Institution: University of Bath

Unit of Assessment: C16 Economics and Econometrics

Title of case study: Developing an economic valuation of environmental damage

Period when the underpinning research was undertaken: 2001-2009

Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Alistair Hunt	Senior Lecturer in Economics, former Lecturer, Research Fellow and Research Associate	September 2000 - present
Anil Markandya	Professor of Economics Honorary Professor	April 1996 - August 2011; 2011-present

Period when the claimed impact occurred: 2014 - December 2020

Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact

As part of a major European study, researchers at the University of Bath led the development of a method for calculating the monetary value of socio-environmental damage. This method has become the standard international approach for valuing environmental impacts and has been adopted by organisations across the world to evaluate projects and policies. It underpins the Environmental Profit and Loss Accounts that PricewaterhouseCoopers has produced for at least 7 major companies, which led to these companies reducing their environmental impacts by up to 30% within 3 years of adoption. Its use has also been recommended by the UK Department for Environment, Food & Rural Affairs, the Organisation for Economic Co-operation and Development, and the European Union.

2. Underpinning research

Funded by the European Commission's Directorate-General for Research, External Costs of Energy (ExternE) was a EUR10,000,000 series of projects that ran until 2005. The programme involved a multidisciplinary research team of engineers, economists and epidemiologists and examined environmental externalities in a number of sectors. University of Bath researchers Alistair Hunt and Anil Markandya were lead partners in ExternE and played a key role in the development of an original methodology, the Impact Pathway Approach (IPA). IPA is a method of estimating and monetising the socio-environmental damage caused by some form of economic activity. The IPA involves calculating the magnitudes of the various environmental channels by which the activity affects a population (e.g. the number of cases of asthma resulting from the increase in soot caused by a new coal-fired power station) and then estimating the total valuation of these impacts in monetary terms.

As part of NewExt, an ExternE project, Hunt and Markandya addressed the uncertainties that result from a lack of empirical data on the monetary valuation of mortality effects and refined the most important external cost value used in the IPA: the value of a prevented fatality (VPF), which measures the amount people are willing to pay to reduce by one the number of premature deaths (also known as the value of a statistical life) (**Ref 1**). An empirical survey was conducted in the UK, Italy and France to gauge this. In an article published in *Environmental and Resource Economics*, Hunt and Markandya, along with a colleague at the University of Maryland, analysed these data and found that the VPF was between EUR1,022,000 and EUR2,264,000 and that a person's health status and a country's income had a greater effect on VPF than a person's age

(**Ref 2**). Hunt and Markandya subsequently applied a similar methodology to São Paulo in 2009 (**Ref 3**).

On ExternE-Pol, another ExternE project, Hunt and Markandya extended the use of IPA by applying it to an energy security context and estimating the external costs due to the risk of quantity and price disruptions to energy supply in the European Union (**Ref 4**).

Markandya and Hunt further extended the IPA by applying it to national accounting. In doing so, they helped develop the concept of 'green accounting', which augments conventional economic accounts by quantifying the environmental damage resulting from economic activities (**Ref 5**). Traditional measures of economic activity, such as GDP, take no account of damage done to the stock of natural capital by environmental change, nor the loss of welfare that economic activity causes through increased pollution. Green accounting attempts to address this, thereby allowing companies to weigh profitability against environmental goals.

Hunt and Markandya contributed to the 2005 ExternE methodological update, which documented the final version of the IPA (**Ref 6**). Hunt and Markandya were the lead authors for Chapter 7, in which they explained how the monetary valuation part of the overall external cost estimates can be obtained and, specifically, how updated monetary values had been calculated for the health impacts of air pollution and amenity losses from noise, building damage, reduced visibility and transmission lines. In this chapter, Hunt synthesised the evidence relating to the valuation of health impacts of air pollution whilst Markandya synthesised the values relating to impacts on building materials, visibility and transmission lines. The pair were also contributing authors to Chapters 3, 8 and 9 of this report.

3. References to the research

1. **Hunt, A**, **Markandya**, **A** & Ortiz, RA 2004, *NewExt: Working Package 2 – Mortality Risk Valuation – Final Report*. Brussels. (*Available on request*)

2. Alberini, A, **Hunt, A & Markandya, A** 2006, 'Willingness to pay to reduce mortality risks: Evidence from a three-country contingent valuation study', *Environmental and Resource Economics*, vol. 33, no. 2, pp. 251-64. https://doi.org/10.1007/s10640-005-3106-2

3. Ortiz, R, **Markandya, A & Hunt, A** 2009, 'Willingness to pay for mortality risk reduction associated with air pollution in São Paulo', *Revista Brasileira de Economia*, vol. 63, no. 1, pp. 3-22. https://doi.org/10.1590/S0034-71402009000100001

4. **Markandya, A & Hunt, A** 2004, *Final Report on Work Package 3: The Externalities of Energy Insecurity*. http://www.externe.info/externe_2006/expolwp3.pdf

5. **Markandya, A, Hunt, A** & Milborrow, I 2005, Developments in Green Accounting. in A Markandya (ed.), *Green Accounting in Europe: A Comparative Study.* vol. 2, Edward Elgar Publishing Ltd, Cheltenham, pp. 15-33. https://doi.org/10.4337/9781845428136

6. **Hunt, A** 2005, Impact Pathway Approach: Monetary Valuation. in R Friedrich & P Bickel (eds), *ExternE Externalities of Energy: Methodology 2005 Update.* Office for Official Publications of the European Communities, Luxembourg, pp. 133-180. http://www.externe.info/externe_d7/sites/default/files/methup05a.pdf

4. Details of the impact

The ExternE IPA methodology, including the contributions of Markandya and Hunt at Bath, has become the standard international approach for valuing the costs of environmental damage. The Head of the European Commission's Research Directorate-General, Achilleas Mitsos, said "*The ExternE methodology is widely accepted by the scientific community and is considered as the*

world reference in the field of air pollution impact modelling. A ranking of technologies can be made according to their social and environmental impacts. Internalising external costs, by taxing the most damaging technologies or by subsidising the cleanest and healthiest ones, can give an impetus to new technologies and could help to achieve a more sustainable world" (**Ref 6**).

