Presentation to OECD workshop
on socioeconomic impact assessment of chemicals management
Hosted by the European Chemicals Agency
Helsinki 6-8 July 2016

The Cost of Air Pollution: Method, Results, Conclusions

by

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Introduction

- This presentation reports on – rather, extracts from – a series of recent studies I have authored/co-authored (incl. OECD, 2014; WHO, OECD, 2015; Roy, 2016; Roy, Braathen, 2016; and the on-going work of the newly-founded Global BCA Working Group).

- It extracts from this to highlight some key features of the evolving method, the results and the conclusions of our calculation of the cost of air pollution.

Introduction (continued)

- Air pollution is, in the words of WHO, “the world’s largest single environmental health risk”. As at 2013, the global death toll from HAP was c. 3 million; the global death toll from AAP c. 3 million … *and rising*.

- But our subject today – what is relevant to this forum – is not air pollution *per se* but rather the progress gained in the calculation of its cost and its potential spill-overs to other areas of socioeconomic assessment.

Method

- Let’s start with first principles. What precisely do we mean by the “cost” of mortalities or morbidities or environmental impacts other than on human health?
- Economics supplies a clear answer. “Value”, aka “utility”, refers to the valuations that individuals place on the objects they desire – incl. consumption, leisure, health and life – and which they are obliged to trade-off at the margin. “Cost” is a measure of their loss.

Method (continued)

- Following Jacques Drèze, economics today possesses a standard method for calculating the cost of mortalities – that is, for calculating the loss of the valued object, life – at the level of society as a whole.

- This centres on the “value of statistical life” (VSL), or the marginal rate of substitution between consumption and a reduction in the risk of dying, as derived from aggregating individuals’ “willingness to pay” (WTP).

Method (continued)

- A simple logic. Each individual has an expected utility function, EU, relating the utility of consumption over a given period, U(y), and the risk of dying in that period, r, of the form: $EU(y, r) = (1 – r) U(y)$.
- The WTP to maintain the same expected utility in reducing risk from r to r' is the solution to the equation: $EU(y – WTP, r') = EU(y, r)$.
- VSL is thus the marginal rate of substitution between consumption and the reduction in the risk of dying, such that: $VSL = \delta WTP/\delta r$.

Method (continued)

- A simple search mechanism. As in OECD, 2012: “[A] survey finds an average WTP of USD 30 for a reduction in the annual risk of dying from air pollution from 3 in 100 000 to 2 in 100 000. This means that each individual is willing to pay USD 30 to have this 1 in 100 000 reduction in risk. In this example, for every 100 000 people, one death would be prevented with this risk reduction. Summing the individual WTP values of USD 30 over 100 000 people gives the VSL value – USD 3 million in this case.”

Defining method (continued)

- And thence: the cost of the impact under study is the VSL value x the number of premature deaths attributed to it; the benefit of a mitigating action is the VSL value x the number of premature deaths avoided.

- Work to be done in standardising the calculation of the cost of morbidities and other impacts. But NB: all evidence suggests that mortalities are the larger part of the cost of air pollution. (Cf. US EPA, 2011; Holland, 2014; OECD, 2014; WHO, OECD, 2015; Hunt, 2016).

Method (continued)

- For value transfer in global calculations: I start with the OECD (2012) meta-analysis of VSL studies yielding the base value of 3 million USD for the OECD world in year 2005. And a simple formula to translate this into values for selected countries (accounting for income differences) and in the selected year (accounting for income growth):
  $VSL\ C_{2010} = VSL\ OECD_{2005} \times (Y\ C_{2005}/Y\ OECD_{2005})^{\beta} \times (1 + \%\Delta P + \%\Delta Y)^{\beta}$

- … but with an income elasticity beta of 0.8 for OECD- and 1.0 for non-OECD countries (Roy, Braathen, 2016).

Results

- The results of applying a cost calculation using VSL values to the data on air pollution in the Global Burden of Disease evidence base (GBD 2010 and now GBD 2013): *millions* of deaths => cost of *trillions* of dollars (USD).

- In our latest calculation of the cost of AAP (APMP + AOP) for the 6 major EMEs known as the BRIICS plus the 34 member-countries of the OECD (Roy, Braathen, 2016): 2.3 million deaths => cost of 3.4 trillion USD.

Results (continued)

- Importantly: whilst the sum of deaths from AAP has fallen in the OECD countries taken together, the fall has been too modest to suppress a rise in the burden of its cost. As incomes rise, so too does the willingness to pay to reduce the risk of dying and, therewith, the cost of deaths from air pollution for any given number of deaths.

- In the BRIICS as well as in the rest of the world, the sum of deaths from AAP continues to rise. And, of course, so too does the burden of its cost.

Conclusions

- At one level, the conclusion from these results is clear. If the cost of air pollution runs into trillions of dollars, the benefits from ambitious policies to mitigate air pollution are likely to outstrip by far the cost of the said policies.

- And so it has proved: witness the United States EPA's 2011 estimate of a BCR of 31:1 in its *ex post* evaluation of the 1990 Clean Air Act Amendments – or the European Commission's 2013 estimate of a BCR of 42:1 in its *ex ante* evaluation of its proposed Clean Air Package.

Conclusions (continued)

- At another level, the conclusion to be drawn is more sobering. For the present availability of extraordinarily high BCRs is also evidence of a past policy failure – a failure to enact policies with ordinarily positive BCRs.

- There is a message here for economists. To make our output more readily usable (as the Global BCA Working Group aims to do). And also to communicate its simple essential meaning. Hence, my return to first principles.