Global Systems Impact

Appendix 2

The economic evaluation of environmental impacts cannot be limited by project boundaries. The internalization of a project's externalities requires the need to look beyond a project's geographic limits. Thus, all impacts, be they on-site, off-site, short-term or long-term must be taken into account. Relevant methods and procedures for the economic evaluation of more obvious and immediate environmental impacts are dealt with in the book's main text. However, accounting for a project's global systems impacts due to their apparent complexity deserves special attention. Although one can simply extend traditional environmental economic methods and arguments to analyze global impacts, several illustrations are provided to capture relevant issues.

I. What are global systems impacts?

Global impacts are transboundary in nature, but not all transboundary impacts are global. As its name suggests, if the impact goes beyond the boundaries of a nation state, they are classified as transboundary impacts. A well understood example, which can be used to explain transboundary impacts, is soil erosion. Soil erosion has on-site and off-site effects. Off-site effects, depending on geographical conditions, can go beyond a nation-state boundary. Suppose the eroded sediments are deposited in an international river, then the soil erosion has transboundary externalities for downstream countries along the river. The externality produces both private and public goods and bads. Expanding the case of soil erosion, loss of productivity for a certain plot of land can be seen as a private bad. On the other hand, loss in aesthetic value for affected water bodies can be seen as a public bad. Air pollutants such as sulfur dioxide and total suspended particulates can also be shown to have transboundary effects. These types of externalities can be easily recognized.

There are transboundary impacts that have a bearing on the whole world and these are classified as global impacts. These global impacts may affect a particular country or a group of countries more than they affect the rest of the world. To complicate the issue further, there are cases where the impact source countries and the affected countries cannot be identified. Global warming, is a global impact. It has been shown in many scientific studies that the increase in greenhouse gases (GHGs) is a major contributing factor of accelerated global warming. Global warming creates a complex array of environmental, social, and economic problems for countries. Because warming affects the whole world, it is clearly a global impact, but the effects may vary from one country to another. For instance, sea level rise that might result from global warming will create more environmental and socioeconomic problems in Bangladesh, Maldives or the Pacific Islands than in many other parts of the world. Another noteworthy point from this example is that the GHG emissions in these countries are much lower than the anticipated damages from their share of emissions.

The table below offers a simplified classification matrix, showing project, transboundary and global impacts. This three-level classification is based on the geographical nature upon which the impacts can be observed. Furthermore, the impacts are divided based on the consumption or nature of use of environmental goods and services—thus the dichotomy between private and public goods and services. Examples of impacts which fall under each category are shown in the table.

II. Can different accounting stances be employed?

It has been argued that EIRRs calculated from the accounting stance of a nation-state should include only costs and benefits accruing to "the country as a whole." In practice, some studies do not include global effects in the main calculation, but has subsidiary calculations showing how cost-benefit analysis changes when global effects are incorporated. Providing

Classification Scheme for Global Impacts

	Project	Transboundary	Global
Private goods/ services	*(a) Respiratory system damages to residents living in the vicinity of a power plant due to SO_2 or TSP emissions* *(b) Reduction of crop yield due to soil erosion*	*(a) Property damages due to acid rain from an adjacent country's power plant's SO_2 emissions* *(b) Eroded soil can be deposited in agricultural lands in the down-stream. Deposited silt can increase/ decrease productivity.*	*Health problems due to damages to ozone layer or sea level rise due to global warming resulting from power plant emissions*
Public or near- public goods/ services	*(a) Reduced aesthetic value or historical value for monu-ments in the vicinity of a power plant due to SO_2 or TSP emissions* *(b) Siltation due to soil erosion reduce aesthetic value of a lake in the project site*	*(a) Destruction of forests, reduction of biodiversity or aesthetic values from acid rain* *(b) Delta formation due to silt deposits in the downstream can cause flood.*	*Biodiversity losses, global warming, and damages to the ozone layer*

global costs and benefits as an appendix to the standard economic analysis work provides additional information. Yet it should be noted that economic theories suggest that global impacts should be an integral part of economic analysis work where a national accounting stance is used as the base. This raises several more questions. For example, how realistic is it to use national boundaries as the accounting stance for economic analysis of environmental impacts when they (the environmental impacts) do not have such limits? Can the analyst use two accounting stances, one based on the nation and the other taking into account the transboundary (global) impacts?

