Estimating the Economic Value of Health Impacts of Climate Change

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How should we value the health impacts of climate change? The answer is, in principle, simple: we should value them by what people are willing to pay to avoid them. This includes the costs of averting behavior—the costs of the energy used to mitigate the effects of temperature extremes on health—as well as the cost of the illnesses themselves. Obtaining empirical estimates of WTP for health—for adults and children—in countries at all income levels is challenging. The purpose of this presentation is to discuss in more detail what empirical estimates are needed and how they might be obtained, in the short run, through benefits transfer.

Nature of Health Impacts to Be Valued

The number of deaths and illnesses associated with climate change are likely to be greatest in developing countries, at least over the rest of this century. Mc Michaels et al. (2004) estimate that in 2000, climate change was associated worldwide with 166,000 deaths—77,000 due to malnutrition, 47,000 associated with diarrhea, and 27,000 with malaria (see Figure 1). The highest number of deaths (per 100,000 persons) was predicted to occur in Africa, South Asia and the Middle East. It should also be noted that the majority of these deaths are children, and that deaths among children account for the bulk of the 5.5 million Disability-Adjusted Life Years (DALYs) that Mc Michael et al. (2004) estimate were lost due to climate change in 2000.

This implies that we must value the lives of children (and adults) in developing countries. The illnesses that these individuals suffer are also important and must be valued. These include non-fatal cases of diarrhea and malaria, respiratory illnesses and cardiovascular disease. Adults and children in higher income countries will also be affected by climate change. The same valuation concepts should be applied in all cases, as discussed in the next section.

Valuating Mortality

To value risk of death among adults, the appropriate valuation concept is what adults would pay to reduce their own risk of dying. For children, it is what parents would pay to reduce their children's risk of dying. Willingness to pay is constrained by ability to pay, and should increase with income, assuming life extension is a normal good. This implies that WTP will generally be lower in low-income than in high-income countries. It is often suggested that lives should be valued equally in all countries—that the same WTP amount should be used regardless of income. The problem with this suggestion is that it forces people in developing countries to spend more on risk reduction than they would choose, based on their own preferences. The correct valuation concept is what a person would pay for a small reduction in his risk of death.

By convention, the sum of WTPs for small risk changes is expressed as the Value per Statistical Life (VSL)—the sum of WTPs for risk reductions that sum to one statistical life saved. For example, if each of 10,000 people would pay $100 to reduce their risk of dying over the coming year, the VSL would be $1,000,000 (10,000*$100). The risk reduction (1 in 10,000) summed over 10,000 people would result in one statistical life saved.

Empirical estimates of the VSL for adults most frequently come from hedonic wage studies, which estimate compensating wage differentials in the labor market, or from contingent valuation (stated preference) surveys in which people are asked directly what they would pay for a reduction in their risk of dying. The empirical literature on the VSL in high income countries is large.[1] There are approximately 4 dozen compensating wage studies in high income countries (see, for example, Viscusi and Aldy (2003)) and over 4 dozen stated preference studies (Braathen et al., 2009). Several recent meta-analyses have summarized the results of these studies (Cropper, Hammitt and Robinson, 2011). The literature in middle income countries is much smaller.[2] Robinson and Hammitt (2009) review 8 wage-risk and 9 stated-preference studies conducted in 9 middle-income countries. Braathen et al. (2009) cite14 stated preference studies conducted in middle-income countries, but only one in a low income country (Bangladesh).

VSL Benefits Transfer

What is clear is that the developing country literature at this point is not sufficiently mature to provide estimates of the VSL for individual countries. This suggests transferring estimates from countries where better studies exist to countries for which there are no empirical estimates of the VSL. Most transfers are based on income differences between countries. The most common approach to benefits transfer assumes that the ratio of the VSL to per capita income is constant among countries. (This is equivalent to assuming an income elasticity of the VSL = 1.) Transferring values from the US, where this ratio is approximately 140 to 1, implies that the ratio of the VSL to income is 140 to 1 for all countries.

Recent analyses, however, suggest that an income elasticity of 1 may be inappropriate for low-income countries. This based partly on a comparison of the ratio of the VSL to income in high income countries with the corresponding ratio based on studies in middle income countries. Preliminary analyses (Cropper and Sahin, 2009) suggest the ratio is closer to 80 to 1 for middle income countries v. 140 to 1 for high income countries. This suggests that the income elasticity of the VSL is > 1. Analyses of the income elasticity of the VSL in the US (Costa and Kahn, 2004; Kniesner et al. 2011) and Taiwan (Hammitt, Liu and Liu, 2000) also suggest that the income elasticity of the VSL is larger at low incomes than at high incomes. Pending additional studies, Hammitt and Robinson (2010) suggest using an income elasticity of the VSL of 1.5 in addition to an income elasticity of 1.0 to provide a range of values of for the VSL in middle and low income countries.

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[1] Cropper, Hammitt and Robinson (2011) summarize this literature, including recent meta-analyses.

