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Environmental Taxation and Development: A Scoping Study

Stephen Spratt
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For further information please contact:

International Centre for Tax & Development
at the Institute of Development Studies, Brighton BN1 9RE, United Kingdom
T: +44 (0)1273 606261 E: info@ictd.ac W: www.ictd.ac

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Stephen Spratt
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Environmental Taxation and Development: A Scoping Study

Stephen Spratt

Summary

Developing countries face increasing environmental pressures across a range of dimensions. At the same time, the capacity of these governments to effectively pursue policy goals is often constrained by a lack of resources, with tax revenues in many countries being half of what is common in developed economies. For some, these are distinct issues that should be considered separately. For others, they can and should be dealt with together. This paper reviews the potential of one type of mechanism to address both goals simultaneously: environmental taxation.

After distinguishing between different forms, the paper uses a Pigouvian framework to organise and analyse theoretical and empirical evidence on the impacts of environmental taxes in developing countries. Despite limited evidence it is possible to draw some conclusions. First, taxes that are carefully designed and reflect local conditions can be effective in achieving environmental goals, and may be the best instruments under some conditions. Second, while it is possible to raise significant revenues, there may be less potential than is often supposed: environmental goals are more likely to be achieved where tax revenues are used, in part, to further the same ends; it may also be necessary – and desirable – to use some revenue to offset regressive effects; also, support for environmental taxes is likely to be undermined if they are seen to be revenue raising tools. More broadly, limits to the effectiveness of environmental taxes become more severe as the number of policy goals increases: achieving ‘double-dividends’ may be hard, and ‘triple-dividends’ harder still. A more realistic aim, therefore, may be a ‘one and a half’ dividend approach, with the environmental goal being the primary focus. Third, regardless of the quality of design, environmental taxes may fail without strong, high-level political support, particularly where they conflict with other policy goals that do have this support.

In the light of this analysis, the penultimate section of the paper develops a decision-making framework, designed to help policy-makers weigh the merits of environmental taxes to achieve specified goals. The paper concludes with a comprehensive research agenda.

Keywords: environmental tax; environmental fiscal reform (EFR); externalities; Pigou; public goods; resource mobilization; poverty; development.

Stephen Spratt is a Research Fellow in the Globalisation Team at IDS. Stephen’s research interests relate to development finance, capital flows and investment, financial regulation, climate change finance, environmental taxation, low carbon development and the intersection between these issues. Professionally, he has been Head of the Sustainable Markets Group at IIED, Research Director and Chief Economist at the New Economics Foundation and a Lecturer in international finance and development at the University of Reading. He has also worked in the private sector in the City of London.

Contents

Summary	3	
Acknowledgements and acronyms	5	
1 Environmental taxation and development: theory and practice	6	
1.1 Definitions, categories and theory	6	
1.1.1 Environmental taxation: definition, forms and some theory	6	
1.1.2 Public goods and environmental taxation	10	
1.1.3 Packages of environmental taxation	11	
1.2 Current and planned practice	12	
1.2.1 First best mechanisms	12	
1.2.2 Second best mechanisms	13	
1.2.3 Third best taxation	23	
1.2.4 Other third best taxes	25	
1.2.5 Environmental Fiscal Reform	26	
1.3 Lessons from the literature	29	
1.3.1 Double dividend(s)	29	
1.3.2 Distributional effects	32	
1.3.3 Summary of lessons from the literature	33	
2 Decision-making framework for policy-makers	36	
2.1 Questions for policy analysis and formulation	36	
2.2 A conceptual framework for decision-making	38	
3 Research gaps and a research agenda	40	
3.1 Research gaps and questions for future research	40	
3.1.1 Technical	40	
3.1.2 Political economy	42	
3.2 Priority research areas	42	
3.2.1 REDD+ and national forest revenue systems	43	
Appendix 1 South Africa's EFR Decision Framework	45	
References	46	
Figures, charts and tables		
Figure 1	Increased global water stress	22
Chart 1	Petrol taxes, 2008	24
Table 1	Environmental tax as share of total tax revenues	26
Table 2	Policy Matrix of Interventions	28
Table 3	Possible Environmental Policy Instruments	39