For practical purposes, it is quite correct economically to use several accounting stances—for instance the nation-state, the nearby region, and the "rest of the world." These stances are additive. It may be helpful to think of accounting stances as a set of books—one for each geographic region pertinent to the analysis (the nation state, the contiguous region, the rest of the world). Accounting for global effects is important because such effects travel beyond the obvious boundaries of the project. The fundamental problem in the economic evaluation of an investment (or of a new rule protecting, say, biodiversity) is to trace out all real (that is, excluding pecuniary) economic implications. In this case pecuniary effects are ruled out because they represent transfers and do not affect global efficiency (though they may well affect equity as in the earlier discussion of global warming effects on Bangladesh).

To illustrate the requirement for accounting for global impacts consider a simple example. Suppose country A seeks a loan from ADB to invest in a steel mill. Analysts would count the economic benefits of producing steel, being careful to use steel prices that accurately reflect the impact of this new steel production on world prices. That is, they would not want to price new steel output at the current price in the country if that price would reflect a distorted market. A "with versus without" analysis rather than a "before and after" analysis is conducted. As for the inputs used in constructing the plant (and in making the steel once the plant is finished) they would also want to be careful in assigning shadow prices.

Assume that this steel mill generates a large amount of toxic waste that is discharged into a nearby lake (entirely contained in country A). It would be incorrect to conduct an economic analysis of this steel plant and yet ignore the damages of this toxic waste discharge into the nearby lake. The net benefits to the nation must be computed so that the losses arising from the dumping of toxic wastes are subtracted from the benefits of steel production. If this is not done, then steel mills will appear to be artificially attractive on economic grounds, and the EIRR will be improperly (and incorrectly) inflated. ADB should not be investing in projects that are not efficient in the full sense (that is, projects with costs that exceed their beneficial effects).

Now, move the location of this steel mill to the very border of the country in which it is to be located, and assume that the toxic wastes from this steel mill are not dumped into a lake but rather into a river that flows immediately and directly into the neighboring country. Notice that the facts of pollution from this steel mill are unchanged, what has changed is simply the accounting stance in which those effects occur. The economist asked to evaluate this project would be guilty of malfeasance if she/he computed an EIRR that ignored the toxic damages in the neighboring country. Perhaps if the economist were working only for the country in which the mill is located, and if she/he were able to adopt such an incomplete accounting framework, she/he might get away with it. But the analyst would be guilty of practicing unsound economic analysis.

If the country building the steel mill sought funds from an external funding agency then there is certainly no incentive to undertake a fraudulent evaluation. Notice that ignoring the damages (whether they occur in the country of the project or in a neighboring country) gives a false impression of the full benefits of the project. The fact that in one case the damages are in country A, while in the second case they are in country B, does not change the economics at all. One may think it correct to ignore costs and benefits that fall outside the national boundaries. But this cannot be the case. If ADB undertakes projects in which major costs (pollution) are not accounted for, then it is promoting inefficient projects.

Now relate this to carbon emissions and global systems impacts. Carbon emissions add to GHGs and accelerate global warming. The figures cited in the box below can be used as a basis for estimating total damages from carbon emissions. If those damages must be apportioned then we might take some small fraction and attribute them to the nation that produces the gases, with the rest of the damages falling elsewhere in the world. But the total damages (in the nation, plus elsewhere) must be counted as the costs of carbon emissions from the new project. For the calculation of the EIRR the total damages must be debited against the project. If they are not, then an external financing source (say ADB) is causing global harm by supporting projects that impose carbon damages on the entire world. It

Estimating global systems impacts: Carbon as an example

Carbon dioxide (CO_2) is released by plant and animal respiration and is a product of the combustion of carbon-containing materials. Carbon monoxide (CO) is formed by incomplete fossil fuel combustion. CO_2 is the primary "heat-trapping" gas associated with global warming. Several authors have produced provisional estimates of global warming damages as shown in the table below.

