The Economic Journal, **113** (*June*), F362–F380. Published by Blackwell Publishing, 9600 Garsington Road, Oxford OX4 2DQ, UK and 350 Main Street, Malden, MA 02148, USA.

ENVIRONMENTAL OPTIMISTS, ENVIRONMENTAL PESSIMISTS AND THE REAL STATE OF THE WORLD – AN ARTICLE EXAMINING *THE SKEPTICAL ENVIRONMENTALIST: MEASURING THE REAL STATE OF THE WORLD* BY BJORN LOMBORG*

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This paper provides a detailed examination of Bjorn Lomborg's controversial and highly publicised book *The Skeptical Environmentalist: Measuring the Real State of the World*. The book examines a wide range of environmental and social issues and concludes that many of these problems are not as bad as the media and environmental organisations claim. This paper concentrates on food and hunger, deforestation, air pollution and climate change and finds that Lomborg's analysis suffers from several problems, including selective use of data, over-simplification of issues, posing the wrong questions and lack of objectivity in his quest for optimistic trends. Ironically Lomborg makes the same errors as those he criticises.

The recent publication of Bjorn Lomborg's '*The Skeptical Environmentalist: Measuring the Real State of the World*' has generated a considerable amount of interest within both the media and academia. A vast array of newspapers and magazines have published articles relating to the book and/or Lomborg himself, and many academics have felt the need to offer a defence against Lomborg's assertions. *The Skeptical Environmentalist* responds to what Lomborg calls 'the litany', that is, the overly pessimistic treatment of environmental issues by the media and many environmental organisations. Lomborg examines many of these issues (climate change, biodiversity loss, deforestation, poverty ...) and concludes that things are not as bad as we may think. In fact he goes further and says that many of these problems are actually improving rather than deteriorating. The response to such optimism has been largely, although not entirely, negative. The scientific community, in particular, appear to be somewhat affronted by a young Danish statistician claiming that he knows more about such problems than they do. *Scientific American, Nature* and *Science*, for instance, have all published lengthy articles by US scientists outlining their critiques of Lomborg's arguments. An 'anti-Lomborg' website has even been set up and, as if to characterise the increasingly personal nature of the response to Lomborg, he was greeted with a custard pie at a book shop in Oxford. One of the few instances of public support has been provided by *The Economist* who, in several recent articles, appear to be generally in agreement with many of Lomborg's claims.

There is no doubt that, at times, both the media and environmental organisations do provide a distorted impression of environmental problems. The

* I would like to thank Eric Neumayer for helpful comments and suggestions.

former are concerned with providing eye catching headlines whilst the latter are concerned with increasing membership. Presumably membership growth is a positive function of bad news rather than good. Since I have long suspected that these doomsday headlines do permeate society, I recently asked my undergraduate Environmental Economics students to tell me their impressions of the state of local air pollution in the UK. The vast majority told me that they thought air quality was deteriorating. They were therefore genuinely surprised when I showed them the steadily declining emissions trends that exist for virtually all local air pollutants in the UK. and most other developed economies. It is these false impressions that Lomborg is responding to. The arguments presented by Lomborg are persuasively written and the book gives the impression of being comprehensive and scholarly (515 pages long, with 2930 endnotes). However, doubts surrounding the objectivity (and hence reliability) of Lomborg's arguments emerge when you realise that he finds good news in literally every environmental and social issue that he examines. This, in fact, turns out to be the key failing of the book. Although he raises some valid arguments, these arguments tend to be one-sided. He sweeps away complicating issues and, by focusing on often highly aggregated data, provides a misleading impression of 'the Real State of the World'. Ironically, these are the same charges that Lomborg levels at the so-called 'litany'.

Many of the articles that examine *The Skeptical Environmentalist* do not subject the book to a rigorous examination (perhaps with the exception of Stephen Schneider's article on climate change in *Scientific American*).[1] Some take exception to the general tone of the book, whilst others rely upon anecdotal evidence to tackle Lomborg's arguments. However, since the book is extremely data intensive (it contains 173 figures, for instance) it is necessary to grapple with some of these data to assess the book's true worth. Thus, in the remainder of this review article I examine several key social and environmental issues that are addressed by Lomborg and illustrate how his claims are often somewhat misleading. It should be noted that it is impossible for a short article such as this to provide a detailed examination of each issue addressed by Lomborg, particularly given the length of his book. However, it should become clear that the weaknesses that I raise are common to many of Lomborg's chapters.

1. Food and Hunger

Like Malthus, individuals such as Paul Ehrlich and Lester Brown have long warned that food production will not keep pace with population growth.[2] Lomborg is keen to disprove such claims and presents data showing the significant increase in production of rice, corn and wheat in developing countries over the period 1960–2000; he illustrates how the daily intake of calories *per capita* in the developing world has increased steadily over the same period; and he shows how the

[1] *Scientific American*, January 2002.

[2] Ehrlich is best known for his book *The Population Bomb*, published in 1968. Lester Brown was, until 2000, president of the Worldwatch Institute who are responsible for the yearly *State of the World* reports.

proportion of starving has fallen in the developing regions. He therefore concludes that 'on practically *every* count, humankind is now *better* nourished. The Green Revolution has been victorious' (p. 67, original emphasis).

If we consider the developing world as a whole, then progress *has* been made. However, there are still hundreds of millions of people for whom no progress has been made, in fact, for whom the situation is actually deteriorating, particularly in Africa. It is notable that one of the UN Food and Agriculture Organisation(FAO) reports from which Lomborg draws his seemingly optimistic data provides the following summary 'in a time of unprecedented plenty 826 million people still do not have enough to eat. Far more disturbing is the fact that little progress is being made in bringing about significant reductions in the number of the world's hungry'.[3] The contrast with Lomborg's conclusion is notable, perhaps suggesting that Lomborg considers the FAO to be part of 'the litany'.

