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Financing the Provision of Global Public Goods

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Abstract

This paper examines the concept of global public goods (GPGs) and in that context explores the extent of aid (ODA) presently being diverted to GPG provision and whether such diversion skews aid-flows towards some recipients and whether diverting aid to GPG provision crowds out aid for conventional development activities. These are examined on the basis of OECD data for the late 1990s. The main argument of this paper is that ODA should not be used for financing GPG provision by developing countries. Instead, it is suggested that other sources of financing the provision of GPGs should be developed keeping in view the various technologies by which the GPGs can be produced and design principles for supra-national institutions. Various arguments from Sandler, Barrett and Kanbur are considered. In particular, Kanbur's suggestion of two tensions involving the principles of economies of scale, subsidiarity, economies of scope and specialization, is explored further. Some examples of issues where a GPG is produced as a joint product of actions by national governments are considered by looking at data on eight different indicators for 1995. Problems in using the joint product approach to GPG provision are also discussed.

Keywords: global public goods, international organizations, aid, externality, Global Environment Facility

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1 Introduction

Pure public goods are goods that fulfil two characteristics. It is not possible to exclude anyone from using them (non-exclusive); and one person's consumption of the good does not diminish the amount of good available for others (non-rival). If exclusion is either technically not feasible or is very costly, it is argued that such public goods will not be supplied in efficient quantities by the market mechanism. Since exclusion is not feasible, economic agents might as well wait for the good to be provided and then free-ride. This is often given as justification for governments to provide the public goods and finance their provision through coercive payment (taxation). In a well-known article, Ronald Coase (1974) examined the case of lighthouses and pointed out that some public goods are indeed produced by market mechanism.¹ Until recently, discussion of public goods provision in public finance text-books is limited to national or local public goods.² However, during the last few years, a number of important studies have extended the concept of public goods to international context arguing that the so called global public goods too would be under-supplied if left entirely to the private decision of individual companies or governments. These studies propose that appropriate institutional mechanisms and financing arrangements must be developed for providing the GPGs (for example, many papers in Kaul *et al.* 1999; Sandler 1997; Barrett 2002). This is one side of the story of GPGs.

A second (and somewhat controversial) side of the story of GPGs is linked with whether aid (hereafter, ODA) *could* be used to finance GPGs (without asking whether it *should*). Four related arguments could be seen. The first argument is that GPGs are crucial to achieving the goals of development and hence, financing the provision of such GPGs is considered to be a legitimate component of ODA (for example, World Bank 2001; Kanbur *et al.* 1999). A second argument appears to be based on the concept of *economies of scope*. Instead of developing new mechanisms and institutions for providing GPGs, the argument is that the existing multilateral institutions could take on this role. A third line of argument is to see what portion of aid is already being spent on GPGs anyway (*fait accompli*) and draw inferences and conclusions from that (for example, Raffer 1999; te Velde *et al.* 2002). A fourth line of argument is that publicising how some share of ODA is actually funding GPGs may help in improving the image of ODA among the public in donor countries and in turn enable donor governments and international organizations to increase aid.

Against this light, the aims of this paper are to examine the concept of GPGs; to identify the various considerations in providing such GPGs and the resulting institutional design issues for GPG provision; to summarize the various estimates of the extent of aid presently being diverted to GPG provision; to examine whether the portion of aid diverted for GPG provision predominantly flows towards some recipients; to consider whether diverting aid to GPG provision is likely to crowd out aid for conventional development activities; and finally to consider some arguments for and against the use of aid for financing GPGs.

¹ See Cowen (1992).

² For instance, in textbooks such as Musgrave and Musgrave (1989), the word 'international public good' or 'global public good' does not appear.

2 Clarifying the concept of global public goods

In this section, a brief survey of the concept of global public goods is attempted. The questions considered are: what is a GPG; what are its characteristics; what are the various mechanisms in which such GPGs can be produced; and since the provision of GPGs requires international cooperation, what are the conditions in which international cooperation works and why.

2.1 GPGs and their characteristics

As in the case of national public goods (the classic example being that of national defence), in the case of GPGs too, benefits must accrue to all global citizens. The definition of GPG used by Kaul *et al.* (1999: 9) is on these lines and it asks the question of who the beneficiaries are, i.e., the *publicum*. In their view, the global public can be in terms of countries, socioeconomic groups and generations. They argue that a GPG should: (i) cover more than one group of countries; (ii) benefit not only a broad spectrum of countries but also a broad spectrum of the global population; (iii) meet the needs of the present generations without jeopardizing those of the future generations. In their view (1999: 11), a pure GPG is marked by universality, i.e., it benefits all countries, all people and all generations; an impure GPG would tend towards universality i.e., it would benefit more than one group of countries and would not discriminate against any population segment or generations. Morrissey *et al.* (2002) define an international public good (IPG) as a benefit providing utility that is available, in principle, to everybody throughout the globe. They consider three types, namely, those that directly provide utility, those that reduce risk (or disutility), and those that enhance capacity.³

The Kaul *et al.* definition can be criticized for including a substantially normative component based on the notion of sustainability. Many public ‘bads’ involving irreversible decisions by current generations are GPGs even though they do not fulfil the third requirement of Kaul *et al.* GPGs that span across generations are only a sub-set of all GPGs. It is conceivable that some GPGs involve only the current generation.⁴ The Morrissey *et al.* definition can be criticized for limiting GPGs only to ‘utilitarian’ goods. For example, some GPGs may be important purely from intrinsic values and not because they generate any utility to either existing or future generations. However, their definition can be justified on the grounds that in the real world where important utility-providing goods are being under-supplied, the question of seeking international cooperation for intrinsic goods will be a long shot.

The above definitions suggest that to be considered a GPG, there must be a spill-over effect beyond a nation’s boundary. GPGs can also be considered in terms of pure GPGs (nonexcludable and nonrival); impure public goods (either partially excludable or partially rival) including the club goods (Table 1).

³ Morrissey et al (2002:37) give various examples. IPGs providing direct utility include conservation of biodiversity, protection of forests and lakes, peacekeeping, etc. IPGs providing risk reduction include actions to reduce climatic risk (of global warming) or risk of financial instability; reducing acid rain, and lowering the incidence of disease. Improving global governance institutions, knowledge generation and research on arid agriculture are examples of IPGs of capacity enhancing type.

⁴ See Sandler (1999) for a discussion on intra- and inter-generational issues.

Kanbur *et al.* (1999: 53) also consider another category, namely, the joint products (goods or activities that yield two or more outputs with varying degrees of *publicness*). For example, actions taken by nations on private considerations (i.e., pure private goods) could also bring benefits to other countries. We will return to examine why the joint product approach to provision of GPGs is problematic.

Another important characteristic of GPGs can be whether it affects neighbouring countries or several countries in a region or all countries globally. Kanbur *et al.* (1999) refer to this as spatial range of spillovers. In addition to spatial spill-over, there could be temporal spill-over of benefits (or costs) to future generations as well (for example, Sandler 1999: 24-5; Kaul *et al.* 1999). However, as already mentioned, it is not essential that a GPG should involve temporal spillovers.

Table 1
A typology of global public goods (GPGs) based on their characteristics

	Rivalrous	Non-rivalrous
Excludable	Pure private goods	Impure public goods—network or club goods: <ul style="list-style-type: none"> • transnational parks • INTELSAT • Canals, waterways • International space station With some exclusion: <ul style="list-style-type: none"> • missile defence system
Non-excludable	Impure public goods—congestible goods: <ul style="list-style-type: none"> • alleviating acid rain • ocean fisheries • controlling organized crime • pest control 	Pure public goods: <ul style="list-style-type: none"> • curbing global warming • basic research • limiting the spread of ‘infectious’ diseases • augmenting the ozone layer • some scientific discoveries and knowledge

Source: Adapted from Kaul *et al.* (1999: 5) and Sandler (2002: 86).