Impact on companies' valuations of environmental impacts

The global accounting firm PricewaterhouseCoopers has adapted the IPA to produce Environmental Profit and Loss Accounts (EP&Ls) for companies. EP&Ls are a method of monetising the costs to the environment of business activities and of estimating the value of the environmental damage associated with a company's activities, including its supply chain. As such, EP&Ls are an implementation of green accounting, which Hunt and Markandya have advocated in their work. PricewaterhouseCoopers cite the 2005 ExternE methodological update (**Ref 6**) throughout their 2015 technical paper on EP&Ls [**Source a**].

EP&Ls have gained popularity over the past decade and are seen as a first step towards ensuring that the prices of goods reflect the use of environmental goods and services. Some companies that have produced EP&Ls are the Kering Group (the parent company of Gucci), Puma, Stella McCartney, Philips, Novo Nordisk, the Taiwan Semiconductor Manufacturing Company, and ASUS. By allowing managers to see how big the environmental impact of their companies are and where in the supply chain this occurs, it allows them to make more informed decisions about their product design, sourcing decisions, manufacturing, and research and development. In the first three years Stella McCartney produced an EP&L, the company's impact per kilogram of material fell from EUR11.82 (in 2013) to EUR7.69 (in 2015) [**Source b**]. Similarly, Puma's environmental impact fell by 15% between 2013 and 2016, primarily due to the company switching to more sustainable leather and cotton suppliers, after their EP&L identified their supply chain as being responsible for far greater environmental impacts than their own operations [**Source c**].

Impact on international policy

In the UK, companies are required to factor in the effects on air quality when evaluating projects. The Department for Environment, Food & Rural Affairs (Defra) describes the IPA developed by ExternE as the "*best practice approach to valuing changes in air quality*". On 17 March 2020, they released new guidance [**Source d**] which advises firms to use the IPA if the impact is more than GBP50,000,000 or the main objective of the policy or project is changes in air quality. For projects where the impact is less than GBP50,000,000, Defra provided a toolkit which provides firms with more approximate "*damage costs*". However, these were themselves calculated by Defra using the IPA.

The methodology to measure the costs of air pollution established in ExternE was also taken up by the Organisation for Economic Co-operation and Development (OECD) in the publication Mortality Risk Valuation in Environment, Health and Transport Policies in 2012 [**Source e**]. With colleagues, Hunt also prepared a companion guide for the OECD in 2017 relating to morbidity. These documents continue to be used as a guide for EU countries and the approach used is recommended as a method for making similar calculations in non-EU countries [**Source f**].

Application of the ExternE methodology underpinned an EU Directive, the Ambient Air Quality Directive (Dir. 2008/50/EC), which required that air quality plans be developed for areas within which concentrations of pollutants in ambient air exceeded target values for the protection of human health, establishing emission abatement measures. The ExternE methodology has been used to perform a cost-benefit assessment of health impacts in many such plans, including in Antwerp, Athens, Lisbon and in several regions of Denmark [**Source g**, p. 441]. In 2018, the EU released guidance that formally recommended that the ExternE methodology be used as part of the air quality plans [**Source h**, pp.92-93].

5. Sources to corroborate the impact

a) PricewaterhouseCoopers (2015). Valuing corporate environmental impacts. PwC methodology document. https://www.pwc.co.uk/sustainability-climate-change/assets/pdf/pwc-environmental-valuation-methodologies.pdf

b) Stella McCartney (2015). 2015 Environmental Profit and Loss Account. https://www.stellamccartney.com/cloud/smcwp/uploads/2016/09/SMC-EPL-Final-Report-2015.pdf

c) Puma. 15 November 2017. Puma's environmental impacts decrease 15% since 2013. https://www.puma-catchup.com/pumas-environmental-impacts-decrease-15-since-2013

d) Air quality appraisal: damage cost guidance, 1 July 2020, Defra. https://www.gov.uk/government/publications/assess-the-impact-of-air-quality/air-quality-appraisal-damage-cost-guidance

e) Organisation for Economic Co-operation and Development (2012). Mortality Risk Valuation in Environment, Health and Transport Policies, OECD Publishing. http://dx.doi.org/10.1787/9789264130807-en

f) Hunt, A., J. Ferguson, F. Hurley, and A. Searl (2016). Social Costs of Morbidity Impacts of Air Pollution, OECD Environment Working Paper 99. https://doi.org/10.1787/5jm55j7cq0lv-en

g) Miranda, Ana, Carlos Silveira, Joana Ferreira, Alexandra Monteiro, Diogo Lopes, Helder Relvas, Carlos Borrego, Peter Roebeling. (2015). Current air quality plans in Europe designed to support air quality management policies. *Atmospheric Pollution Research*, Volume 6, Issue 3, May 2015, 434-443.

h) Code of Good Practices for Cities Air Quality Plans (2018). EU Urban Agenda – Partnership on Air Quality https://ec.europa.eu/futurium/en/system/files/ged/2019.02.18_code_of_good_practices_for_cities_aqps_full_report.pdf