To illustrate how the proportion of those undernourished has fallen, Lomborg presents the following data.[4] It is important to be clear that Figure 1 provides a relative measure of undernourishment rather than an absolute measure. Nevertheless, we can see that for all developing regions, with the exception of the Near East and North Africa, thenumbers of undernourished, as a proportion of population, have fallen. For sub-Saharan Africa the figures are high, but slowly falling. However, even if we continue to measure undernourishment in terms of the percentage of total population, we find that there are a large number of sub-Saharan African countries for whom these numbers have increased. In fact, the data suggest that it is only really West Africa (and, in particular, Nigeria) that has

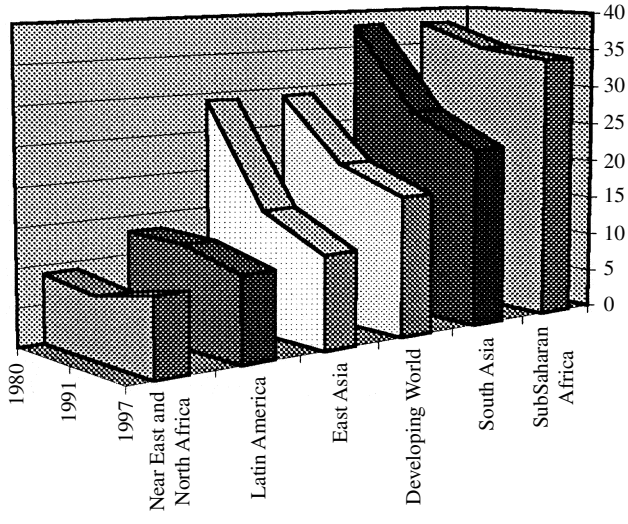

Fig. 1. *Regional Proportion of Undernourished* (%)

[3] See http://www.fao.org/news/2000/001002-e.htm as cited by Lomborg.

[4] Source: FAO (2000). Note that Lomborg also reports data for 1970, although that proved unattainable from the sources cited in the book.

experienced a significant improvement in the proportion of undernourished. Figure 2 illustrates the data for ten sub-Saharan African countries for whom the proportion of undernourished is not falling. In these countries, the undernourished therefore form a rising proportion of a rapidly rising population. There are other African countries in a similar position.

It is also, of course, debatable whether progress should be measured in relative terms. To his credit, Lomborg does discuss this issue and asks whether we would prefer to live in a world where 500,000 die of starvation out of a total population of 1,000,000 or a world where 750,000 die of starvation out of a population of 2,000,000. Lomborg argues that in the latter situation, although more people have died, an individual's probability of death is 37.5 per cent compared to 50 per cent in the first example. He therefore concludes that a relative measure is preferable and does not report the absolute numbers of undernourished. Whilst such an argument may be defensible, clearly the absolute figures cannot be ignored. Furthermore, it is very difficult to claim that real progress has been made if the absolute numbers of undernourished are rising. Figure 3 therefore reports the absolute numbers of undernourished in each developing region. It can be seen that these numbers are increasing in sub-Saharan Africa (SSA) and the Middle East and North Africa (MENA), while they are reasonably stable for Latin America and the Caribbean (LATAM). The right hand diagram shows the situation for Asia and the developing world as a whole (LDCs). We can see that the absolute number of people who are undernourished in Asia has fallen throughout the period 1980–97, and hence it is this region alone that drives the reductions experienced by the developing world as a whole.

If we now consider data on calories *per capita* per day, a measure of nutrition, we can identify very similar patterns. Figure 4 shows that, as Lomborg states,

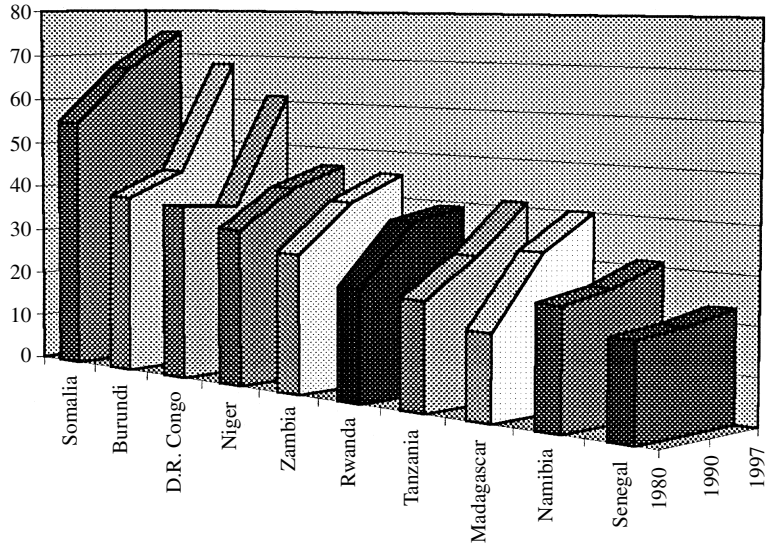

Fig. 2. *Proportion of Undernourished, Ten Selected African Countries* (%)

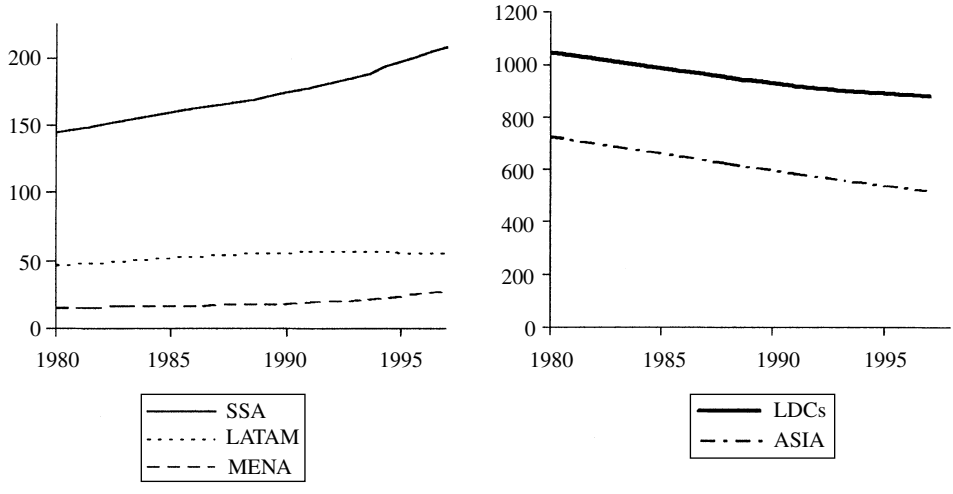

Fig. 3. *Absolute Numbers of Undernourished in Developing Regions* (millions)

calories *per capita* per day are rising in the developing world as a whole, again largely due to the influence of Asia. However, we also find that in central and east Africa, for instance, the levels of calories *per capita*, per day are low and actually falling.