2.2 Providing GPGs: the issue of technology of aggregation

The classic public goods provision problem is that once the good is provided, it is available to everyone. Hence, citizens do not have an incentive to reveal their true preferences but could wait for the good to be provided and then free-ride. This problem applies to pure GPGs as well. According to Kaul *et al.* (1999: 450) there are three gaps in global policymaking that leads to underprovision of GPGs: (i) a jurisdictional gap due to discrepancy between global boundaries of major issues and essentially national boundaries of policymaking; (ii) a participation gap due to international cooperation being essentially inter-governmental even though many other stakeholders contribute to GPGs; and (iii) an incentive gap as moral suasion alone is not enough for countries to correct their international spillovers or to cooperate for GPGs. They recommend re-engineering international cooperation to create a clear jurisdictional loop (coordinating national, regional and global actions), a participation loop (bringing in governments,

civil society, business and population groups) and an incentive loop (finding the right incentive structure, offering financial incentives as well as international recognition as a world leader).

Sandler (1998; 2001 and 2002) and Kanbur (2002) extend to GPGs Hirshleifer's (1983) approach of considering technology of aggregation (i.e., relationship between individual contributions and the overall supply of the public good concerned). According to Sandler (1998), technology of aggregation determines how best to provide different GPGs and what kind of international action is needed. He considers four alternative technologies for producing GPGs.⁵

- a. Summation: Each nation's contribution to the public good adds to the overall level of the good. This is expressed by:

$$Q = \sum_{i=1}^n q_i \quad (1)$$

where Q is the total level of public good; q_i is the contribution by country i . Examples of summation technology include basic research and knowledge generation of greenhouse gas emissions, protection of ocean species. In each of these cases, the global level of the GPG depends on the contributions of all nations. Sandler points out that summation technology results in agents not cooperating if the benefits to individual agents exceed the cost in terms of contribution. In the case of summation technology when voluntary contributions are positive, the neutrality theorem applies. That is, 'a unit contributed by anyone has the same additional impact on the total provision, so that contribution of one agent serves as a perfect substitute for that of another' (Kanbur *et al.* 1999: 65).

- b. Weighted sum technology: In this technology, the amount of public good received by a nation is given by:

$$Q^i = \sum_{j=1}^n \alpha_{ij} q^j \quad (2)$$

where q^j is country j 's provision of the public good and α_{ij} is the share of country j 's provision received by country i . This technology seems to be better suited to regional public goods which affect a few countries in a region (e.g. European Union, NAFTA) or GPGs relevant to countries having some common feature (tropical location, English language, shared history) than the whole world. Sandler uses the acid rain problem as an example and points out that when nation-specific private benefits are large enough, they motivate unilateral action by nations to curb sulphur emissions.

⁵ See Appendix Table A1 for Arce M and Sandler's presentation where examples of the four technologies are presented for pure public goods, impure public goods, club goods and joint products.

- c. Best shot technology: In this, the level of public good equals the largest individual provision:

$$Q = \max\{q^1, \dots, q^n\} \quad (3)$$

where q^i is i 's contribution of the public good. Confronting a rogue nation or finding a cure for AIDS or other viruses etc., are given as examples.

- d. Weakest link technology: In this the level of public good equals the smallest individual provision:

$$Q = \min\{q^1, \dots, q^n\} \quad (4)$$

where q^i is i 's contribution of the public good. Examples given are efforts to curb the spread of infectious diseases, protection of tropical rain forests, control of forest fires etc.

In the cases of the best shot and the weakest link technologies, the global level of the GPG crucially hinges on actions of just one country. Global cooperation will still be needed to identify such a country and decide whether there is a case for other countries to share the cost of providing this good. In the case of summation technology, the question is not of who should provide (as all nations need to contribute) but how to ensure that all nations do contribute. In the case of weighted sum technology, the crucial question is to decide which nations are relevant members.

2.3 GPGs as transnational externalities

From the discussions above, it is clear that GPGs are a class of cross-border spill-over of externalities⁶ (Kanbur *et al.* 1999: 50). There is considerable literature on international or transboundary environmental externalities (Mäler 1989; Barrett 1990; Dasgupta *et al.* 1997; Folmer and von Mouche 2000). Many of these studies take a game theoretic approach and attempt to identify conditions in which countries may or may not cooperate with other countries to reduce the transnational pollutant. Using repeated⁷ cooperative and non-cooperative games, the conditions in which cooperation takes place and the correction of incentives are identified (Hardin 1982; Carraro and Siniscalco 1993; Barrett 1990 and 2001).

The Mitchell and Keilbach (2001) approach⁸ of international externalities may help in clarifying which kind of externalities are GPGs. Symmetric externalities affect all

⁶ An externality is present when one agent's utility or production function has real variables whose values are chosen by other agents without any compensation to the loser/s (see Cornes and Sandler 1996).

⁷ In these, the interaction between two nations is modelled over a sequence of games where the information matrix evolves to reflect a history of interaction and players may choose strategies in a particular game taking into account the pay-offs in that game but also the opponent's strategy in the previous game/s.

⁸ Mitchell and Keilbach consider a simple framework of two nations; an international externality may arise with either one or both being the perpetrator/s or producer/s and at least one of them being a victim.

nations⁹ (the example being an international lake from which both countries draw water and to which one or both of them may deposit pollutants). Asymmetric externalities (the example being an international river) tend to be unidirectional and mainly affect the victims (i.e., the downstream countries). Mitchell and Keilbach (2001: 892) point out that:

In symmetric externalities the fact that all states prefer mutual cooperation to the *status quo* predisposes states toward narrow institutions that rely on issue-specific reciprocity. Although coercion or side payments could also be used to combat incentives to defect, such linkage is usually unnecessary. Asymmetric externalities, however, present more severe distribution and enforcement problems. An institution limited to the single issue of an asymmetric externality would provide benefits only to victims and impose costs only on perpetrators. To create incentive-compatible institutions in the face of such distributional problems, states dissatisfied with the *status quo* must broaden institutional scope, using the linkage of incentives or coercion to convince perpetrators to join the institution....

From this approach, they identify three mechanisms (or actions) available to states in the context of externalities: issue-specific reciprocity (for symmetric externalities), coercion or negative linkage (mainly for asymmetric externalities with strong or powerful victim) and exchange or positive linkage (mainly for asymmetric externalities with weak victims).

Barrett (1990) points out that in the case of a symmetric externality, each country must choose its abatement level (or quantity of a public good) on the basis of marginal costs and benefits of abatement (i.e., providing the GPG). The situation faced by a country is depicted in Figure 1.¹⁰ In the absence of international action, each country will choose abatement level of Q^0 . When there is full cooperation, all countries will benefit from the global public good and hence, will find it rational to abate up to Q^* . Barrett (1999: 198) indicates that the larger the number of countries (N), the larger the gap between non-cooperative and fully cooperative outcomes.¹¹ Benefits from cooperation are large if the