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Acronyms

C&C	Command and control
CDM	Clean development mechanism
CGE	Computable General Equilibrium
CORNARE	Corporación Autónoma Regional Rionegro-Nare
CO	Carbon monoxide
CO ₂	Carbon Dioxide
DD	Double Dividend
ECLAC	Economic Commission for Latin America and the Caribbean
EEA	European Environment Agency
EFR	Environmental fiscal reform
ETR	Environmental tax reform
FAO	Food and Agriculture Organisation
GEF	Global environment facility
GFC	Green fiscal commission
GHG	Greenhouse gases
HCFCs	Hydrochlorofluorocarbons
IEA	International Energy Agency
LDC	Least developed country/ies
LIC	Low income country/ies
MA	Millennium Ecosystem Assessment
MDGs	Millennium Development Goals
MIC	Middle income country/ies
NAMA	Nationally Appropriate Mitigation Actions
NO _x	Oxides of Nitrogen
OECD	Organisation for Economic Cooperation and Development
OFR	Orthodox fiscal reform
OIOR	Outcome input output recycle
PES	Payment for Ecosystem Services
PM ₁₀	Particulate matter
REDD	Reducing Emissions from Deforestation and Forest Degradation
REMA	Rwanda Environment Management Authority
SMEs	Small and medium enterprises
TEEB	The Economics of Ecosystems and Biodiversity
UNEP	United Nations Environmental programme
VOCs	Volatile organic compound
UNFPA	United Nations Population Fund

1 Environmental taxation and development: theory and practice

1.1. Definitions, categories and theory

1.1.1. *Environmental taxation: definition, forms and some theory*

If a tax is defined as a compulsory and non-reciprocated payment to the state by an individual or other legal entity, how should we define an environmental tax? Helpfully, there is a standard definition, which is used by major statistical agencies such as Eurostat, the OECD and the International Energy Agency (IEA). It is as follows: 'A tax whose tax base is a physical unit (or a proxy of it) that has a proven, specific negative impact on the environment.' (OECD, 2010a)

Three main categories can be used to frame environmental taxation issues. First, we can think of taxes on natural resources, both non-renewables, like oil or metals, and renewables, such as forests or fisheries. Second, there is the Pigouvian framework, wherein taxes are used to correct market prices so as to take account of externalities. Third, there are user fees and Payments for Environmental Services (PES).¹

Despite the overlap between these categories, each illuminates environmental tax issues in specific ways and all are therefore employed at different stages of this report. In this first section, we briefly outline the relevant features of each of these categories.

a) *Natural resource taxation*

It is important to distinguish between non-renewable and renewable forms of natural resource taxation. While we are primarily interested in renewable resources², it is worth spending some time on non-renewable taxation issues, which have a more mature literature.³ Two basic propositions from this literature are particularly relevant. First, because non-renewable resources do not require inputs⁴ to create them, companies can earn supernormal profits – more formally termed economic, or natural resource, *rents*. Second, the depletion of natural capital⁵ through natural resource extraction should be offset by investment⁶ in other forms of physical capital (such as infrastructure) so as to preserve the same level of total capital (von Haldenwang, 2011).

¹ While these are reciprocated payments – and so strictly speaking not taxes at all – they are included here as they share many of the properties of taxation.

² While non-renewable resource extraction clearly has environmental impacts, often, very significant ones, in this report we focus on tax mechanisms that have at least a partial environmental motivation. Generally speaking, the taxation of non-renewable resources is examined through a revenue raising and distribution lens. Taxes may be structured to influence the rate of resource extraction, for example, but the aim is to influence the resulting revenue stream rather than to achieve an environmental goal.

³ See Dasgupta and Heal (1979) for an early example.

⁴ There are (significant) extraction costs, however, so this is not akin to plucking fruit from a tree.

⁵ Natural capital is the extension of the economic notion of capital (manufactured means of production) to environmental goods and services. A functional definition of capital in general is: 'A stock that yields a flow of valuable goods or services into the future.' Natural capital is thus the stock of natural ecosystems that yields a flow of valuable ecosystem goods or services into the future. For example, a stock of trees or fish provides a flow of new trees or fish, a flow which can be sustainable indefinitely. Natural capital may also provide services like recycling wastes or water catchment and erosion control. Since the flow of services from ecosystems requires that they function as whole systems, the structure and diversity of the system are important components of natural capital.' (Costanza, 2008: www.eoearth.org/article/Natural_capital)

⁶ Known as Hartwick's Rule, such re-investments are designed to preserve intergenerational equity, ensuring that countries do not become progressively poorer over time (Hartwick, 1977). von Haldenwang (op cit) correctly points out

Both these propositions are relevant to the taxation of renewable resources such as forests and fisheries: a) are rents effectively captured?; and b) are proceeds reinvested in other forms of capital? There are also important differences, however, particularly as local people may be dependent on environmental goods and services from renewable resources in a way that is not the case with non-renewables. Another difference is that renewable natural resources may have global, as well as national and local functions.