Thus, to conclude, Lomborg's basic point has some truth. We do see some evidence of progress, particularly in Asia, which then influences the data for the developing world as a whole. However, since it is clear that levels of nutrition are actually worsening for hundreds of millions of people, his conclusion that 'humankind is better nourished' on 'practically every count' would appear to be somewhat misleading.

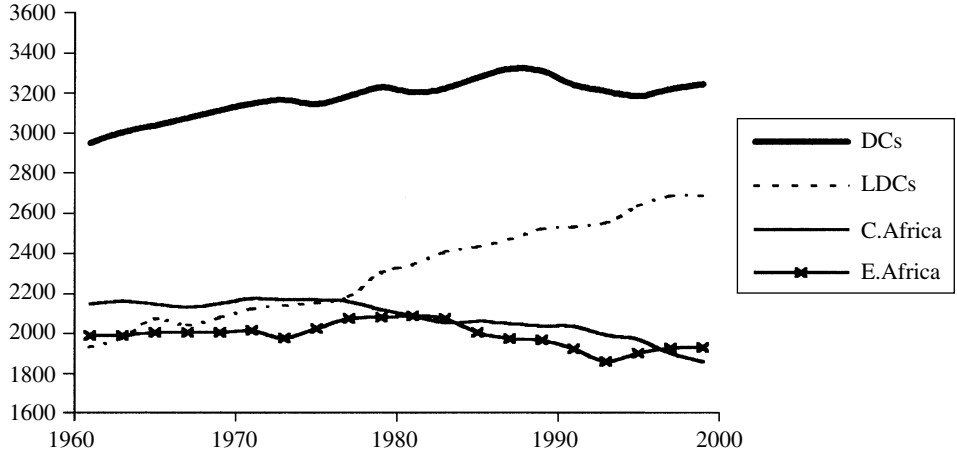

Fig. 4. *Calories Per Capita, Per Day in Selected Regions*

2. Air Pollution

As mentioned in the Introduction, emissions of virtually all local air pollutants have fallen steadily in the developed world over the last 30–40 years. Lomborg provides emissions and concentrations trends for the UK and the USA for lead, particulates, sulphur dioxide, nitrogen dioxide, and carbon monoxide and concludes that air quality in these countries has significantly improved. He then draws on the World Bank's World Development Report 1992 which contained one of the first 'Environmental Kuznets Curve (EKC) studies, later published by Shafik (1994). The EKC refers to an empirical finding which indicates an inverted U-shaped relationship between local air pollution and *per capita* income (see Figure 5). Lomborg argues that, although air pollution emissions are rising in many developing countries, the EKC indicates that it is possible to 'grow out' of environmental problems through technological advance and environmental policy. Thus, he claims that today's developing countries should one day experience the reductions in pollution currently enjoyed in the developed world.

The EKC relationship (see, for example, Grossman and Krueger (1995); Cole *et al.* (1997)) is typically explained in terms of the interaction of scale, composition and technique effects. The scale effect says that, *ceteris paribus*, economic growth will increase pollution. At low levels of *per capita* income, the scale effect is believed to be dominant. However, as *per capita* incomes increase, the composition of a nation's economy changes as we typically see a change of emphasis from manufacturing to services. The effect of these compositional changes is likely to be a reduction in the pollution intensity of output. In addition, as *per capita* incomes rise it is argued that the income elasticity of demand for environmental quality becomes positive resulting in an increased demand for environmental regulations. The resultant changes to the techniques of production are known as the technique

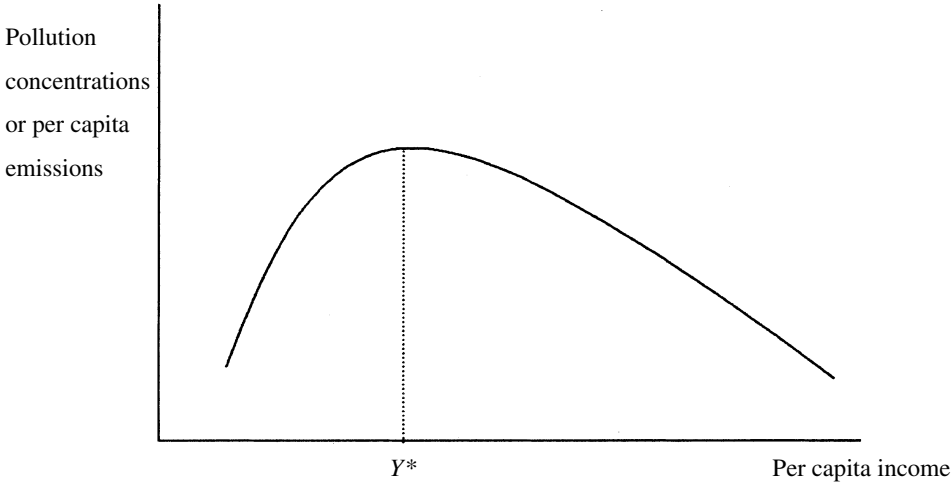

Fig. 5. *A Hypothetical Environmental Kuznets Curve (EKC)*

effect. The combination of technique and composition effects therefore eventually outweigh the scale effect, resulting in the downturn of the EKC.

