence to show that families with larger numbers of children are less likely to provide them with as much education. While investing in the quality of children through human capital can have a higher return for parents than investing in larger numbers of children, this is certainly a riskier proposition in the face of high mortality rates for infants and children.

This situation is made worse by the fact that most poverty is concentrated in rural areas where access to education and health services are particularly bad. Access to credit has also been notoriously bad for the rural poor, though that is beginning to change to some extent with the microfinance revolution. There is another aspect of the poverty-demography trap that is a particular problem for the rural poor that has not yet been explored, namely the demographic impact of biomass fuel use. The next section will explore this particular aspect of the linkage more closely.

The Poverty-Energy-Demography Trap

Energy is an integral input to modern life, and is critical to a wide range of human needs. The range of fuel options available vary widely with usage primarily being determined by household income levels. The various energy carriers form what is commonly referred to as an energy ladder. Each rung corresponding to the dominant fuel used by successive income groups (see Hosier and Dowd 1987; Reddy and Reddy 1994). The lowest rung is represented by wood, dung, and other biomass. Charcoal and coal form the second rung, kerosene the third, and LPG (Liquified Petroleum Gas), and electricity represent successively higher rungs. The notion of an energy ladder is borne out by cross-country estimates of biomass share in energy use, with poor countries showing a disproportionately high use of these fuels, and the poor within countries also using a disproportionately high share of biomass.

The ordering of fuels on the energy ladder also corresponds to their efficiency (i.e., the fraction of available energy that is actually applied in a particular end use) and their cleanliness. For example, the cook stove efficiencies of firewood (as traditionally used), kerosene, and gas are roughly 15, 50, and 65 percent, respectively, relative to that of electricity. As one proceeds up the energy ladder, the emission of carbon dioxide, sulfur dioxide, and particulates into the air also tends to decline. And as discussed below, higher rungs of the energy ladder correspond, in general, to cheaper energy. As people's income rises, they tend to consume more energy, meaning that the energy ladder widens at its higher rungs: total energy used tends to be more at higher rungs.

The poor tend to rely on a significantly different set of energy carriers than the rich, consuming considerably more wood, dung, and other biomass, and less electricity and LPG. In fact, income appears to be the main characteristic that influences a household's choice of energy carrier (Leach 1992, Reddy and Reddy 1994). While this may seem unsurprising at first glance, . Bloom, Gallup, and Beede (1996), point out an interesting contradiction. While it is true the electricity is the most expensive fuel as measured in cost per unit of energy, in an analysis that takes into account efficiency of the stoves used with each type of fuel, electricity is, in fact, potentially the least expensive energy source for cooking. LPG, kerosene, and wood all cost more, with the amount of the difference depending on the particular assumptions made.

Since the poor rely so much on wood for energy, they pay more for usable energy than do the rich. Why do they do this? Bloom, Gallup, and Beede explain it as primarily a result of the high fixed costs associated with higher forms of energy use. For LPG, these include high costs of stoves and high canister deposits. For electricity, consumers face two types of fixed costs: first, the initial connection of the household to the grid, and second, typically, a fixed basic charge for the first unit of electricity used. They also posit that credit constraints pose a problem as the poor often cannot afford the relatively high deposits on LPG canisters.

The evidence presented above appears to indicate the existence of an energy-poverty trap. Energy use is also, however related to demographic factors. Biomass fuel can cause high levels of indoor pollution, and there are many studies demonstrating the positive correlation between indoor pollution generated by the use of traditional fuels and the incidence of respiratory illness or congestive heart failure (Smith 1987, Mumford et al. 1987, Chen et al. 1990, van Horen et al. 1993). Bloom, Craig and Malaney (1999) explore the relationship of biomass use with demographic factors. They posit the following hypothesis: Burning biomass in a poorly ventilated area may significantly harm many individuals' health, reducing life expectancy in a group of people. Unhealthy people, in turn, typically have less capacity to work sufficiently to earn income. As they earn less than they would if they were healthy, they continue to have very restricted access to health services and education and they, die disproportionately young. So, too, do their children, who are especially vulnerable to indoor pollution. Dependence on children for labor (including gathering of wood and dung, formation of dung paddies, etc.) and for old-age security leads people to continue to bear children at high rates. Aversion to the risk of infant and child death means that fertility behavior more than compensates for expected mortality, resulting in higher rates of population growth. When women have more children, both the women and the children tend to have worse health, more of the children die, and the status of women continues to stagnate.

Table 1 shows the results of cross-country regression analysis that examines the association between the use of traditional fuels and a set of demographic and health indicators, based on a sample of 108 countries for which the necessary data are available. These regressions evaluate the relationship of biomass use on fertility, mortality, population growth, and gender inequality, controlling for the effects of income differences across countries. The analysis does indeed show a strong association between a broad array of such demographic indicators and the ratio of traditional fuel use to total fuel use.