Forests illustrate these differences well. Countries may legitimately wish to deplete their stock of forests⁷, but as with non-renewable resources, the captured rent should be subject to the reinvestment test of Hartwick's Rule. An important difference with renewable resources concerns the optimal level of resource stock to be conserved. In the case of forests, it is no longer a question of simply maximising revenue streams, but of balancing potential revenue with the benefits forests generate for local people – as well as their global functions as carbon sinks or centres of biodiversity. A key point is that the optimal level (and form) of forest cover – when balancing revenue potential and *local* needs – will be different when global functions are considered.

The taxation of renewable natural resources thus takes two forms. First, we have situations where stocks are being depleted and rents captured; here, insights from renewable resource taxation on revenue maximisation and reinvestment are important. Second, there is the very different question of sustainable resource management, where the aim is to preserve the capital stock at a particular level. What this level should be, and how taxes can contribute towards maintaining it, is best analysed within a Pigouvian framework.

b) Pigouvian taxation

Where the social costs of an activity are greater than the private costs, private actors will undertake more of it than is socially optimal. Conversely, where the social benefits of an activity are greater than the private benefits, less of the activity will be undertaken than would be socially optimal. The first outcome results because private operators capture the rewards but do not bear all the costs; the second, because they bear the costs but do not capture all the rewards. Where social and private costs and benefits diverge in this way, markets will tend to overproduce 'bads' and underproduce 'goods'. These concepts of negative and positive externalities were developed by the economist Arthur Pigou (1877-1959), and provide a theoretical rationale for using environmental taxation to enhance social welfare.

Societies could eliminate pollution by eliminating polluting activities. They do not, however, because these activities yield other benefits in the form of employment, income or access to consumer goods. Similarly, logging or fishing could be halted, but both yield economic benefits. What is needed is an optimal level of activity where competing costs and benefits are balanced across society. If well designed, Pigouvian taxes can maintain production at a level where marginal social costs equal marginal social benefits.⁸

Pigouvian taxes can also be negative. Where an activity yields positive externalities,⁹ a subsidy can increase private returns to the activity and so raise the willingness of private actors to undertake it. Marginal private benefits are thus aligned with marginal social benefits, and production can be maintained at the (higher) socially optimal level.

that Hartwick's Rule underestimates the amount of investment required, however, as it does not take account of the costs of redressing the environmental impacts of resource extraction.

⁷ The UK, after all, was once covered in thick forests

⁸ If production – or resource use – is higher than this, marginal social costs exceed benefits, making society worse off. If below this level, further usage would create net social benefits.

⁹ The sustainable management of forests to support biodiversity, for example.

Pigouvian taxes take one of three forms: first, second and third best. First best taxes generate the largest net social benefits by maximising the difference between total social costs and benefits. While elegant in theory, in practice this raises severe problems. To calibrate a tax accurately, it is necessary to know the shape of the marginal social costs and benefits curves. For the latter, this requires knowledge of the value people place on environmental goods and services. As these are rarely traded, such valuations must be estimated using a variety of measures¹⁰, all of which have theoretical problems. Perhaps more importantly, both are extremely time-consuming and expensive to undertake. When combined with the difficulty of measuring marginal costs,¹¹ and the fact that both costs and benefits are constantly changing, first best forms remain an abstract ideal rather than a reality (Bluffstone, 2003).

Second best taxes do not optimise, but start from a desired environmental outcome (e.g. a particular pollution level or atmospheric concentration; logging rate or total forest cover) and design taxes to achieve this. Desired outcomes may be based on scientific indicators of safety (e.g. air pollution) or sustainability (e.g. fish stocks), or the best estimates of the optimal resource stock given local needs (e.g. forest cover). Alternatively, desired outcomes may be driven by external factors, such as commitments resulting from international agreements, or pressure from donors. If well calibrated, second best taxes provide incentives for individual private operators to innovate such that the desired reduction (in pollution, logging or fishing, for example) is achieved at the lowest possible cost to the economy (*ibid*).¹²

Where there is uncertainty over how industries will react to a given tax rate, but it is important that a threshold is not breached, two-tier taxes may be used. Here, a low or zero-rate applies up to the threshold, beyond which punitive rates kick-in.¹³ While these forms of mechanisms can ensure thresholds are not breached, they do not provide incentives for change in behaviour below this threshold – i.e. they are not dynamically efficient. They also have considerable information requirements. Activity needs to be monitored on an ongoing basis, for example, whether this is pollution (in the form of emissions) or deforestation (in the form of logging).