It is the composition effect, in particular, that means it cannot be taken for granted that today's LDCs will follow the same pollution-income path as today's developed economies. If the pollution intensity of output has fallen in the North as a result of the migration of heavy industry to the South (or the market displacement of Northern industries by Southern industries), then it is unlikely that the South can expect to enjoy similar reductions in pollution intensity. In a recent EKC study, Suri and Chapman (1998) include the ratio of manufactured imports to domestic manufacturing production and the same ratio for exports, as determinants of *per capita* energy consumption. They find that the import ratio has a negative relationship with energy use whilst the export ratio has a positive relationship. This would suggest that compositional changes, as reflected in changing trade patterns, are influencing energy consumption and hence pollution. Cole (2000) also finds that the increasing cleanliness of the composition of the manufacturing sector is at least partly responsible for falling pollution in the developed world. However, other evidence has shown that the North is still a net exporter of many pollution intensive products (Janicke *et al.*, 1997) suggesting that such compositional changes may not be as significant as we may think. The related pollution haven hypothesis, which asks whether pollution intensive industries are attracted to countries with low environmental regulations, has also found only limited support (Lucas *et al.*, 1992; Birdsall and Wheeler, 1993; Mani and Wheeler, 1998), with other studies finding little evidence of the formation of pollution havens (Tobey, 1990; Van Beers and Van den Bergh, 1997; Xu and Song, 2000). As if to complicate matters further, recent papers by Antweiler *et al.* (2001) and Cole and Elliott (2003) find some evidence of pollution haven pressures but also find evidence to suggest that the high capital intensity of many pollution intensive sectors means these sectors are best suited to the capital abundant North. As trade becomes increasingly liberalised, such sectors may therefore find themselves subject to opposing forces of comparative advantage, with the net effect indeterminate.

In short, the impact of the composition effect and hence the extent to which LDCs can 'grow out' of pollution problems is unclear. However, this issue is entirely ignored by Lomborg who explains the downturn of the EKC purely in terms of the impact of environmental regulations. Since, in principle, there is nothing to stop LDCs from eventually attaining stringent environmental regulations, Lomborg's conclusions are more optimistic than they perhaps should be.

The issue of the composition effect aside, there are several recent studies that question the actual existence of the EKC (Stern *et al.*, 1996; Ekins, 1997; Stern and Common, 2001; Harbaugh *et al.*, 2002). Harbaugh *et al.* (2002), for instance, estimate the relationship between income and concentrations of local air pollutants and test the sensitivity of the results to different functional forms, to additional covariates and to changes in the nations, cities and years sampled. They find their results are highly sensitive to these changes and conclude that there is little evidence of a systematic relationship between local air pollution and income. Stern and Common (2001) also find that results are sensitive to the choice of countries

in the sample. In addition they find that both their sulphur dioxide emissions data, and their *per capita* income data are non-stationary and speculate that this may be the case for the data used in other EKC studies. Again, this questions the reliability of the econometric results. Finally, Vincent (1997) points out that there is often a lack of overlap between the developed and the developing country data series within a sample. Thus, all high income observations are from developed countries and all low income observations are from developing countries. The EKC may therefore reflect 'the juxtaposition of a positive relationship between pollution and income in developing countries with a fundamentally different negative one in developed countries, rather than a single relationship that applies to both categories of countries.' (Vincent 1997, page 417).

It is worth noting that the authors of many EKC studies warn against making the sort of conclusions made by Lomborg. Grossman and Krueger (1995), for instance, are careful to emphasise that 'there is nothing at all inevitable about the relationships that have been observed in the past. These patterns reflect the technological, political and economic conditions that existed at the time.' (Grossman and Krueger 1995, p. 372). Similarly, Arrow *et al.* (1995) point out that EKC studies do not imply that 'economic growth is sufficient to induce environmental improvement in general, nor that the environmental effects of growth may be ignored, nor, indeed, that the Earth's resource base is capable of supporting indefinite economic growth.' (Arrow *et al.* 1995, p. 92). Many studies also point out that EKCs are typically only estimated for local air pollutants, with global pollutants such as carbon dioxide often estimated to increase monotonically, or at a decreasing rate (with a *projected* turning point), with *per capita* income (Holtz-Eakin and Selden, 1995; Cole *et al.*, 1997). However, Cole and Neumayer (2002) show that even the existence of a turning point at a relatively low level of income, such as those estimated for local air pollutants, implies worsening air quality in developing countries for many years to come.

Finally, Table 1 provides estimation results for two EKCs estimated for *per capita* emissions of sulphur dioxide (SO_2) and nitrogen oxides (NOx). These are estimated using a region-specific fixed effects specification with data for 27 developed and developing countries with observations for 1975, 1980, 1985 and 1990. For both pollutants a within sample turning point is estimated, which is comparable with the results of other studies (e.g. Selden and Song, 1994).[5] If we momentarily put to one side the criticisms raised above, then these results are consistent with the story told by Lomborg that suggests we are winning the battle against local air pollution.

However, it is important to note that even these seemingly optimistic results still imply that, globally, total emissions of SO_2 and NOx continue to rise. Global emissions forecasts are estimated by forecasting regional *per capita* income up to 2020 and then estimating regional *per capita* pollution emissions using the estimates in Table 1.[6] These *per capita* estimates are then multiplied by population for

[5] Note that turning points for NOx are typically at higher income levels than for other local air pollutants as NOx emissions have fallen less dramatically than other emissions in the developed world. This reflects the large proportion of NOx emissions that stem from the ever growing transport sector.

[6] World Bank (2001; 1999) and UNEP (1993) provide *per capita* income and population data together with forecasts until 2020.