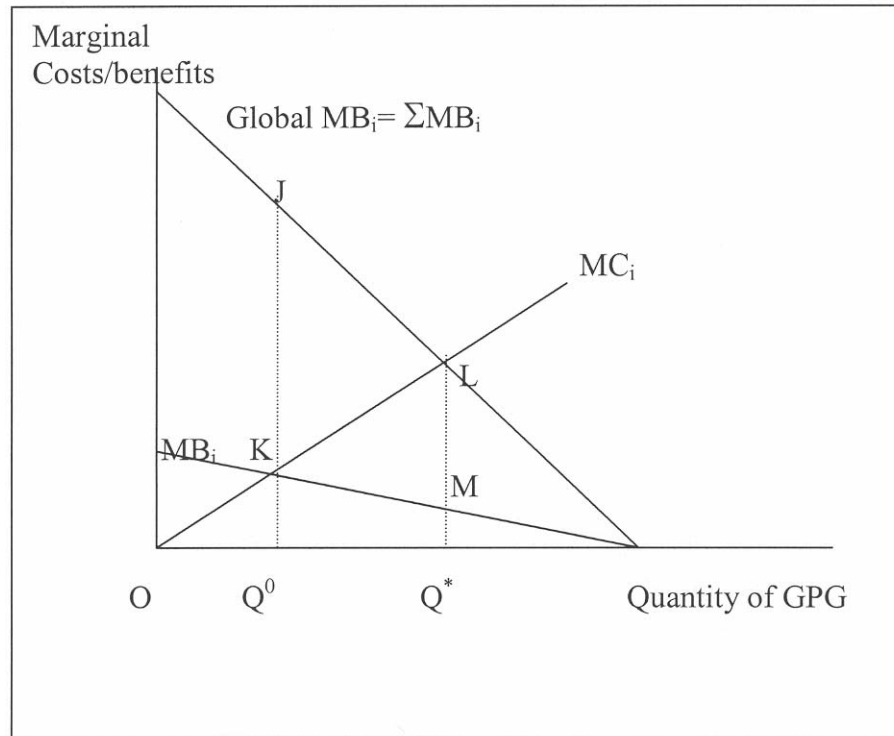
⁹ Elsewhere, Mitchell and Keilbach (2001: 895) clarify: 'Although the payoffs of mutual cooperation are rarely evenly distributed, we consider these situations symmetric in the sense that all believe they would benefit from mitigation of the externality, and all can either exacerbate or mitigate the problem by engaging or not engaging in the behaviour generating the externality'.

¹⁰ Barrett's figure concerns an international environmental issue. This seems to assume the *summation* technology. In the case of the *weighted sum technology*, the slope of the MB curve will vary from country to country. In the cases of the *best shot* and *weakest link* technologies, the global marginal benefit curve and individual marginal benefit curve will coincide. A comparison will be made between such benefit curves of different countries and the country which can produce a marginal benefit curve farthest from the origin will be the best shot provider. In the case of the *weakest link* technology, while there is a single marginal benefit curve, different countries may have different marginal cost curves and the weakest link country will be the one whose marginal cost curve is the steepest.

¹¹ Barrett (1999) points out that in the case of issues with a considerably flat MC_i and a steeper MB_i , substantial abatement will be undertaken by all countries unilaterally and cooperation may not improve matters much. He argues (1999: 206) that in the case of ozone depletion, the rich countries had a strong unilateral incentive to substantially reduce their emissions, whereas in the case of climate change, the incentives to reduce GHG emissions may be much more muted. Murdoch and Sandler (1997) also reach a similar conclusion about ozone depletion. Also see Sandler (1998: 236), who

number of countries is sufficiently large (so that $\sum MB_i = N \cdot MB_i$ is sufficiently large compared to MB_i); the marginal benefits from global action do not diminish quickly as quantity is increased and the marginal costs do not rise steeply with quantity (see Connolly and Munro 1999: 474). Barrett suggests that in the case of asymmetric externalities, the asymmetry shrinks the difference between the non-cooperative and fully cooperative outcomes. According to Barrett, to be successful, an international treaty must be self-enforcing, i.e., countries must be free to choose whether to be a signatory. The treaty negotiating diplomats may include rewards (carrots) for compliance and threats of sanctions (sticks) for violators.

Figure 1
To cooperate or not to cooperate?



Source: Based on Barrett (1999: 199).

If there are substantial global benefits, is there a case for signatories to offer side payments to non-signatories to join an international treaty (i.e., to produce GPGs)? This issue is considered in Barrett (1990 and 2001). Side payments could be Pareto-improving if global benefits are sufficiently large. By joining an agreement, a developing country will have to increase its contribution to the GPG from Q^0 to Q^* with the triangle KML representing the additional costs. So long as the additional benefits in terms of the triangle JKL are in excess of KML, there is a case for side payments to compensate the non-signatory country for the additional costs. Funding of environmental expenditures by the Global Environment Facility (GEF) is based on this incremental cost approach. Heltberg and Nielsen (2000: 279) also use a similar formulation as shown in Figure 1 to explain this. However, the important point is that

argues that if the proportion of nation-specific benefits to total benefits (from a transnational public good) increases, the likelihood of national action increases.

the GEF approach of financing incremental cost¹² limits financial transfer to area KML only. We will return to this issue in section 4.

2.4 Providing GPGs as a joint product

Foreign aid is considered to be an example of the provision of GPG as a joint product. For example, aid to finance forest conservation or flood control measures, or improving financial regulation or law enforcement in a developing country may generate global benefits as a by-product. Other examples of GPGs produced as joint products are:

- Improving the quality of basic education (with implications in terms of the choices made by a better-educated population about health, governance, human rights and freedom of speech);
- Research, development, innovations;
- Vaccines, development of treatment techniques
- Driving the advancement of technology; for example, the wide-spread use of Internet communications by one country can encourage further research and development to bring the costs down, which then benefits other countries.

Examples of joint products that include global public *bads* (i.e., where unilateral actions by one nation may impose costs on other nations) are:

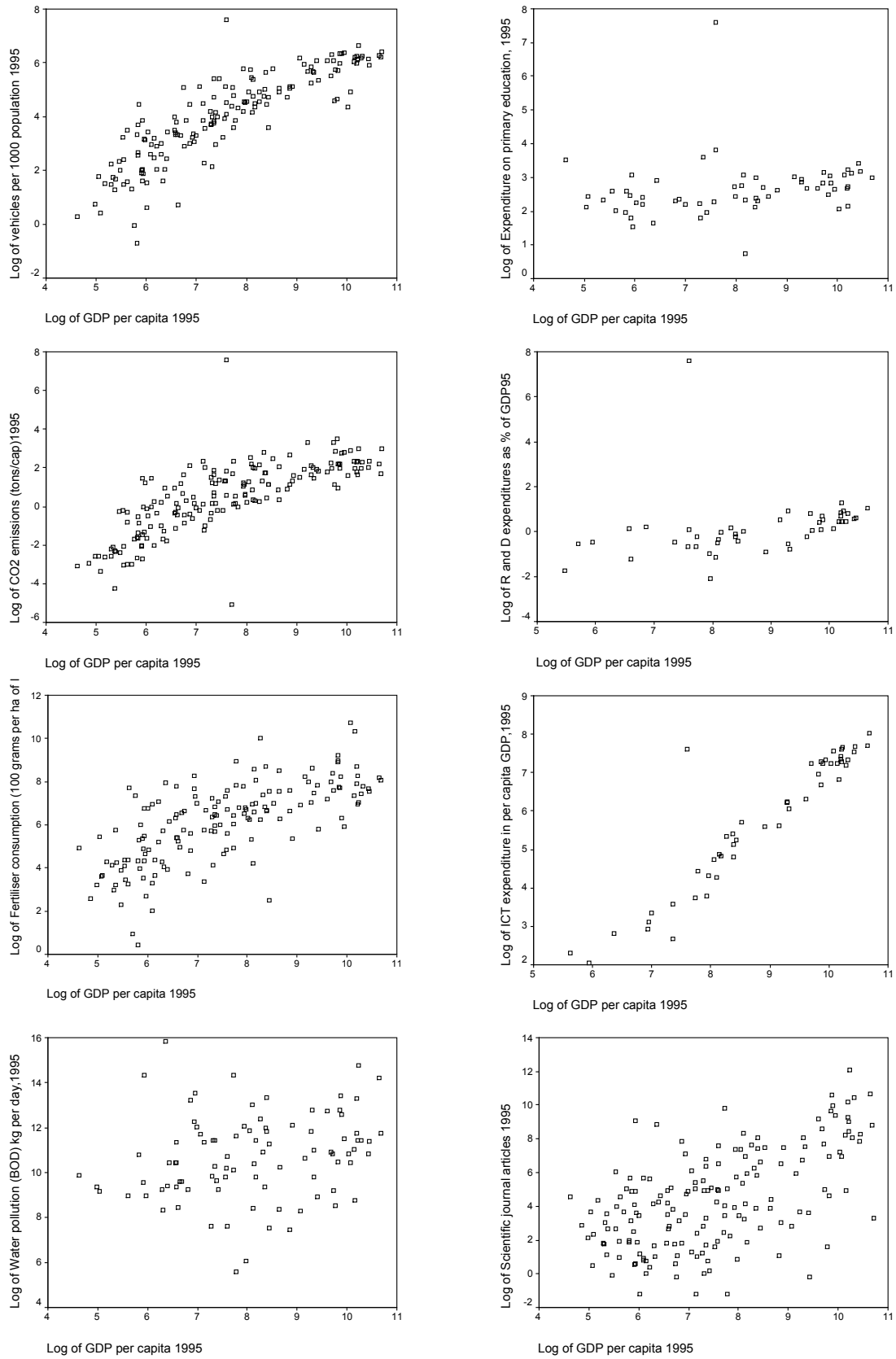
- Pollution in terms of emissions into atmosphere, effluents into rivers and seas;
- Energy use decisions (which apart from the pollution caused, may have implications for sustainability and inter-generational fairness in case of non-renewable sources);
- Consumption of fertilizers or pesticides which can have both local as well as distant impacts (depending on where the fertilizer is produced and where the output is consumed); and
- Lax regulation or weak enforcement which may lead to smuggling or terrorist networks to emerge.