With third best Pigouvian taxes, the activity is not targeted directly but through related inputs or outputs that are more easily measured. For example, emissions of CO₂ may be difficult to monitor, but fuel usage – a major source of CO₂ – is not. A tax on fuel, therefore, will reduce usage and so reduce CO₂ emissions.

The main advantage of third best taxes is that they are easy to implement and enforce; the main disadvantage is that they incentivise only a particular class of solutions. For example, it is possible – if improbable – to imagine a motor vehicle that used petrol but did not emit CO₂. However, a tax on fuel would not create an incentive to develop such a vehicle, as the level of tax paid would be unaffected.

¹⁰ There are two main types of mechanism: measures that infer people's valuations from their behaviour (so-called 'revealed preference'); and those which estimate subjective valuations from what people say. For example, hedonic pricing attempts to mimic market prices and capture people's valuations in 'revealed preferences'. A well known example is the value people place on peace and quiet, measured through the discount of house prices near to airports. The main alternative is contingent valuation, where surveys ask people what they would be willing to pay to maintain access to an environmental good such as a forest, or what they would be willing to accept as compensation for the removal of this access.

¹¹ Again, information asymmetries are a problem in this regard, as companies have little incentive to reveal their true average or marginal cost structures.

¹² Although it is not necessary to measure marginal social benefits to set second best tax rates, the relevant industry's average marginal costs need to be understood. In order to know how private actors will respond to a tax of a particular rate – and so what the environmental outcome will be – it is necessary to know how the tax will affect costs and therefore profits.

¹³ Two-tiered systems were used extensively in transition economies (Vincent and Farrow, 1997)

c) User fees and payments for ecosystem services (PES)

Strictly speaking, user fees are not taxes – voluntary payments are made and goods or services received in exchange. They are included here, however, because they resemble (Pigouvian) taxes in important ways. Specifically, user fees and Pigouvian taxes have the same potential functions: regulation of use and revenue generation.¹⁴

When considering the appropriate level of user fees there is a need to balance cost recovery/sustainable resource use and affordability. It may be that user fees compatible with full cost recovery and the maintenance of sustainable resource use are higher than many people can afford. Possible policy responses are: a) to reduce fees across the board; b) to reduce fees for particular groups; or c) to reduce fees for a given level of usage.¹⁵

The first option is unattractive on both revenue and environmental grounds. Reducing fees for everyone would require an expensive subsidy, while also not providing the desired incentive to reduce use. By being more targeted, the second option does better on both counts, but is more time and resource intensive as a result. Whether ex-ante (e.g. exemptions) or ex-post (e.g. rebates) mechanisms are used, it is necessary to identify those who qualify. The third option also requires some monitoring, but this time with respect to the amount of usage rather than to identify the user. For example, fees may be very low (or zero) up to a level of subsistence usage, and beyond this escalate sharply.

The similarities with Pigouvian taxes are clear. Issues of equity and distribution (i.e. affordability) are central to debates on Pigouvian taxation, for example. Where a regressive impact is likely, proposed solutions are broadly the same as those suggested for user fees.

Payments for ecosystem services (PES) are not taxes either, but payments for which a reciprocal service is provided, as with user fees. In this case, however, the 'service' is provided by the stock of natural capital (forests, fisheries, etc).

The Millennium Ecosystem Assessment (2005:39) defines PES in four different categories as follows:

Ecosystem services are the benefits provided by ecosystems. These include provisioning services such as food, water, timber, fiber, and genetic resources; regulating services such as the regulation of climate, floods, disease, and water quality as well as waste treatment; cultural services such as recreation, aesthetic enjoyment, and spiritual fulfillment [sic]; and supporting services such as soil formation, pollination, and nutrient cycling.

These services underpin all economies and can be thought of as a high-value input to production processes. An early estimate by Costanza et al (1997) put the global value of ecosystem services at \$33 trillion. More recently, The Economics of Ecosystems and Biodiversity (TEEB) project was established by the UNEP to explore the value of ecosystem services. By including these values, appraisals of economic projects can arrive at very different conclusions.¹⁶ Taking these broader – but still 'real' – values into account, a project that appeared economically rational can look anything but.

¹⁴ In principle, user fees for water should raise sufficient funds to finance the treatment and supply of safe water and maintain water usage at sustainable levels. A Pigouvian tax levied on water usage, where the proceeds are hypothecated for water treatment and distribution, would perform the same functions.