Table 1

Estimated EKC Results

	Sulphur Dioxide	Nitrogen Oxides
Y	150.23	3.88
	(7.6)	(4.4)
Y^2	−0.0087	−0.011
	(−7.7)	(−2.3)
R^2	0.76	0.85
n	108	108
Turning point (1985 US$)	8,561	16,506

Notes: Pollution data from UNEP (1993), income data from the Penn. World Tables (Summers and Heston, 1991).

each region to find total regional emissions. The aggregation of the regions then provides global emissions, as illustrated in Figure 6. It is clear that, although *per capita* emissions are estimated to peak at *per capita* income levels that have been surpassed in the developed world, global emissions are predicted to increase beyond 2020. This arises since, quite simply, reductions in emissions in the North are outweighed by increases in emissions in the South. In turn, this reflects the skewed nature of global income distribution, with far more people possessing income levels below the global *per capita* mean income, than above it.[7]

In sum, the evidence presented by Lomborg is simplistic. He assumes away any uncertainty surrounding the actual existence of a systematic relationship between income and pollution, and fails to consider the role of the composition effect

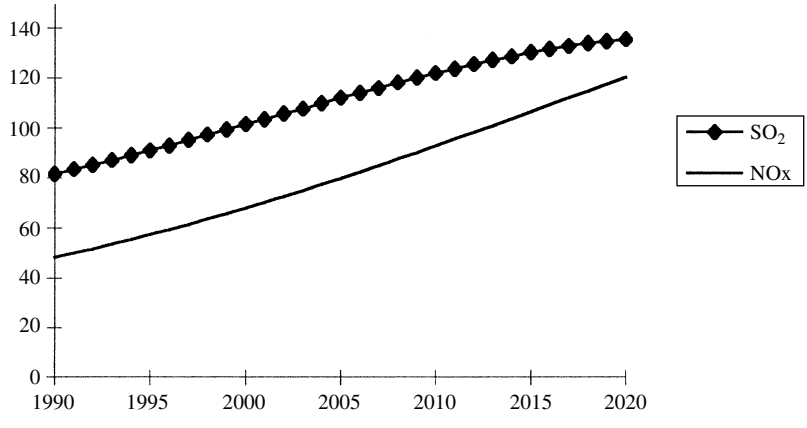

Fig. 6. *Projected Global Emissions of Sulphur Dioxide and Nitrogen Oxides, 1990–2020* (million tonnes). Based on the Estimation Results in Table 1

[7] Although the forecasts presented in Figure 6 are obviously imprecise, it is worth noting that an alternative sulphur dioxide dataset (ASL and Associates, 1997), estimates global emissions to have increased throughout the period 1850–1990, with little sign of a downturn even towards the end of this period.

which at least partly explains the reductions in emissions in the North. The composition effect raises a question mark over the possibility of the South following the same income-pollution path as the North. Finally, he does not acknowledge the fact that, despite the progress made in the developed world, global emissions of local pollutants appear to be still increasing. We have not yet won the battle against local air pollution.

3. Deforestation

The issue of deforestation has generated headlines throughout the last 20–30 years and is considered by many to be one of the most pressing environmental problems of current times. Lomborg, not surprisingly, disagrees and, in fact, devotes only eight pages to this topic. To illustrate that deforestation is less prevalent than we may think, he presents three different FAO estimates of global forest cover, covering various periods. These different estimates reflect different measurement methods, with only the most recent estimation method incorporating remote sensing (satellite imagery). The previous estimates were based fully, and even the later estimates were based partially, on national surveys. In such surveys, deforestation is defined as the removal of forests and their replacement by another land use class (such as mining or permanent agriculture). Logging, therefore, does not result in deforestation if the forest is allowed to regenerate, or simply left alone whilst someone decides what to do with it. There are therefore, by the FAO's admission, a number of uncertainties and potential inaccuracies within forest cover data. However, Lomborg points out that, at a global level, forest cover has fallen only very slightly in recent years. He concludes that 'basically...our forests are not under threat' (page 117).

The problem with Lomborg's argument is that, within his global aggregate, he is masking conflicting trends in tropical and non-tropical regions and also confusing natural forests with plantations. In the non-tropical developed world, total forest cover is actually increasing due to the increased use of plantations.[8] Natural woodland, which is of far greater ecological value than the often monoculture plantations, is still declining. However, in the biodiversity rich tropical forests total deforestation rates are much higher. Since plantations still form a very small percentage of total forest cover in tropical regions (approximately 1 per cent, for instance, in Latin America (FAO, 2001*a*)) this deforestation is almost entirely occurring in natural forests. It is notable that the detailed FAO report from which Lomborg draws his data again comes to a very different conclusion to him, claiming that over the period 1990–2000 'the world's natural forests continued to be lost or converted to other land uses at a very high rate' (FAO, 2001*a*, p. 343). Figure 7 uses this FAO dataset (FAO, 2001*a*) to illustrate trends in global forest cover together with forest cover in the regions containing tropical forests. Note that tropical forests are restricted to Latin America, Central Africa and Asia, with

[8] An extreme example is the UK, in which almost 70% of total forest cover consists of plantations (FAO, 2001*a*).

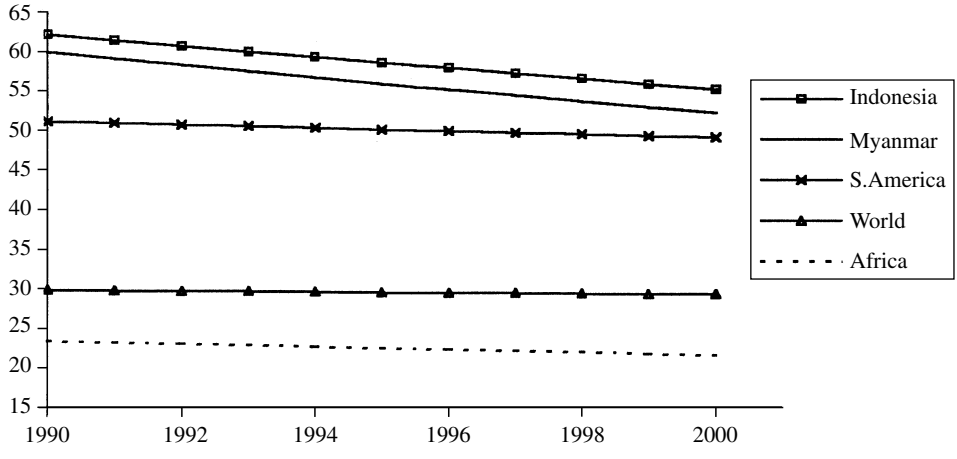

Fig. 7. *Changes in Forest Cover, 1990–2000* (Percentage of total land area)
Note that Lomborg provides only the world trend.