Figure 2 presents some scatter-plot graphs for eight different variables in relation to per capita GDP of 1995 (from the World Development Indicators). The four diagrams in the right-hand column are examples of variables relating to activities with potential positive global impacts; those in the left-hand column are examples of variables relating to activities with negative global impacts. In general, we find a positive relationship between per capita GDP and the levels of activities with both positive and negative impacts.¹³

¹² See Mintzer (1993) for details on GEF's incremental cost approach.

¹³ The relationship between income and water pollution is less straightforward. A regression equation was estimated. The adjusted R square was 0.038. However, the parameter for log GDP per capita was positive and significant (t -statistic of 2.134).

Figure 2
 GDP per capita 1995 (X-axis) and various indicators with GPG implications



The problem with joint products is that these are incidental by-products of unilateral decisions by nations. Should a nation be given credit for such actions or punished for negative impacts? Nations could argue that on the one hand while their actions do generate global public *bads*, their other actions (such as the ones on the right hand column in Figure 2) generate global public goods, and these may, in the end, compensate for the *bads*. Other nations are likely to demand remedial action in case of negative externalities far more urgently than they are willing to complement for positive externalities. The issue of the provision of GPGs as joint products is problematic from an accountability point of view. Depending on a joint product approach to GPG provision makes such provision highly vulnerable to private interests of nations and whims of their electors. Since GPG provision is incidental, there is no guarantee that donors and developing countries will accord high priority to what is essentially a by-product. There could be a number of alternative ways to achieve the domestic policy goal (for example, resources spent on education per pupil or level of pollution deemed acceptable) and only some of them will have GPG as a joint product. Thus, in this approach, it is entirely up to donors and developing countries to choose particular alternatives and thus make ‘voluntary’ contribution to the provision of GPGs when it suits them. If the provision of national and local public goods cannot be entirely left to voluntary contributions, is it not problematic to depend on voluntary contributions for providing equally crucial global public goods?

3 The design of institutions for GPG provision

Any arrangement for the provision of GPGs involves several questions: who provides the good (with a further question of who should produce the good), who benefits from the good, whether any exclusion can be applied, how the provider should be financed, whether the beneficiaries can be expected to reveal their marginal willingness to pay for the good, and if not, how the costs of providing the good can be best met. The fiscal doctrine concerning pure public goods within a nation is to finance (pure) public goods from general revenue. In the absence of a global government with tax raising powers, voluntary cooperation and collective action are the main instruments to supply GPGs. In Sandler’s (2001: 37) view, ‘financing does not pose insurmountable problems for many IPGs’ (international public goods). He argues that institutional design depends crucially on technology of aggregation: provision of pure and impure public goods by international community; weakest link or best shot goods through public-private partnership;¹⁴ club goods essentially through the development of private collectives that fully finance the shared good through tolls. In the case of joint products, the relative size of country-specific benefits determines whether coaxing is needed by international community. Thus, the crucial element is that of the design of appropriate institutions. In this regard, some key principles can be considered.

¹⁴ The concept of ‘push’ and ‘pull’ approaches to financing GPGs is related to this OED (2001: 25). Traditional approach to public goods has been that of a ‘push’ model where the government or a lead supplier bears the full financial risk and leads the provision of the good. In the ‘pull’ model, though public sector still bears some responsibility, the private sector or other interested actors take the initiative. See World Bank (2001: 120).

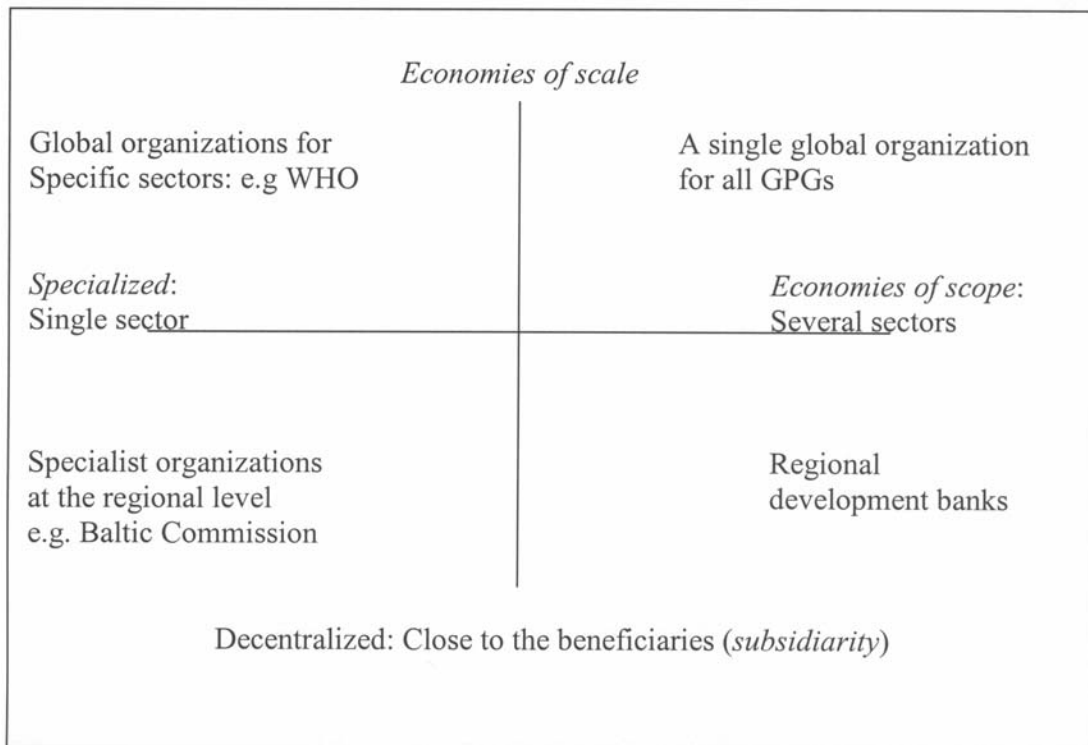
3.1 Economies scope or subsidiarity?

Sandler (2001) notes that in practice, many supranational structures address more than a single IPG due to *economies of scope* which suggests that the transaction costs of organizing collective action may not necessarily increase with increased number of activities (or GPGs) being supplied by a supranational organization. To benefit from economies of scope, all relevant GPGs should be provided by a single organization.