The effects of traditional fuel use on infant and child mortality rates are positive, statistically significant, and sizable in magnitude. The magnitude of the effects are comparable and interestingly differ from the results on the effect of traditional fuel use on the crude death rate, which, though positive, is smaller in magnitude and not statistically significant. This result is consistent with the view that the negative consequences of indoor air pollution are disproportionately experienced by children, who are physiologically most vulnerable to its effects. It is also striking that the statistically significant negative effect of traditional fuel use on life expectancy is larger for females than for males. Presumably, this result reflects the fact that women have greater exposure to the effects of indoor air pollution, since they spend more time indoors.

Fertility rates are also positively and significantly associated with traditional fuel use, as are crude birth rates. The magnitudes of these effects once again appear to be quite sizable. A 40 percent increase in traditional fuel use (which corresponds, for example, to the difference in traditional fuel use between Vietnam and Malaysia) translates, on average, into one extra birth per woman over her lifetime and into an increase of seven births per thousand population. The differential between the crude birth rate effect and the crude death rate effect explains why traditional fuel use has a positive and significant effect on the population growth rate. For example, the same 40 percent increase in traditional fuel use translates into an increase of nearly a full percentage point in the population growth rate.[1]

While this analysis does not deal with the important issues of reverse causality, it is certainly suggestive of yet another poverty-demography trap, with the poor being bound to patterns of energy use that are associated with high infant and child mortality and with high birth rates maintained in part by high demand for children's labor contribution. These demographic and production circumstances, in a context of low education levels, reinforce existing patterns of energy use. Continued dependence on wood for fuel helps to depress income and maintain rural poverty by (a) ensuring that time and money resources are devoted to collecting firewood, (b) harming the health of those who use it, and (c) abetting high birth rates. In the many areas where deforestation is taking place for agricultural purposes, the burden of gathering firewood, and all the associated derivative effects, is increasing, since ever-greater amounts of time are needed to reach areas where firewood can be gathered.

Breaking Out of the Cycle

The notion of a system of interlinkages which can lead to upward or downward spirals indicates that is possible to enter the system at various points. The discussion of the traditional linkages between human capital and demography emphasizes the importance of the provision of social services such as health and education (especially for girls) to the poor to as an impetus to change demographic behaviour. Improving labor markets for women, for example through access to credit, can have a similar effect, as much of the evidence from microcredit programs such as the Grameen Bank would indicate. Development of financial markets that the poor have access to can also change the incentives to have children as a form of old age security.

Of course, the other obvious point at which to enter the cycle is through directly affecting demographic choices. The above analysis has consistently assumed that all fertility is desired fertility. This is well known to be false. Unwanted fertility is a significant factor in the demographic equation for practically all developing countries. Access to contraception is particularly weak for the poor, and in rural areas. Family planning programs can have an considerable effect in bringing down fertility rates, and providing reproductive health services to the poor can enable them to share in the positive effects of the demographic transition.

The poverty-energy-demography nexus in particular can be targeted by taking measures to promote the availability of modern energy sources to the poor through policies and programs that increase their use of energy carriers other than biomass, or to improve the efficiency and cleanliness of biomass fuel use through modern technologies. For example, having utilities amortize the fixed costs of connecting to electricity and natural gas grids will lower what appear to be sizable barriers to the use of low-cost fuel in rural areas. So, too, will mechanisms that allow people in rural areas to “rent” the appliances needed to utilize energy carriers such as electricity and LPG or to provide smaller LPG canisters that therefore require smaller deposits.

[1] The results in Table 1 are robust to the inclusion of additional variables in the analysis, such as income inequality, rural population share, and region of the world, as well as to changes in the functional form in which income is included.

Providing access to credit is once again an important tool as it can help the poor overcome the high fixed costs associated with efficient energy use.

Table 1: The Relationship between Demography and Traditional Fuel Use

Dependent Variable	Constant	Percent Traditional Fuel Use	Log GNP per capita	Inverse Log GNP per Capita	R Squared	N
Crude Death Rate	-227.919**	0.007	13.247**	1044.726**	0.54	108
Infant Mortality Rate	-795.305**	0.247**	37.945**	4203.384**	0.83	108
Under 5 Mortality Rate	-1377.804**	0.494**	67.613**	7066.313**	0.82	108
Crude Birth Rate	66.412	0.176**	-5.336	-6.581	0.77	108
Total Fertility Rate	-0.011	0.025**	-0.213	37.326	0.78	108
Population Growth Rate	3.031	0.021**	-0.184	-3.546	0.43	108
Life Expectancy	213.215**	-0.088**	-5.453*	-816.024**	0.86	108
Male Life Expectancy	195.649**	-0.076**	-4.708	746.366**	0.84	108
Female Life Expectancy	231.647**	-0.102**	-6.234*	-889.108**	0.86	108
Life Expectancy Gap (F-M)	35.998	-0.026**	-1.526	-142.741	0.35	108

Note: Data from 1993 and surrounding years. Traditional Fuel includes fuelwood, bagasse, charcoal, animal wastes, vegetable wastes, and other wastes. Traditional fuel use is expressed as a percentage of total fuel use.
Source: Traditional fuel use data from United Nations *Energy Statistics Yearbook 1993*.
Demographic data from *World Development Indicators 1998,* World Bank CD ROM.