Brazil, Indonesia, Myanmar and the Democratic Republic of Congo containing almost 45% of all such forests.

During the 1990s, *annual* average deforestation rates were 0.2% for the world as a whole, but were 0.4% for South America, 0.8% for Africa, 1.2% for Indonesia and 1.4% for Myanmar. Thus, *during the 1990s alone*, South America lost 4% of its forests, Africa lost 8%, Indonesia lost 12% and Myanmar lost 14%. Only the sheer scale of Brazil's rainforests keep its figure as low as 4%. However, if we think in terms of land areas, the FAO estimates that Brazil lost over 22 million hectares during the 1990s, an area approximately the size of the UK. The only 'sub-global' deforestation rate provided by Lomborg is actually for the Amazon region as a whole. Drawing on INPE (2000), he claims that between 1978–99, as a share of its total forests, Amazonian deforestation has 'only been about 14%' (page 114). His use of the word 'only' implies that this is an insignificant sum, although given that this occurred in little over 20 years it would appear to be quite significant. Furthermore, given the deforestation rates above, it is likely that Africa, Indonesia and Myanmar lost an even greater percentage of their forests during this period.

Table 2 provides the percentage of original forest cover that remained in 1996, for a selection of countries. Original forest cover refers to estimated forest cover 8,000 years ago. This table alone indicates the extent of regional variations in deforestation rates.

Reporting only trends in *global* forest cover can therefore be seen to be extremely misleading. Deforestation is far more rapid in tropical regions than in temperate regions. Furthermore, the fact that tropical forests are so much richer in biodiversity compared to temperate forests, not to mention the fact that they also form human habitats, suggests that deforestation in tropical regions deserves special emphasis.

Given that tropical forests are typically located in relatively low income countries with rapid population growth, there may be a case for arguing that the socially

Table 2
Percentage of Remaining Forest Cover

Country	% of original forest cover remaining in 1996
Bolivia	77
Brazil	66
Indonesia	64
Malaysia	63
Mexico	63
Colombia	53
Cameroon	42
Myanmar	40
Thailand	22
India	20
Philippines	6

Source: World Resources Institute (2000).

optimal rate of deforestation is not zero (assuming that we could identify the full costs of deforestation). However, it is important to be clear that this is not Lomborg's argument. He is not claiming that the deforestation that is occurring is socially efficient. Instead he is arguing that deforestation is not happening, or else is so minor as to be insignificant. He offers no cost-benefit data to convince us of this latter point.

4. Climate Change

Lomborg's examination of climate change begins with a discussion of the science of climate change and, in particular, the issue of the sensitivity of global temperatures to emissions of carbon dioxide. The scientific consensus on climate change is represented by the Intergovernmental Panel on Climate Change (IPCC) and it is the predictions in their various reports that Lomborg considers. He points out the many uncertainties that underlie these estimates (of which the IPCC were well aware) and argues that carbon dioxide emissions may have a smaller effect on temperatures than the IPCC thought, citing a few supporting studies. At no stage does he cite a study or raise an argument to suggest that carbon dioxide may have a *greater* impact on temperatures. I am no expert on climate science but given the uncertainties that surround climate change it would be very surprising if such studies did not exist. In sum, this section reads as if it is written by someone wanting to prove that climate change may not be as bad as we, or the IPCC, think. A more balanced examination would have been welcome.

Lomborg then moves on to consider the potential costs of climate change, focusing on the effects on sea levels, agriculture, human health and weather patterns. Again he reviews the potential physical (and occasionally monetary) impacts and generally claims that the IPCC has over-estimated the true impact of climate change. Lomborg argues that the monetary cost of rising sea levels is likely to be significantly less than the IPCC's estimates since these concentrate on damage costs and assume that sea defences will remain constant as they are today or else will only be partially undertaken. Lomborg claims that the cost of such sea

defences will often be significantly less than the damage costs that would arise in their absence and hence in reality we would not allow significant damage costs to arise. What Lomborg does not discuss is the fact that these damage costs are generally estimated in terms of the lost market value of the land that is flooded. Where this is high, as in the developed world, then extensive sea defences are more likely to be built, but where land values are low, as in the developing world, the likelihood of sea defences being constructed would appear to be lower. Who, for instance, will provide the vast sums of money that will be necessary to protect Bangladesh and Mozambique? Some damage costs are inevitable and it is clear that the lost market value of the land is a significant underestimate of the true costs of the lost land. Samuel Fankhauser, who provides extensive estimates of the costs of climate change (Fankhauser, 1994, 1995; Fankhauser *et al.*, 1998), acknowledges that 'for many people their home land may be worth more than its market value. Further, the resettlement of people from abandoned areas may not take place without friction and may be subject to considerable adjustment costs' (Fankhauser, 1994, p. 32).

With regard to agriculture, Lomborg points out that climate change may provide both costs and benefits. The IPCC (1996) predicts there may be agricultural losses in both industrial and developing countries if the effects on temperature alone are modelled. However, increased concentrations of carbon dioxide may act as a fertiliser. If these effects are included, a doubling of carbon dioxide concentrations by 2060 is predicted to change cereal production in industrialised countries by between −4% to +11% while in developing countries they predict a fall of between 9% and 11%. The greater the adaptation measures undertaken, the greater the likelihood of benefits in the North and the smaller the costs in the South. For the world as a whole, the IPCC predicts a small loss of production. Other studies find different results. Eyre *et al.* (1997) predict a global agricultural net benefit, while Cline (1992), in his 'long term' scenario predicts world agricultural losses of $212 billion, equivalent to 35% of world agricultural output. Cline's figure of $212 bil1ion is equivalent to approximately 1.1% of world GDP. However, if world agricultural output fell by 35%, the impact would surely be considerably greater than a little over 1% of world output, particularly given the fact that the world population is still growing rapidly. Thus, as with the case of sea level costs, it seems likely that a cost such as this is an underestimate of the true cost.