An alternative conclusion comes from extending Olson's (1969) concept of *fiscal equivalence*. Kanbur *et al.* (1999: 54-5) emphasize the need for matching the geographic coverage of the good's benefits and the nations to be included in the collective, 'unless the decisionmaking body's jurisdiction precisely matches the countries affected by the public good's benefits and costs, there is no assurance that good's provision will properly equate the requisite benefits to the associated costs'. They refer to this as the *subsidiarity* principle. Sandler (2001: 25) points out that, 'subsidiarity not only places the problem on the most appropriate participants—those with most at stake—but it also economizes on transaction cost'. Thus, subsidiarity principle implies that, 'there should be a plethora of supranational structures each of which corresponds to the relevant economic domain of the underlying public good' (Sandler 1998: 243).

Figure 3
An interpretation of the two tensions suggested by Kanbur (2001)
for designing organizations to provide GPGs

Figure 3



According to Kanbur (2001: 6) the design of institutions for IPGs depends *inter alia* on resolving two tensions, namely, one of 'organizing [the supply of IPGs] as close as possible to the beneficiaries, versus taking advantage of economies of scale' and the

other of ‘organizing supply along narrowly defined sectoral lines versus taking advantage of the economies of scope’. Figure 3 is an attempt to graphically represent these two tensions and the implications for institution design.

Until a global government or a global organization responsible for the provision of GPGs emerges, the top-right quadrant may remain an enigma. Kaul *et al.* (1999) suggest the formation of a global financing arrangement for providing GPGs, a GPG fund,¹⁵ distinct from ODA (which according to them is mainly focused on individual countries). Such a fund, if established, would fall under top-right quadrant. There have been demands for creation of global agencies focused on specific sectors.¹⁶ Such specialized institutions would fall under the top-left quadrant.

The suggestion by Kanbur (2001) is to develop an organizational structure ‘which is clustered around broad sectors, with groupings by regions within each sector’. He argues that in the case of sectors having clear IPG or GPG properties, resources and aid should be skewed in favour of sector agencies (the example he gives is that of WHO); and to take advantage of the subsidiarity principle, resources and aid in other sectors should be more heavily skewed towards regional institutions, such as regional development banks. On this basis, it is suggested that aid should be channelled through a ‘common pool’ mechanism (Kanbur *et al.* 1999: 86; Rajaraman and Kanbur 1999). The institutional framework suggested by Kanbur would thus have several tiers with a broad and loosely defined global organization (top right quadrant) with several sector specialist organizations (top left quadrant) mainly to inform policy; followed by various common pools developed at the regional level (bottom-right quadrant).

According to Kapur (2002), the crux of the problem in the common pool approach for the provision of GPGs is not about rivalry of consumption within a GPG, but rivalry of consumption among different GPGs in the absence of a ranking of GPGs. This, he argues (2002: 349) results in the pursuit of private interests by donors in the guise of GPGs. With regard to the role for regional organizations, critics argue that such regional organizations are ‘more inefficient, slow and bureaucratic’ (Segasti and Bezanson 2001: 65). Making a distinction between global and regional public goods may be appropriate when collective action is affected by group size or membership (due to transaction costs of organizing collective action and distribution of costs and benefits: Sandler 1998; Barrett 2001; also Ferroni 2002). Regional public goods are in some respects like clubs—benefits mainly accrue to countries in the region. In the absence of a distinction between GPG and RPG, donors are more likely to spend resources towards the latter. For example, the DAC countries seem to contribute a lot more to European Commission compared to their contributions to other global multilateral organizations.¹⁷

¹⁵ It must be reasoned that Kaul *et al.*’s suggestion is for global pool, not to be confused with another fund of the same name, set up by the World Bank with an allocation of a budget of US\$ 7.5 million in 2002 (OED 2001: 5).

¹⁶ For example, a number of authors have proposed the creation of a global environmental organization (see Doyle and Massey 2000: 418; Lodefalk and Whalley 2002). Others argue that such organizations will be effective only if issue-linkage is permitted so that developing countries receive other incentives for taking actions to correct the externalities (for example, Jha *et al.* 2002).

¹⁷ For example, EC’s share of contributions by DAC countries to multilateral institutions increased from 16 per cent in 1983-84 to nearly 30 per cent by late 1990s.

3.2 Further principles related to designing institutions

Sandler (1998: 238) considers five principles in designing institutions (or supranational structures) for supply of GPGs. The first principle can be called *collective rationality*, which requires that such structures must be instituted only when the aggregate net benefits from collective action are positive for the group of potential participants. The second principle corresponds to *individual rationality* i.e., there should also be net positive benefits to each and every participating nation.¹⁸ The third principle can be called *issue-choice or jurisdiction* in which the parameters of collective action should be chosen so that the marginal benefits are equal to marginal costs for each such parameter. The fourth principle can be called *flexibility*, where there should be scope to re-evaluate and redesign the structure as circumstances change. The fifth principle is that of *self-enforcement* i.e., cooperation should be incentive-compatible so that participating nations find it in their interest to cooperate.

Some of the above principles also resonate in the discussions in the field of international regimes and institutional design¹⁹ (see Koremenos *et al.* 2001a and 2001b; Wendt 2001). The rational design of the international institutions project examined five design considerations, namely: membership rules, the scope of issues covered, the degree of centralization of tasks, rules for controlling the institution and flexibility of arrangements (Koremenos *et al.* 2001a: 763). On the basis of various studies, they summarize 16 hypotheses relating to the above five design issues of international institutions (Koremenos *et al.* 2001b: 1055). They find that both membership of an international regime and its scope increase with the severity of enforcement and the severity of distribution (i.e., asymmetric externality) while scope and centralization increase with number of participating countries, flexibility decreases with number.

This brief review seems to support Sandler's (1998) assertion for a plethora of supra-national institutions. It is possible that of the various principles discussed earlier, in some cases economies of scale or economies of scope take precedence, which may justify the development of formal organizations from an efficiency point of view. In other cases, the subsidiarity principle may take precedence and the most appropriate institution nearest to the level of required decisionmaking (for example, regional development banks) could take the responsibility for delivering GPGs. Further research is needed to clarify the question as to which principle should take precedence in different circumstances. This may depend on the characteristics of the GPG and its provision (i.e., suitable technology, monitoring costs, scope for self-enforcing institution, number of countries, issue-linkage, side payment etc.), but other considerations include participation, inequality and power-asymmetry.

¹⁸ It may be recalled from Figure 1 that in the case of GPGs, the global net benefits (i.e., the area of triangle JKL depends on the slopes of global marginal benefits curve and the marginal cost of abatement curve). According to Barrett (1994), an international agreement may achieve high degree of cooperation only when the difference between global net benefits under the non-cooperative and full cooperative outcomes is small (as in the case of Montreal Protocol, see Barrett 1999). He points out that when this difference is large, a self-enforcing international agreement cannot support a large number of countries. While Barrett's focus has been on environmental agreements, these striking results seem to suggest that caution needs to be exercised in designing institutions for the supply of GPGs.

¹⁹ The institutional approach to regimes has been extended to the context of global environment. See, for example, Young (1997); Haas *et al.* (1993); Keohane and Levy (1996); and Luterbacher and Sprintz (2001).

4 Using ODA to finance the provision of GPGs

The discussion in the previous section indicates the rich theoretical basis for designing institutions for provision of GPGs. However, the empirical reality is that we seem to be ‘muddling through’, with various *ad hoc* arrangements to provide some GPGs, using economies of scope in some cases and economies of scale in others. Many GPGs including those related to international security, peace and development aid are joint products of national decisions. Also, presently almost all financing for the provision of GPGs is taking place as part of ODA. In this context, the following questions may be considered: What extent of ODA is being diverted to finance GPG provision?; Does such diversion skew ODA towards some countries?; Does spending on GPGs crowd out aid for conventional development?; Should aid be used for financing GPG provision?; Should developing countries receive side-payments in addition to ODA for any contribution they make to GPGs?

4.1 The extent of ODA spent on GPG provision

Three studies which estimate what extent of ODA goes to finance the provision of GPGs are reviewed here. These are by Raffer (1999), World Bank (2001) and te Velde *et al.* (2002). These studies use the Credit Reporting System (CRS) data on ODA issued by the OECD. These data are available in categories of up to 5-digit classification.