[2] I follow the World Bank's definition, based on market exchange rates. The groups are: low income, $995 or less; lower middle income, $996 - $3,945; upper middle income, $3,946 - $12,195; and high income, $12,196 or more.

Estimating the VSL for Children

There is a small but growing literature on parents' WTP to reduce health risks to their children, including mortality risks. In the US and Europe, revealed preference studies have used information on the purchase of car seats and bicycle helmets to infer WTP for reduced death and injury. Other studies are based on parents' WTP for chelation therapy for children with body lead burdens. Some of the literature relies on stated preference studies. As stated in a recent OECD volume on children's health (OECD, 2010) only 15 studies directly compare parents' willingness to pay for improvements in their own health with WTP for improvements in their children's health. Many of these studies value reductions in acute illness, and only one study was conducted outside of the US and Europe (Liu et al., 2000).

The consensus from studies conducted in high income countries is that parents are willing to pay more to reduce health risks to young children than to themselves—generally about twice as much—but that this effect decreases with child age. The result is also not universal: Jenkins et al. (2001) and Mount et al. (2001) find that parents are willing to pay more to reduce mortality risks to themselves than to their children. The USEPA uses the same VSL for children as for adults.

The question is whether the VSL is higher for children than for adults in low income countries; in particular, in countries with substantial under-5 child mortality and high fertility rates. There no studies of which I know that directly address this issue. In studies conducted for the World Bank (Larsen, 2011), VSLs used for children are often less than those used for adults. This is a topic clearly requiring more research. The literature on the allocation of food and health care resources within the household may shed some light on this issue.

Valuing Morbidity

Willingness to pay for avoided illness should capture the value of the pain and suffering avoided, as well as the value of time lost due to illness (both leisure and work time) and the costs of medical treatment. If some of these costs are not borne by the individual, and are therefore not reflected in his willingness to pay, the value of the avoided costs must be added to WTP to measure the total benefits of reduced illness. The Cost of Illness (COI) approach, which captures medical costs and lost productivity, is often used as a lower bound to the more comprehensive valuation concept.

In high income countries, WTP estimates for avoided morbidity are available for some illnesses, but COI estimates are often used to measure the value of avoided illness. Due to the heterogeneous nature of illness, providing WTP (or even COI) estimates for a variety of diseases is a huge task. The most sensible approach would be to determine the diseases that are likely to lead to the largest number of DALYs lost due to illness and to focus on obtaining COI estimates for these diseases.

Morbidity, especially in Sub-Saharan Africa, is likely to have impacts on the economy beyond traditional illness costs. Child morbidityis likely to affect human capital formation. (See for example, Alderman, Hoddinott and Kinsey(2006) on the impacts of malnutrition on human capital formation.) Malaria may have impacts on economic growth through land use, crop choice and other mechanisms (Gallup and Sachs, 2001; Tol, 2008). These effects are certainly worth exploring.

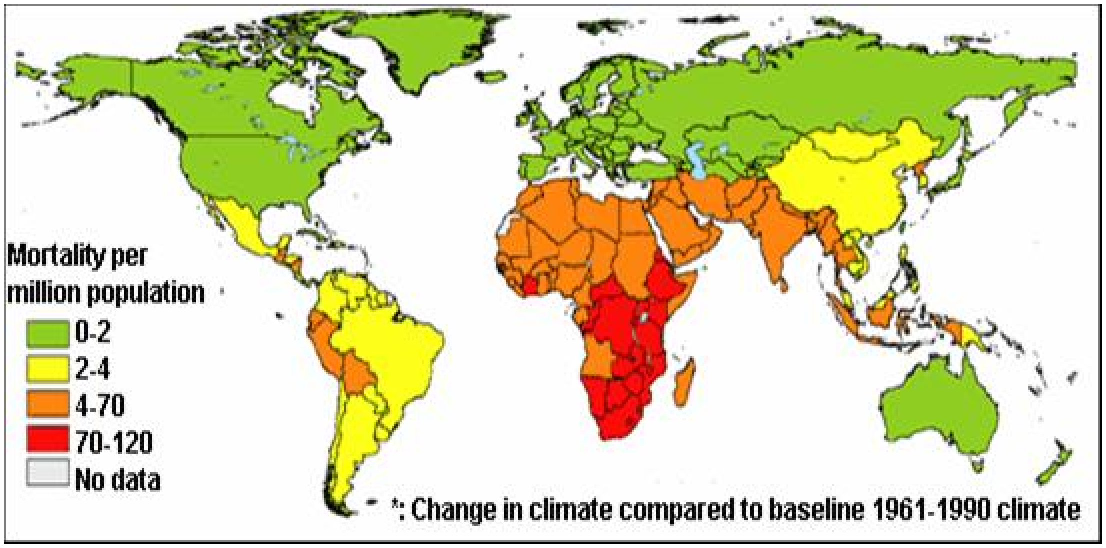

Figure 1: Estimated Deaths due to Climate Change in 2000, by WHO Sub-Region

Source: Map created by Center for Sustainability and the Global Environment (SAGE), University of Wisconsin using data from McMichael et al. (2004).

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