In terms of other potential impacts of climate change, Lomborg argues that despite the increase in average temperatures throughout the last century, weather patterns are not actually becoming more volatile. He claims that weather related damage costs (such as insurance costs) only appear to be increasing because population densities are increasing and so too are the number of insured valuables. Finally he questions whether climate change will have a significant impact on human health. He does not tackle the issue of whether it is appropriate to scale the value of a statistical life according to *per capita* income, despite the media attention that this issue received when it was alleged that the IPCC valued life in developing countries less than life in developed countries. This is a notable omission from Lomborg's book, which claims to correct the misrepresentation of environmental

and social issues within the media. If 'life' costs are not scaled by income then the global cost of life from climate change is likely to increase (given that far more deaths are predicted in developing countries than developed countries). However, this clearly opposes the point that Lomborg wishes to make.

Turning to attempts to aggregate all the costs and benefits of climate change, Lomborg cites the IPCC's estimate of an *annual* cost of 1.5–2% of current global GDP ($480–640 billion) (associated with a doubling of carbon dioxide concentrations) and Nordhaus and Boyer's (2000) total estimate of $4,820 billion by 2100. Nordhaus and Boyer's figure comes from their Regional Integrated Climate-Economy model(RICE) and it is to this model that Lomborg turns in order to assess whether the costs of implementing the Kyoto Protocol will exceed the benefits in terms of climate change costs avoided. The RICE model estimates that, in its proposed form, with only carbon trading permitted amongst developed (Annex 1) countries, the Kyoto Protocol will lead to a net loss to society. By only capping developed country carbon dioxide emissions, the proposed Kyoto Protocol is predicted to have only a small effect on global emissions, due to the high growth rates of such emissions in developing countries. Thus, damage costs avoided will be minimal. Abatement costs are likely to be high, however, since it is the developing countries who have the lowest marginal abatement costs and yet they will not be trading permits. The RICE model does show that if global trading were permitted, the Kyoto Protocol would provide an overall net benefit.

Lomborg's recommendation is clear. Basing his conclusions solely on the RICE model, he states 'the cost of such a Kyoto pact, just for the US, will be higher than the cost of providing the entire world with clean drinking water and sanitation.' (p. 318). He does not enlighten the reader as to how he calculated this latter cost. It is notable that the faith Lomborg places in the RICE model's estimates appears to be greater than that of its authors. Nordhaus and Boyer stress the large number of uncertainties in their model. First, they acknowledge that the possibility of abrupt or catastrophic climate change cannot be ruled out. Second, they note that their model does not incorporate risk aversion and the possibility of learning, which may influence both the costs and stringency of abatement. Also, the possible interactions between climate change and market failures such as local air pollution and taxes are not modelled, nor are the potential effects on research and development. Finally, and perhaps most importantly, Nordhaus and Boyer note that the climate change damage function is 'poorly understood', particularly the response of developing countries and natural ecosystems to a changing climate.

Despite this poor understanding, and the inherent uncertainties surrounding the variety of damages that may arise from climate change, Lomborg makes the following bold statement; 'Global warming will not decrease food production, it will probably not increase storminess or the frequency of hurricanes, it will not increase the impact of malaria or indeed cause more deaths. It is even unlikely that it will cause more flood victims, because a much richer world will protect itself better.' (p. 317). No serious researchers on this topic appear to share such a strong conclusion. The IPCC (1996), Nordhaus and Boyer (2000), Fankhauser (1995), Tol (1995), Titus (1992) and Cline (1992), to name but a few, all predict

significant costs resulting from *every one* of the above categories (and many others). It is when he makes statements of that kind that Lomborg pushes our confidence in him to the limits. We have to remember that he makes this conclusion through reviewing a selection of studies of the impacts of climate change and through emphasising the most optimistic of their findings. In contrast to the studies cited above, he does not undertake original scientific research.

Michael Grubb (2000) also warns against putting too much faith in benefit-cost estimates such as those made by Nordhaus and Boyer. Specifically, he claims that Nordhaus and Boyer's estimates lie towards one extreme of a wide range and do not sufficiently reflect the risk aversion that should stem from such large uncertainties. The sensitivity of Nordhaus and Boyer's results to their chosen discount rate is also potentially important, but is not reported.

Whilst there may be question marks surrounding the economic efficiency of the proposed Kyoto Protocol, politically it represents something of a landmark, even though George W. Bush's refusal to ratify the Protocol has now thrown its future into doubt. As Grubb (2000) notes, 'The Protocol has moved the debate on international economic instruments from whether to use them, to how to implement them. Economists should not underestimate the scale of that achievement.' (Grubb, 2000, p. 31). Furthermore, it seems unlikely that we will ever achieve an economically efficient Kyoto Protocol (i.e. allowing global trade in permits) without accepting this present version, which should be seen as just the first step. Negotiations in Kyoto revealed that it is politically important for the developed regions to be seen to be addressing the problem of climate change. Since the developing countries consider the developed world to be largely responsible for this problem, their inclusion in later international agreements would seem more assured if the developed regions took the initiative now.

To conclude, Lomborg is correct to point out that there is a trade-off between low abatement costs today and high damage costs tomorrow (and *vice versa*) and he is also right to point out that there are opportunity costs associated with both of these expenditures. These are difficult issues that we should not shy away from. However, because these are difficult issues it is crucial that we address them in an objective and balanced manner. This is Lomborg's failing. He is keen to play down the damage costs of climate change, never once citing a study or raising an argument that suggests that we may be underestimating these costs, instead always suggesting that we are over-estimating them. In contrast, the reverse applies to his treatment of the costs of abating carbon dioxide. This lack of balance prevents Lomborg from providing a more useful contribution to the discussion of the appropriate policy response to climate change.