4.1.1 The extent of GPG financing from ODA

In one of the first studies to examine the extent of ODA allocated to GPGs, Raffer (1999) defines GPGs in two ways—GPG-1 consisting of various activities which can be judged from their CRS codes as having GPG character, and GPG-2 consisting of all the above plus structural adjustment (510), action relating to debt relief (600) and emergency assistance (all groups starting with 7). Raffer analyses data from 1973 to 1997. Data for selected years from his analysis are presented in Table 2.

Raffer estimates that ODA for GPGs is in the range of 3 to 14 billion dollars. He observes that the share of GPGs in ODA increased significantly in the 1990s. He notes a number of limitations of using the CRS data including the fact that CRS data includes both commitments and disbursements as being synonymous.

Table 2
Financing of global public goods as a share of DAC aid to developing countries

Year	CRS (DC) total in US\$ millions	Amount allocated in US\$ millions		As % of CRS total	
		GPG-1	GPG-2	GPG-1	GPG-2
1973	7940.8	646.3	786.4	8.14	9.90
1978	15568.4	1436.7	2400.8	9.23	15.42
1983	20844.6	2269.8	2931.6	10.89	14.06
1988	38340.1	4070.9	7073.0	10.62	18.45
1993	40347.3	7787.2	14713.3	19.30	36.47
1997	11917.7	3022.2	3166.5	25.36	26.57

Source: Raffer (1999: 11).

4.1.2 Estimates of GPG financing from ODA

The World Bank (2001: 109) estimates that the extent of development assistance for the production of global public goods (core activities) amounted to about US\$5 billion annually and another US\$11 billion annually for complementary activities²⁰ (Table 3).

The study notes that the level of funding for GPGs is significant in comparison with aid flows of US\$40 billion, excluding technical assistance or US\$55 billion when technical assistance is also included. The percentage of total ODA allocated to core activities of IPGs increased from about 1 per cent in 1970s to about 8 per cent by 1999 (World Bank 2001: 117). Throughout the 1990s, a major share of global funding for IPGs has gone to core and complementary activities in low-income countries (see Table 4).

In terms of sectors, in the 1970s, most of the resources were spent on health and knowledge (agricultural and other research). Health sector remained the top recipient. The shares of GPGs in different sectors as a percentage of total ODA in 1999 were about 8 per cent for health, about 3 per cent for environment, about 4 per cent for knowledge, and about 7 per cent for peace and security.

Table 3
Estimates of funding for core and complementary GPGs
Annual averages for 1994-98 in billions of US dollars

	Global and regional funding		Country-based finance		Total
	Foundations	Trust funds	Concessional	Nonconcessional	
Core activities	1	2	2	–	5
Complementary activities	–	–	8	3	11
Total	1	2	10	3	16

Source: World Bank (2001: 112).

Table 4
Funding for IPGs:
Core and complementary activities in low- and middle-income countries
(given as percentage of total ODA)

	Average for 1990-94		Average for 1995-98		1999	
	Low-income countries	Middle-income countries	Low-income countries	Middle-income countries	Low-income countries	Middle-income countries
Core activities	2	1	2.5	1	4.5	3.5
Complementary activities	7	4	9	6	7.5	7.5
Total	9	5	11.5	7	12	11

Source: Based on World Bank (2001: 119).

²⁰ These numbers, substantial as they are, are dwarfed by the figures of rescue packages for financial crises such as Mexico (1995), Thailand (1997), Indonesia (1997 to 1999). For example, the rescue package for Mexico alone was to the tune of 47.8 billion dollars (see World Bank 2001: 124). Though such spending is country-oriented (with benefits excludable and rivalrous), it could be argued that some spillovers from that spending are GPGs. Thus, the figures in Table 3 may be under-estimating GPG financing.

4.1.3 Estimates of GPG financing as per te Velde

te Velde *et al.* (2002) ask two questions, namely: How much aid has been allocated to finance national public goods (NPG) and international public goods (IPG)? And second, whether the increasing prominence of IPGs increased the share of aid allocated to public goods? They find that the share of aid allocated to public goods has increased from about 16 per cent in the early 1980s to about 38 per cent in the late 1990s (Table 5). It is noted that a major share of this goes to finance NPGs which in the late 1990s accounted for about 29.40 per cent of all aid. The share of aid to IPGs was about 5 per cent in the early 1980s which slightly increased to nearly 7 per cent by early 1990s and to about 9 per cent by late 1990s.

te Velde *et al.* considered public goods under five categories/sectors, namely, the environment, health, peacekeeping and conflict prevention, knowledge generation and economic and financial governance, though they consider governance to be essentially a NPG (Table 6).

There is a significant difference between the calculations of te Velde *et al.* and the World Bank (2001). According to te Velde *et al.* (2002: 130), environment attracted the greatest share (over 70 per cent) of aid allocated to IPGs. However, as per the World Bank (2001), the share of environment in funds allocated to GPGs is fairly small (about 3 per cent). The main reason for this difference is due to the different definitions adapted in these two studies.²¹

Table 5
Spending on IPGs and NPGs as a percentage of aid by all DAC donors

	1980-82	1990-92	1996-98
International public goods	4.98	6.76	8.79
National public goods	11.24	21.67	29.40
Total	16.22	28.43	38.19

Source: te Velde *et al.* (2002: 126-8).

Table 6
Shares of funding for IPGs and NPGs going to different sectors

	1980-82	1990-92	1996-98
IPGs Environment	78.30	80.70	70.50
Health	4.10	6.80	11.40
Peace	4.20	0.20	2.60
Knowledge	13.40	12.30	15.50

Source: te Velde *et al.* (2002: 133-6).

²¹ The definition of environment sector by te Velde *et al.* includes activities which were not included in the World Bank (2001) definition, such as river development, waste management, water resources policy, water resources protection, low-cost housing, housing policy, ocean power, and various activities related to agriculture.

4.2.4 Is the use of ODA for GPG provision skewed towards some countries?²²

An attempt is made here to identify whether the use of ODA for GPG provision results in substantial quantities of aid flows to particular countries, leading to a skewed distribution of ODA. This is examined by using the OECD's Credit Reporting System (CRS) data for all recipients for the sample year of 1998. The analysis is limited to te Velde *et al.*'s definition of IPGs. A summary is reported in Table 7. During that year, the extent of ODA for GPGs in these four sectors²³ was to the tune of US\$3.3 billion.²⁴ About US\$2.8 billion of this amount was allocated to country-based programmes and the rest to regional and global programmes.

About 90 per cent of the amount was allocated in the form of grants while the remaining 10 per cent was allocated either as concessional or non-concessional loans. This is approximately similar to the ratio of grant and non-grant components of ODA. This suggests that GPG financing is not any peculiarly skewed towards grant-financing as compared to ODA in general.

Table 7
Summary statistics of recipients of ODA funding for GPGs, 1998
(amounts in US\$ '000)

Volume of ODA for IPGs (Class interval)	Frequency (no. of countries)	Frequency		Average ODA per country	Average grant per country
		ODA for IPGs	Of which, grants		
Over 100 million US\$	5	1,294,279	1,050,812	258,856	210,162
50 to 100 million US\$	6	424,631	393,725	70,772	65,621
20 to 30 million US\$	14	345,827	323,603	24,702	23,114
10 to 20 million US\$	19	260,675	247,074	13,720	13,004
30 to 50 million US\$	6	237,570	235,510	39,595	39,252
5 to 10 million US\$	21	160,175	157,681	7,627	7,509
1 to 5 million US\$	42	109,136	108,000	2,598	2,571
0.5 to 0.999 million US\$	11	7,871	7,871	716	716
<0.5 million US\$	32	5,791	5,791	181	181
Total- for all items with data on country allocation	156	2,845,955	2,530,066	18,243	16,218
ODA where country Was unspecified		507,801	507,801		
Total for all CRS		3,353,757	3,037,867		

Source: Author's calculations based on CRS data for 1998; OECD (2000).