Alternative damage costs of global warming

	Cost per ton of carbon equivalent ($)	Cost as a proportion of gross world product
Nordhaus (1991,1992)	1.83	0.25
	7.30	1.00
	14.60	2.00
	66.00	2.00
Cline (1992)	8.10	1.10
Ayres/ Walter (1991)	15.30-17.50	2.10-2.40
	69.30-79.20	2.10-2.40
Fankhauser (1992)	14.00	1.50

Source: Adapted from Brown and Pearce.

Based on global warming estimates, the Intergovernmental Panel on Climate Change (IPCC), and other sources estimated global climate change damage from carbon emissions for the case studies using the values below:

Average annual global damages from carbon emissions

Year	Total damages ($)
1991-2000	7.85-17.66
2001-2010	8.64-19.43
2011-2020	8.90-20.03
2021-2030	8.89-20.00
2031-2040	8.72-19.63
2041-2050	8.53-19.20

The values assume that average global temperatures will rise at a linear rate to 2.5°C by 2100.

Source: Adapted from RCG/Hagler Bailly, "Global Climate Change Damage Spreadsheet."

Carbon sequestration as a global benefit

The damage estimates may also be applied to assess the impacts of changes in land use—particularly where forests are concerned. Forests play a role as carbon sinks. Forest ecosystems store 20 to 100 times more carbon per unit area than croplands and play a critical role in reducing ambient CO_2 levels by sequestering atmospheric carbon in the growth of bio-mass through photosynthesis. When a forest is cut down photosynthesis ceases, and if the forest products are burned then carbon stored by the trees in the past will be released as CO_2, contributing to the risk of global warming.

The storage of carbon in biomass or carbon sequestration, when used in connection with policy instruments, refers to afforestation and reforestation programs designed to increase carbon sinks so as to offset emissions of CO_2 and other greenhouse gases. Carbon will be released at different rates according to the method of clearance and subsequent land use. The table below shows the change in carbon storage as a result of various land-use conversions.

Carbon storage in different land uses (tC/ha)

	Biomass	Soils	Total
Closed primary forest	167	116	283
Closed secondary forest	85-135	67-102	152-237
Open forest	68	47	115
Forest fallow (closed)	28-43	93	121-136
Forest fallow (open)	12-18	38	50-56
Shifting cultivation (year 1)	10-16	31-76	41-92
Shifting cultivation (year 2)	16-35	31-76	47-111
Permanent cultivation	5-10	51-60	56-70
Pasture	5	41-75	46-80

ha = hectare, tC = tons of carbon.

Source: Adapted from Brown and Pearce, 1994. "The Economic Value of Non-market Benefits of Tropical Forests: Carbon Storage" in Weiss, J. (ed.) 1994. The Economics of Project Appraisal and Environment. *England: Edward Elgar Publishing Ltd.*

does not matter that the nation is the borrower, because by their borrowing they are imposing costs on the rest of the world.[2]

III. Can global impacts be a direct part of the national accounting stance?

Although the previous section shows the need for integrating global impacts into project-level economic analysis, there may still be concern about the inclusion of global impacts. Two possibilities arise:

1. An international financial organization (such as ADB) undertakes project analysis work with the nation-state at the center; impacts to the nation are relevant and others are not.

2. While there may not be disagreement about presenting all costs and benefits of a project, some may suggest that it should be done on the basis of different accounting stances without necessarily integrating them. That is, the nation cares only for the costs and benefits relevant to it so a project analysis based on a national accounting stance does not have to present all the benefits and costs of the project. Therefore global benefits and

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[2] *The development of a least-cost shadow project to mitigate global emissions as a component of total project cost has also been suggested as a way of capturing global impacts. This solution takes global environmental cost into account, yet it does not provide specific solutions for capturing global environmental benefits created by a project. Some studies have shown that the use of a shadow project grossly underestimates environmental costs. For example, netting out against cost — the ancillary health benefits from reducing NO_x in the calculation of the cost-effectivness of reducing nitrate loadings to a lake — does not provide a reasonable estimate of health benefits from NO_x reduction in polluted air. Resources for the Future (RFF) conducted a study where the benefits associated with conventional air pollutant reductions was netted out against cost of carbon control. In this approach it is appropriate to add the damage from additional global warming to the cost of a project instituted for some other reason. However, it is not necessarily appropriate to net out control cost (least cost). The damage may far exceed, or be far lower than, least cost. If this is the chosen approach, there should be an extensive caveat on the methodology, including a statement that cost is not an appropriate substitute for damage.*

> costs must not be added in a project analysis conducted on the basis of the national accounting stance.