5. General Points and Conclusions

The above are just four of the many issues addressed by Lomborg, with space constraints preventing me from examining others in detail. However, it should be clear by now that his analysis of these issues suffers from a number of common problems.

(i) *Selective Use of Data*

The examination of food and hunger and forestry provide examples of Lomborg's selective use of data. He consistently reports trends that support his argument and rarely draws the reader's attention to data that may oppose it. Almost without exception, he limits his use of graphs to the presentation of 'optimistic' data. A related problem is his preference for highly aggregated data which, he states, have the advantage of summing all the positive trends and all the negative trends, thereby allowing us to assess the overall situation. At times this may be appropriate, but providing global data for a variable such as forest cover hides a multitude of sins and aggregates very different types of forest. Lomborg is also guilty of inconsistency and downright hypocrisy at times. Having informed us of his advocacy for global trends, Lomborg is highly critical of Lester Brown's Worldwatch Institute for providing a graph showing *global* grain production *per capita* falling from a peak in the mid 1980s (Worldwatch Institute, 1997). Lomborg shows that grain production *in developing countries* is still increasing and therefore states that Brown's global graph 'gives the wrong impression'. (page 94). This neglect of regional trends in favour of highly aggregated, or global, trends is precisely the charge that I have levelled at Lomborg in my examination of forestry, air pollution, and food and hunger, in particular.

(ii) *Asking the Wrong Questions*

Lomborg is careful only to engage in arguments that he thinks he can win. At times this means he does not focus on the key issues but on side issues (or even non-issues). An example is when he asks if we are running out of fossil fuels. Few working in the field of energy have asked this question, since the 1970s. It is widely known that the static reserve index (current reserves/current consumption) is actually increasing for most fossil fuels and minerals. In fact, the only quote which Lomborg found to motivate this chapter was from an obscure US magazine which predicted that we would run out of oil in the near future. Having set up this straw man, Lomborg spends 20 pages telling us that we are not in fact facing a short or medium term fossil fuel crisis. The far more pressing environmental problem, however, is whether the atmosphere can assimilate all of these fossil fuels.

A second example is Lomborg's examination of fish stocks. Having seen the FAO's (2001*b*) assessment of the world's fisheries, I was intrigued as to how Lomborg could put a positive 'spin' on this issue.[9] He does so by asking whether we will have enough fish to feed a growing population. Although he shows that the global *per capita* marine catch is falling, he also shows that if we include the contribution from fish farms then the total *per capita* production of fish is still rising. He is therefore able to conclude that we are not running out of fish as a source of food. However, his analysis is deficient in two ways:

[9] The FAO (2001*a*) estimates that in 1999, 9% of global fisheries were depleted, 18% were over-exploited, 47% were fully exploited, 21% were moderately exploited and only 4% were under-exploited.

(a) Lomborg does not appear to realise that the majority of farmed fish live on a diet of fish. Thus, the growth of fish farms is itself partly responsible for the over-exploitation of many marine fisheries. Although farmed fish are typically fed small fish which humans would not directly consume, these small fish would be a part of the food chain and would themselves provide food for the larger species. Fish farms can only ever provide a partial answer to declining marine fisheries.[10] These issues are totally ignored by Lomborg.

(b) By couching his analysis of fish stocks purely in terms of the provision of food he does not consider the ecological impact of over-fishing the oceans. The growth of the global marine catch appears to have been close to zero over the last 10–15 years (meaning that the *per capita* catch is falling). However, this has happened despite significant technological improvements such as the use of satellite technology to track schools of fish, increased net sizes and the use of factory ships which process the fish at sea thereby removing the need to keep returning to land. For the total catch to stagnate in the presence of these improvements would suggest that fish stocks, and the ecosystems of which they are a part, are far from healthy. This would appear to be an environmental issue as important as any of the others considered by Lomborg, yet he chooses to ignore it.

(iii) *Lack of Objectivity*

Lomborg's biased optimism permeates the entire book and manifests itself in a number of ways. One is his selective use of data, as mentioned above. Another is the lack of attention he pays to complicating factors. His arguments are often very simplistic and complications are mentioned in passing or in endnotes, if at all. In general, Lomborg appears far more accepting and less critical of 'contrarian' findings compared to findings that are often widely accepted within the scientific community. A prime example of this is his treatment of climate change where he tackles the scientific consensus position, as represented, by the IPPC, with relish, yet appears to accept any opposing studies at face value. He emphasises the uncertainty that surrounds climate change estimates but, on the basis of a few studies, argues that the IPCC's estimates (which were subject to three rounds of review by hundreds of experts) are too high. Such arguments are not the hallmarks of objective analysis.

To conclude, there is no doubt that environmental pessimists and scaremongers often portray a distorted impression of the world. If the media relay this message to the public then the public impression of environmental issues is likely to be equally distorted. In reality, there is evidence of progress for at least some environmental and social problems, and it is this progress that prompted Lomborg to attempt to measure 'the real state of the world'. This book could therefore have

[10] There is also some concern over the environmental impact of fish farms. Large concentrations of fish contained within a small area of water produce an unnatural amount of waste for the local ecosystem to assimilate. It is also feared that farmed fish may pass on diseases and parasites to the local wild populations. Fish farms have been partly blamed for the decline of wild salmon stocks in Scotland, for instance, although the fish farms themselves dispute this point.

provided a very useful contribution if undertaken in a more rigorous and balanced manner. As it stands, the book has attracted a great deal of publicity, no doubt sold a large number of copies, but ultimately earned little respect from those who study the issues that Lomborg addresses. The irony is that Lomborg makes the same errors as those he criticises, essentially providing the other end of the spectrum to the environmental pessimists. The 'Real State of the World' would appear to be somewhere between these two extremes.

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