Valuing impacts of environmental noise

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Deriving environmental values

- Revealed preference (e.g. hedonic pricing, travel cost method)
- Hypothetical questioning (e.g. contingent valuation method, stated preference (trade-off) approach)
- Dose response / impact pathway approach
- Mitigation cost
- …
valuation of transport-related noise in Birmingham
Bateman et al. 2004

ITS / TSG review
Nellthorp et al. 2005
revised TAG Unit 3.3.2

Transport Analysis Guidance TAG
Unit 3.3.2
2003

IGCBN 1st report 2008

dose response relationships review
Berry & Flindell 2009

IGCBN 2nd report 2010

hypertension review
Berry 2014

noise-related hypertension
Harding et al. 2011
productivity impacts of noise
Muirhead et al. 2011
economic value quiet areas
URS Scott Wilson 2011

Note: timeline represents publication dates
Results from study on property prices in Birmingham generalised to national averages for TAG appraisal

Several issues identified:

- Valuations for noise from road vs rail vs air traffic
- Valuations may capture effect of other environmental factors (air pollution, severance, pedestrian risk and safety, vibration, visual intrusion,…)
- Choice of lower noise threshold (55dBA vs 45dBA)
- Influential variables – annoyance, noise sensitivity, personal noise exposure, income, socio-economic and area effects, time of day, household tenure, …
- Residential vs non-residential | urban vs rural context
- Generalisation of study results – using household income vs property price | national averages vs local values

Nellthorp, Bristow, Mackie (2005)
Nellthorp, Bristow, Day (2007)
An Economic Valuation of Noise Pollution – developing a tool for policy appraisal

First report of the Interdepartmental Group on Costs and Benefits, Noise Subject Group

August 2008

documents available from https://www.gov.uk/guidance/noise-pollution-economic-analysis
1st IGCB(N) report – 2008

Identified four broad groups of impact:

- **Health impacts**, this includes the most severe health effects such as changes in cardiovascular mortality;
- Effect on **amenity**, which reflect people’s “conscious annoyance from noise exposure”;
- **Productivity**, which relates to areas such as reduced work quality through tiredness or noise acting as a distraction; and
- Environmental, where noise levels may impact on the functioning of the **ecosystems**, such as through birds breeding patterns.”
“Based on the existing evidence, initial estimates of the cost of noise pollution suggest that it is currently imposing a cost in excess of £7 billion per annum. This estimate is made up of between £3 - £5 billion in annoyance costs, adverse health cost of around £2 - £3 billion and productivity losses of another £2 billion. Therefore, even where best practice is being observed this means monetised impacts could be around half their true value.”

- Decision to prioritise work on estimating dose response functions between noise exposure and a range of health outcomes.
An Economic View of noise pollution:
developing a tool for economic assessment

First report of the Interdisciplinary Group on Costs and Benefits of Noise Subject Group

documents available from https://www.gov.uk/guidance/noise-pollution-economic-analysis

8 IGCBN reports
the work carried out by Babisch and van Kempen et al. deemed to provide the most robust assessments to date of the increased prevalence of acute myocardial infarction and other cardiovascular effects

- links between noise and transient sleep disturbance well developed, statistically-robust data and dose-response relationships, BUT
  - no consensus on any single dose-response relationship which could be used to inform cost benefit analysis
  - no quantitative link between acute or transient sleep disturbance caused by noise and any long term adverse health effects.
  - estimation of self-reported sleep disturbance is possible using dose-response relationships in 2004 EU position paper.

- strong evidence was found to link noise and hypertension, however evidence was not seen to be advanced enough to support fully quantitative assessment.
An Economic Vision for the environment: developing a tool for assessing the economic impacts of environmental policies.

First report of the Interdepartmental Group on Costs and Benefits of the Noise Subject Group

Estimating Dove.

Noise & Health –
Valuing the Human Health Impacts of Environmental Noise Exposure

A Response By
The Interdepartmental Group on Costs and Benefits Noise Subject Group (IGCB(N))

July 2010

documents available from https://www.gov.uk/guidance/noise-pollution-economic-analysis
2nd IGCBN report (2010)

- Indicative quantification of hypertension and sleep disturbance impacts.
- Continued use of the Department for Transport’s WebTAG monetary values for amenity impacts of noise.
- Prioritising and monitoring policy-oriented research in areas where impacts are believed to be significant, (i.e. hypertension and sleep disturbance impacts).
Environmental Noise:
Valuing impacts on: sleep disturbance, annoyance, hypertension, productivity and quiet.

Noise & Health –
Valuing the Human Health Impacts of Environment Exposure

A report informed by: the Interdepartmental Group on Costs and Benefits Noise Subject Group

July 2010

documents available from https://www.gov.uk/guidance/noise-pollution-economic-analysis
3rd IGCBN report (2014)

- Summarises current understanding of the links between environmental noise and various effects including sleep disturbance, annoyance, hypertension and related diseases.
- Includes some commentary on productivity and the value of quiet areas.
- Presents recommended methods to assess these impacts to support policy, programmes and project appraisal.
- Concerned solely with environmental noise from transport.
3rd IGCBN report – recommendations

1. Monetise (self-reported) sleep disturbance
2. Monetise annoyance using a DALYs approach
   • reduce risk of double counting (e.g. sleep disturbance, quiet areas)
   • a more consistent approach with other impacts
   • robust evidence to treat road, rail, air separately
3. For changes to environmental noise levels, consider the impacts on hypertension—and consequently on dementia and stroke, and monetise where proportionate. Continue monetising AMI impacts.
4. Prioritise further research into productivity impacts of noise
5. Value impacts on quiet areas, where sufficient evidence is available
• **Marginal values** – intended for use where noise is not expected to be a significant factor in decision making.