Take the example of a nation that was using its own funds to build projects then extra-nation impacts (both costs and benefits) might be ignored. In doing so the nation would be taking the position of an individual firm that ignores costs imposed on others by its pollution. The concept of total economic value presented in the main text's Figure 1 does not permit such a narrow analysis. It requires that all five components of value be taken into account. For example, use values are based on consumer's immediate needs while existence value reflects altruistic aspects of a consumer's utility function. The simple procedure of multiplying price by quantity cannot be applied, as a value of environmental goods and services, when the commodity is not traded in a well-developed market. Thus, taking only the nation-based costs and benefits for a project is incorrect. Such an approach does not estimate the nation's willingness to pay comprehensively, in terms of global welfare.

An international organization that uses regional and international funds to undertake development projects that impose costs and benefits on the region (and the larger world) cannot act in a cavalier manner. It must insist that all costs and benefits—including global ones—be taken into account. The issue of global impacts must be addressed together with the financing aspects of the development projects. It does not make economic sense to discuss only one side of the coin. If project funding is from an external source, the nation-state should allow projects to move forward only when all global impacts of the project are recognized. Otherwise, even if the nation ultimately repays all of the funds necessary for the project, adversely affected countries will surely not wish to contribute to the financing of a globally polluting project. That is, why should country B, through its financial contributions to ADB, be made to bear the social costs of projects built in country A? This is bad politics and faulty economics. If this happens country B is forced to pay twice—once to finance the project, and then as a recipient of the external (extra-nation) costs.

Consider another situation in which some pollution from an ADB-funded project generates private costs on neighboring countries. An example might be acid rain that destroys trees in a neighboring country. Those pollution effects are not public in the sense that acid rain falling on one's trees is not therefore available also to fall on another's trees. In Baumol and Oates' (1975) terminology, acid rain is a "depletable" bad. It can also be argued that SO_2 ingested by one person is not available to harm another and therefore SO_2 emission can be a private bad (on the site). In another situation SO_2 can function as a GHG and create a public bad to the project site, the country in which the project is located, and the globe. That is, some pollution, even though it travels to another place and is "consumed" as a private bad, can also be a public bad. In other words, the classification of a pollutant can be complex and we must be careful to make sure that pollution effects are properly accounted for; the bio-physical relationships and other factors must clearly be established before making conclusive statement about the nature of the pollutant.

As shown in the previous table, environmental impacts of a project can fall under six broad categories. The last cell provides an example of a pollutant that can be a global public good/bad. Public goods can be valued and included in the economic analysis of environmental impacts through various methods—including different contingent valuation methods. There should not be, at least in theory, any difference in the economic assessment of a public good merely because of its location. However, there are differences due to existence in markets, institutional arrangements, and beneficiary locations between public goods in project site and global public goods.

Based on externality theory and public good theory it is possible to add these (national and global) benefits/costs. That is, we can certainly add (or analyze in the same context) global impacts to the national accounting stance. For example, agreements in the Kyoto Protocol under the United Nations Framework Convention on Climate Change (UNFCC) allow the Organisation for Economic Cooperation and Development and Eastern European countries (called Annex 1 countries) with legally binding emission targets, to reduce emissions in non-Annex 1 countries through specific projects and other activities. When the countries sign this type of agreement they are obliged to adhere to conditions stipulated in the agreement. In other words the countries have agreed to treat say CO_2 as a resource which was not considered as a resource thus far. Then, as in the case of other public goods, we take the nation state's willingness to pay as a proxy to value the global benefits/costs of the impact in question. In other words when a nation signs an international protocol, the nation is saying that (whatever the impact in question) this is our willingness to pay for global welfare.