²² Kaul *et al.* (1999: 495) suggest that the existing development finance system offers only the roles of either a donor or a recipient, and urge that there is need for greater clarity and for expanding the categories of actors.

²³ The four sectors in which IPGs were considered by te Velde *et al.* include environment, health, peace and knowledge.

²⁴ This figure is much smaller than the World Bank (2001) figure of US\$16 billion. Here only activities defined to constitute IPG by te Velde *et al.* are considered, whereas the World Bank (2001) definition covers many other activities some of which are classified as NPGs in te Velde *et al.*

The top five recipient countries in terms of volume of ODA funding for IPGs were China, Indonesia, India, Philippines and Bangladesh, each receiving over US\$ 100 million (1998) for IPG activities. However, compared to the recipient country's GDP, these amounts were not substantial.

Philippines and Indonesia received between 20 and 25 per cent of total ODA for providing IPGs. However, for a large majority of the recipient countries, the share of IPGs in ODA was very small—less than 5 per cent for 82 out of 132 countries analysed; for another 21 countries, this was between 5 and 10 per cent of total ODA received. Only for 12 countries, the share of ODA for IPGs constituted more than 20 per cent of the ODA received in 1998. Of these, it formed over 50 per cent of ODA received for Costa Rica and Jamaica, and this was between 40 to 50 per cent of ODA for Turkey, Dominica and Maldives.²⁵ Appendix 2 presents a breakdown of the amount of aid for IPGs in terms of the four sectors and the top 5 recipients in each sector. Again, the share of environment was well represented (as can be expected based on te Velde *et al.*'s definition).

The figures above suggest that for 103 out of 132 recipients, the aid received for GPG provision formed less than 10 per cent of total aid received by these countries, implying that even though the share of aid spent on GPGs has been increasing, donors are not allocating those resources any differently than they allocate the rest of the aid.

4.1.5 Summary: the extent of ODA on GPGs

From the foregoing discussion, we have different estimates of the extent of ODA that is diverted to finance GPGs. These are summarized in Table 8. The wide variation is due to the different definitions that one could adapt as to what is an IPG or GPG.

Table 8
The extent of ODA diverted to GPG-provision

Author	Year of estimate	Extent, US\$	GPG or IPG provision as a share of ODA, %
Raffer (1999)	1997		25.30
World Bank (2001)	Late 1990s	US\$5 billion out of US\$40 billion of aid	12.50
te Velde <i>et al.</i> (2002)	1996-98		8.79
Author's estimates	1998	US\$3.3 billion compared to aid of US\$88.8 billion	3.72

4.2 Does diversion of ODA for GPG provision crowd-out aid for conventional development?

To examine the question of whether spending on public goods has taken away from other forms of aid, te Velde *et al.* estimate various regression equations using first differences based on data for the periods of 1980-82, 1985-87, 1990-92 and 1996-98. Their findings from the various regression results indicate that (i) an increase in the share of aid allocated to IPGs is not associated with a rise in ODA to GDP ratio;

²⁵ There is an anomaly in case of Mexico where the amount of ODA for IPGs is 178 per cent of its total ODA.

(ii) donors who allocate more aid to IPGs also tend to allocate more of their GDP to aid (i.e., generous donors); (iii) spending on IPGs tends to displace other aid spending, and (iv) increased spending on IPGs has not displaced aid from complementary NPGs, but probably from other activities producing benefits that are private goods in nature.

In conclusion, te Velde *et al* argue that the ‘future increases in spending on IPGs in developing countries should not come from further increasing the share of aid allocated to this purpose’ (2002: 152). They suggest that either the value (quantity?) of aid should be increased or sources of funding other than aid should be found for IPGs.

An alternative exploration of the question of whether GPG provision crowds-out aid to conventional development is attempted by examining the relationship between the contributions that donors make to the Global Environment Facility (GEF) and Montreal Protocol Fund (MPF) in year t and the remainder of the increase in multilateral ODA between years t and $t-1$. The following equation is estimated:

$$\Delta \text{MULTIODA}_{t,t-1} = a + b * (\text{GEF} + \text{MPF})_t$$

The results for the years between 1997 and 2000 are shown in Table 9.

In the regression results for two out of three years and the pooled regression results for the entire period, the independent variable has a negative sign. This suggests that allocation of ODA for providing GPGs such as GEF and MPF diminishes the resources available for other multilateral ODA. This by itself is not a test of crowding out hypothesis but it is in line with such a hypothesis.

Table 9
Does contribution to GEF and Montreal Protocol Fund crowd out other multilateral contributions?
Regression estimates

	Constant	Parameter of (GEF+MPF) _t	Adjusted R Square
$\Delta \text{MULTIODA}_{1998,1997}$	-74.428 (-2.767)	11.340 (4.308)	0.687
$\Delta \text{MULTIODA}_{1999,1998}$	10.764 (0.188)	-3.982 (-3.243)	0.442
$\Delta \text{MULTIODA}_{2000,1999}$	112.950 (1.218)	-5.624 (-2.580)	0.288
Pooled regression: $\Delta \text{MULTIODA}_{t,t-1}$	47.405 (1.155)	-4.377 (-4.166)	0.312

Note: Figures in brackets are t -statistics.

Source: Author's calculations.

4.3 Should aid be diverted to finance GPGs?

The existing system of financing GPGs makes *no distinction* between GPGs and other development activities. This *no distinction* viewpoint seems to assume that all GPGs could be supplied by expanding and restructuring the role of existing multilateral organizations (such as the World Bank, UNEP and UNDP, etc.) and financing such GPGs through ODA. However, such diversion of ODA for GPGs can be criticized as being (i) *unethical*, as diverting ODA to GPGs diminishes resources available for the

primary purpose of ODA, namely, poverty reduction priorities and development of poor countries; (ii) *inefficient*, as institutions and knowledge developed for development may not be the most appropriate ones for delivering GPGs; (iii) *unaccountable*, as such funding of GPGs takes place on an *ad hoc* basis and unrelated to any assessment of requirements and priorities; (iv) *myopic*, as it may be mainly influenced by the perceptions of current generation.

While there is a case for making a distinction between ODA and the financing of GPGs, two viewpoints are possible. Under the *strong distinction* approach, we need to delink the financing of GPGs from ODA straight away by creating an altogether different institution to provide GPGs and to finance them from separate sources other than ODA. Under the *weak distinction* approach, some GPGs may have to be provided by new global organization/s while other GPGs, which are joint-products and relevant to poverty reduction goals, can be provided through existing channels and financed via ODA.

Each approach has its advantages and disadvantages as shown in Table 10.

We have already argued above that the existing approach of diverting aid for GPG provision is riddled with philosophical and procedural problems. In spite of these problems, why do donors continue to divert resources to finance GPG provision? GPGs cover important issues, some of which generate favourable public opinion amongst the public in donor countries. Besides, no one seems to object to such diversion; many GPGs lack champions and this gives donors a chance to appropriate important causes to champion, at a time when their moral high ground has come under question in western societies (as seen in the globalization protests in Seattle and Prague). There is a critical need to break away with this ‘practice of convenience’.

From the discussion of institutional design principles in the previous section, it was seen that a ‘plethora’ of institutions may be needed to provide GPGs. While the weak-distinction version is a compromise, it may be relevant only as a short-term solution. In the long run, there is need to delink the financing of GPG provision completely from ODA which should focus only on the purpose for which it was originally created, i.e., poverty reduction and promotion of development.