• **Detailed analysis** – should be considered where noise is central to the decision. Guidance provides key data such as the best available exposure response functions, but depending upon the significance of the issue “*it may however be necessary to undertake a bespoke review of the latest available evidence to supplement this information*.”
Uncertainties / limitations

- Disability weights for annoyance, (self-reported) sleep disturbance
- Impacts below 45dBA $L_{den} / L_{night}$
- “Change effect”
- Monetary value of one QALY/DALY (£30-80k)
- Statistical average response
- The influence of personal characteristics and context
QUANTIFYING THE LINKS BETWEEN ENVIRONMENTAL NOISE RELATED HYPERTENSION AND HEALTH EFFECTS

CLIENT PROJECT REPORT CPR1080
Estimating the productivity impacts of noise

P A Morgan, L Morris and M Muirhead

Prepared for: Defra, Air and Local Environment - Natural E
Project Ref: NO 0233

Quality approved: M Muirhead (Project Manager) M J Atiga (Technical Referee)

documents available from randd.defra.gov.uk
Noise-induced hypertension

Two-stage approach:

- estimate expected incidents of hypertension \(\text{function of noise exposure, odds ratios for noise-induced hypertension, prevailing risk of hypertension in the affected area}\)
- value the expected incidents of hypertension by quantifying and valuing consequential changes in incidents of dementia and stroke
- Does not include worsened impacts in those with pre-existing conditions
- Health values only reflect the cost to the individuals affected
Productivity

- Research investigated the potential pathways through which noise could affect productivity.
- Potential pathways:
  - noise experienced during working hours,
  - noise experienced outside of working hours;
  - noise impacts on academic performance linked to later-in-life productivity
- Indicative estimates for the productivity costs to England from sleep disturbance attributable to environmental noise ~ £2-4billion per annum.
Productivity – noise during working hours

Source of noise or disturbance or lack of noise

Environmental noise sources
Including road traffic, rail traffic and aircraft

Neighbourhood noise sources
Including industrial premises, retail premises, pubs and clubs, roadworks, construction sites

Neighbour noise sources
Including noise from inside or outside peoples homes

Effect

Loss of concentration

Disruption of communications

Stress, pressure or tension

Mechanisms linking effects of disturbance and loss of productivity

Accidents or personal injury

Errors or inefficiency

Errors or inefficiency

Loss of focus or poor multi-tasking

Loss in productivity
Long-term absent from work

Loss in productivity
Increased task duration

Loss in productivity
Increased task duration

Loss in productivity
Long-term absent from work

Loss in productivity
Increased task duration
Productivity – noise outside working hours

- Source of noise or disturbance or lack of noise
  - Environmental noise sources: Including road traffic, rail traffic and aircraft
  - Neighbourhood noise sources: Including industrial premises, retail premises, pubs and clubs, roadworks, construction sites, night-time deliveries
  - Neighbourhood noise sources: Including noise from inside and outside people’s homes

- Effect of disturbance
  - Evening/Night-time (at home)
    - Sleep disturbance
      - Tiredness or loss of concentration
    - Lack of recuperation or relaxation time
  - Daytime (at home or on the journey to/from work)
    - Stress, pressure or tension
    - Loss of focus or poor multi-tasking

- Mechanisms linking effects of disturbance and loss of productivity
  - Accidents or personal injury
    - Loss in productivity
      - Long-term absence from work
  - Errors or inefficiency
    - Loss in productivity
      - Increased task duration
  - Accidents or personal injury
    - Long-term absence from work
  - Errors or inefficiency
    - Increased task duration

- Change in productivity
Productivity – academic performance

Source of noise or disturbance or lack of noise
- Environmental noise sources including road traffic, rail traffic and aircraft
- Neighbourhood noise sources including industrial premises, retail premises, pubs and clubs, roadworks, construction sites
- Neighbourhood noise sources Noise from other classrooms

Effect
- Night-time (at home)
- Sleep disturbance
- Daytime (in school)
- Loss of concentration, Reduced academic performance

Mechanisms linking effects of disturbance and loss of productivity
- Short-term memory loss, lack of concentration
- Poorer grades and academic qualifications

Change in productivity
- Errors or inefficiency during employment
- Reduced skill levels in employment
- Loss in productivity Reduced GDP contributions

The period between these impacts may be a number of years
Economic value of quiet areas

- **Defining** quiet and quiet areas
  - quantitative methods, subjective methods, sound quality, potential use
- **Benefits** of quiet and quiet areas
  - improved creativity, problem solving, mental health, concentration and undisturbed sleep.
- **Value** of Open Spaces – survey in 3 green urban spaces
  - deriving a noise-sensitive demand curve for urban open spaces.
- **A conceptual approach** to valuing quiet and quiet areas
  - total use value for visits to quiet areas in England estimated between £19 million and £1.4 billion per year.