In addition, The World Bank Global Carbon Initiative estimates that by the year 2005 the potential market for carbon emission trading could range from $3 billion to $16 billion. In principle, emission trading can be achieved by creating offsets such as carbon sink forests, district heating upgrades, and the utilization of renewable energy sources. There are various other systems that have been developed to address the global impacts. The Joint Implementation and the Clean Development Mechanism, are two other examples where large amounts of resources have already been transferred. The Forest Absorbing Carbon Dioxide Emission (FACE) was established in 1991 by a consortium of Dutch power companies with the objective of planting trees as carbon sinks for absorbing some of the CO_2 produced by their power stations. In Sabah, Malaysia, the FACE project plans to eventually establish 1,000 hectares of forests per year over a 23-year time period. Similarly, the New England Power Company seeks to reduce its CO_2 emissions by introducing reduced impact logging in Malaysian tropical forests. It is estimated that this can reduce the cost of CO_2 damage from $28 to $25 per ton. There are many other worldwide examples showing carbon reduction partnerships. Carbon trading is becoming a real market transaction. Thus, due attention is required in taking into account the economic evaluation of environmental impacts. International agreements such as the Basle convention, the Montreal Protocol and domestic pollution control policies adopted in many countries all serve to strengthen the rapid development of emission trading markets.[3] But the interesting point here is that if markets are developing for global environmental impacts, there is a need to account for such goods and services in economic analysis regardless of what particular accounting stances are used.

Despite these arguments, an analyst may still omit global systems in an economic analysis based on a national accounting stance. This would

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[3] *According to the World Development Report (1999/2000), since the 1972 Stockholm Conference on the Human Environment, governments have signed more than 130 environmental treaties, with increasingly substantive regulatory provisions.*

result in an incomplete analysis. If an analyst decides to perform global impacts analysis, the following good practices may be considered:

(i) Completeness of Information.

- All benefits/costs should be accounted and included in project documents and background reports (such as EIAs). When exact data is unavailable, probabilities, uncertainties, and likely scenarios must be given.

- If economic valuation cannot be undertaken, biophysical information should be provided for informed decisions regarding risks (local, national, regional and global) attached to the project.

(ii) Clarity in Assumptions. All assumptions (economic, social, biophysical and engineering) relevant to the analysis must be clearly stated and their validity must be examined. The usual economic assumptions to document are prices, quantities, tradability, and consumption patterns. Examples of biophysical and engineering assumptions relevant to the analysis include growth patterns of trees or forests, lifespan of GHGs, and technical reliability of mitigation measures.

(iii) Identification of Market and Institutional Conditions. Institutional arrangements for global impact mitigation, government commitments, and national and international agreements should be clearly stated.

(iv) Clarity in Methodology. When a market mechanism to account for global impacts exists, the mechanism should be documented and resultant inputs should be used. All methods, conversions, valuation, quantification, pricing and adjustments used in the valuation process should be clearly stated, and the justification for the selection of the methodology should be provided. Local, national, regional, and global distributional impacts should separately be identified, quantified, and presented whenever possible.

(v) Transparency. Valuation should be carried out prudently, with the analysis providing an annotation of all procedures for transparency and replicability. Widely accepted and reliable sources should be used as creatively as possible without sacrificing the credibility of the analysis.

In the assessment of global impacts, it should be clear that the analyst does not replace the duties of the decision-maker. A global impact and its economic consequence is only one of many aspects which decision-makers need to consider to make an informed decision. The analysis should provide information, including risks associated with each decision option. The analyst must be accountable for providing the maximum relevant information possible. Presentation can suit the decision-makers' need, but information should be complete rather than selective. The decision to integrate or dissagregate costs and benefits is up to the decision maker. The decision-maker bears the risk of including or excluding such information into the decision process. The main goal of undertaking such an analysis is to facilitate decision-making while providing all benefits/costs including risks, which would have otherwise been unknown if all impacts were not fully accounted.

The preceding section illustrates that—whether global impacts are private or public, goods or bads, whether markets exist or whether there is a special institutional mechanism developed to address global environmental impacts—global benefits and costs can be presented in project-level economic analysis.