Table 10
Comparison of the three approaches to financing of GPGs

	Strong distinction	Weak distinction	No distinction
Creating a clear champion for GPGs	High	Moderate	None
Use of economies of scope	High	Moderate	Moderate/some
Use of subsidiarity principle	Moderate	High	Moderate/some
Flexibility to craft and adapt a range of institutions	Moderate	High	Moderate
Dependence on a new international agreement (hence, preparation costs)	High	Moderate	None
Administrative and transaction costs of creating institutions	High	Moderate/some	None

4.4 How does current funding of GPGs compare with the requirement/demand?

From the present statistics, we only know that a total of about US\$16 billion is allocated by donors for GPGs. We do know that only some GPGs are provided and it is quite possible that many other important GPGs remain under-provided or not provided at all. There is a dearth of estimates of the magnitude of funds required to provide GPGs to ascertain adequacy (Development Committee 2001: 8). As highlighted by the high level panel constituted by the UN Secretary-General, it was estimated that compared to the about US\$5 billion allocated to GPGs, annual requirement may be of the order of US\$20 billion (Zedillo *et al.* 2001: 71) i.e., a four-fold increase. Even this is likely to be a conservative estimate.

4.5 Financing the provision of GPGs

The discussion in section 3 indicates that the main problem is likely to be that of financing GPGs of pure public goods nature. Sandler's analysis (discussed earlier) suggests that where exclusion is possible, clubs will emerge to supply such GPGs (example being, NATO, other military alliances, international space station). From the viewpoint of technology, the most problematic ones are those that are of summation technology and weakest technology. In the case of the former, contributions are needed by every nation. In the case of the latter, a consensus is needed to transfer resources to the 'weakest link' country. In case of GPGs requiring weighted sum technology, their location seems to be crucial. Problems affecting regions with sufficient self-interest to donors (for example, European Union or NAFTA), the weighted sum technology will work. In case of problems that require action by several poor countries, for example in South Asia or Sub-Saharan Africa, the weighted sum technology by itself is unlikely to work unless aid is given. Thus, the priorities for global action are fairly clear.

Should developing countries be subsidized for providing GPGs? As we saw earlier, many developing countries receive a small portion of aid for GPG provision. As already mentioned, this is an *ad hoc* approach and is likely to lead to crowding out of aid for conventional development purposes. The various arguments considered earlier suggest that GPGs should be financed independently of aid. The discussion from Barrett's analysis of self-enforcing international agreements provides a basis for determining the extent of transfers to be made to non-signatories. When developing countries are signatories to an international treaty, and when their country-specific benefits are themselves significant, Barrett's analysis directly applies. When developing countries are not signatories, obviously, side payments will be needed to cover any costs incurred by them in the provision of GPGs. When developing countries are signatories but their country-specific benefits are fairly small as compared to country-specific benefits for other (richer) signatories, the analysis can be extended by considering developing countries to be in the same situation as nonsignatories and identifying the extent of side-payments.

Apart from the area KML in Barrett's diagram (Figure 1), developing countries may need to be given aid to cover some of the administrative costs of producing GPGs. These are expenses for developing the necessary institutional capacity (some complementary activities). Hence, for a global agreement to work, the net additional benefits to a global community (i.e., area JKL) should be sufficiently larger than the

incremental cost to the developing country (i.e., area KML) plus some or all of the servicing costs of developing the institutional capacity.²⁶

5 Conclusions

The provision of global public goods remains an important governance-challenge. As we continue to ‘muddle through’ with only *ad hoc* arrangements for the provision of GPGs, many such GPGs will remain under-provided. There is a rich literature on what kind of institutions are appropriate for providing different GPGs; how such institutions must be designed; when international agreements are likely to emerge and when they are likely to be successful. At present, the provision of GPGs is mainly financed by diverting ODA. There is considerable variation in different estimates of the extent of ODA so diverted, but it is in the range of 3 per cent to 25 per cent. Using aid for activities which generate GPGs as joint products may appear as a cost-less way of generating GPGs. However, several problems in this regard were discussed in the paper. These include the lack of accountability, the susceptibility to whims of political waves in the donor countries, difficulty in determining whether positive joint products are more than offset by negative joint products, and so on. If aid should not be used for financing the provision of GPGs, what are the other sources? From the preceding discussion, the following financing priorities can be identified:

- i) For GPGs of pure public good variety, institutions in the form of international treaties and regimes need to be developed. In the short run, such treaties and institutions are likely to remain issue-specific based on specialization rather than economies of scope.
- ii) GPGs amenable to the *weighted sum technology* that are particularly relevant to the needs of developing countries are likely to remain under-supplied. The priority for global action in this regard is to facilitate the development of robust, yet flexible regional institutions which can provide such GPGs effectively.
- iii) In the case of GPGs which are amenable to the *best shot* or the *weakest link* technology, the priority for global action is to develop institutions which can identify the most efficient way of providing the GPG, coordinate global contributions and channel these resources to the relevant country and be able to hold that country accountable.

Institutions for GPG provision need to be designed on the basis of the various principles of economies of scale, economies of scope, (economies of) specialization and subsidiarity. There is a need for further analysis to determine which kind of institutional arrangement is the most efficient way to deliver which set of GPGs. This requires work on how the different principles interact and how the relative balance of underlying policy variables changes. In the absence of a global government with tax-raising

²⁶ If these additional costs are also taken into account, the MC curve should be steeper than the MC shown in Figure 1. Taking those into account, the true optimum quantity of GPGs may be lower than Q*.

powers, voluntary cooperation and building of global or regional coalitions is necessary. Initially, we may need to develop several specialist institutions. However, by using consistent and similar organization design principles, membership and accountability requirements, we could design these individual institutions so that over a period of time they could move towards a single international organization as a collective (moving from top left quadrant to top right quadrant in Figure 3).

Appendix Table A1
Technology of aggregation and category of public goods

Aggregation technology	Pure public	Impure public	Club	Joint product
<i>Summation</i>				
Overall level of public good equals the sum of country contributions	Limiting air pollution Desertification	Providing public health infrastructure Market boards for commodities	Satellite communication network Transnational parks	Deterrence through peacekeeping Preservation of rain forests
<i>Weighted sum</i>				
Each agent's contribution can have a different additive impact on the overall level	Reducing ambient pollutants Limiting the spread of AIDS	Limiting run-off pollution Curbing acid rain	Free trade agreements Power grids	Eliminating threat of terrorism Eliminating threats of revolutions
<i>Weakest link</i>				
The smallest effort determines the public good level	Inhibiting the spread of pests Labour standards	Surveillance of a disease outbreak Drug interdiction	Transportation network Basle Accord among G-10	Family planning Security intelligence
<i>Best shot</i>				
The largest effort determines the public good level	Cure for orphan diseases Monitoring technologies	Agricultural research findings Genetically engineered crops	Crisis management squad Satellite launch site	Quelling of a flare up by peacekeepers Bioprospecting

Source: Arce M and Sandler (2002: 21).

Appendix Table A2
The amount of aid for IPGs: Sector-wise total and top 5 recipients, 1998

IPG sector	Total ODA for IPGs	Of which, grants	ODA for IPGs for the country		
	(amounts in US\$ '000)		Top 5 recipients in the sector	(amounts in US\$ '000)	
Environment	2,140,261	1,862,758	Indonesia	120,810	74,250
			India	114,480	114,480
			China	100,000	78,935
			China	97,785	78,668
			Indonesia	70,099	43,083
Health	182,736	182,736	China	22,005	22,005
			Uganda	8,948	8,948
			China	8,487	8,487
			Kenya	6,150	6,150
			Burkina Faso	5,684	5,684
Knowledge	415,585	377,718	India	100,000	79,028
			Ethiopia	60,000	48,281
			Tanzania	21,800	17,568
			Bangladesh	15,739	15,739
			Mexico	12,039	12,039
Peace	107,229	106,709	Guatemala	24,650	24,650
			Mozambique	7,052	7,052
			Angola	6,791	6,791
			Afghanistan	6,473	6,473
			Bosnia-Herzegovina	5,380	5,380

Note: The sectors—environment, health, knowledge and peace—are based on definitions of these sectors te Velde *et al.* (2002).

Source: Author's calculations based on CRS data for 1998 from OECD (2000).

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