¹⁵ See Estache (2006) for an excellent review of these issues in the infrastructure sector.

¹⁶ For example, clearing mangrove swamps to create shrimp farms in South East Asia is common. A TEEB study from 2007 describes how these farms can generate returns of \$1,220 per hectare in Thailand, which far exceeds the direct benefits of the mangrove swamps (Barbier, 2007). The study also estimates the wider value of ecosystem services to

The problem is that the owner of the land on which a mangrove swamp is located, for example, does not capture this value and so has no incentive to maintain the swamp when offered a commercially viable alternative. PES aims to overcome this by paying landowners to manage resources so that environmental services continue to flow sustainably. This can be understood in the same way as the positive externalities associated with forests described above. Natural forests support a wide range of biodiversity, which has real economic benefits for many stakeholders. They also help to protect and regulate water sources, benefiting everyone within a given area. Forests also function as global carbon sinks and thus provide environmental benefits from which everyone in the world potentially benefits.

Pigouvian subsidies, calibrated to reflect this wider value, are a way of encouraging private actors to maintain these environmental services. As with Pigouvian taxes, such subsidies can, in principle, be calibrated to maintain this flow at the 'optimum' level. This raises the important question of optimal for whom, however. The next section considers this in the context of local, regional and global public goods.

1.1.2. Public goods and environmental taxation

The concept of public goods is credited to Paul Samuelson (1954). Pure public goods have two defining characteristics: non-rivalry and non-excludability. Non-rivalry means that one person's consumption does not affect the ability of others to consume. Non-excludability means that once the good is provided, it is not possible (or feasible) to prevent anyone from consuming it.¹⁷

A variant is the 'joint product', defined as a public good that results from the production of another good, which is often private. For example, an individual may wish to educate themselves to further their own private interests, but in doing so, the sum of knowledge in society increases, with positive impacts on economic productivity. A public good arises as a result of the pursuit of a private good, and is therefore a form of positive externality. Arce and Sandler (2002: 15) extend this idea to the international sphere:

A transnational activity that gives rise to multiple outputs that may vary in their degree of publicness is an example of a joint product. In particular, an activity that yields both purely public transnational benefits and country specific benefits is an instance of joint products. Such joint product activities may also confer private benefits on all, or a subset, of the providers of public goods.

Neither public goods nor externalities need be nationally confined, and the extent of 'spillover' varies. For example, a national government may want to preserve a particular quantity of forest cover for commercial purposes and to maintain a supply of forest services to local people. From a taxation perspective, this would suggest a particular set of structures and rates. It is also the case, however, that the quantity and quality of forest cover has a significant effect on watershed management, which influences the supply of water to rural and urban communities. Watersheds do not respect national boundaries and are often

local people, however, including the regulation of fisheries and coastal management. When combined with forest projects, the value of these services is \$12,000 per hectare.

¹⁷ While distinct in theoretical and epistemological terms, public goods are similar to positive externalities – where social benefits exceed private benefits – in practice. For a pure public good, there is no private benefit at all, so none of the good will be produced by private actors. In practice, there are very few public goods that are completely 'pure' in this sense. More common are impure public goods, which exhibit partial rivalry or excludability. For example, it may be difficult to exclude people from access to fishing waters, but fishing is 'rival' in that one person's usage depletes another's. Road transport is another example: beyond a certain level of congestion, access to the road by additional people does affect the ability of others to consume the good. When goods are partly rival but non-excludable, overuse is the likely result, which can be addressed by exclusion mechanisms such as fishing quotas or congestion charges (Sandler, 2002).

transnational. As a result the maintenance of good watershed management can be thought of as more of a regional than a national public good (*ibid*).

The logic is readily extended to the global sphere. Because of the role that tropical forests play in providing carbon sinks and protecting biodiversity, increased forest cover – and sustainable management with respect to biodiversity – has global spillovers.

Given that any country will have a locally optimal level of forestation for domestic reasons – at least in principle – a combination of national taxes (calibrated to achieve this) and global Pigouvian subsidy/PES (calibrated to maintain a globally optimal level and form of management) may be a way of balancing national and global public goods.

1.1.3. Packages of environmental taxation

While taxes have long been levied on natural resources, proposals to use them to achieve environmental goals are more recent. More recent still are frameworks which bring together a portfolio of environmental taxes (and subsidies) as part of wider fiscal reforms. There are two main approaches:

First, Environmental Tax Reform (ETR) can be defined as:

[...] a reform of the national tax system where there is a shift of the burden of taxation from conventional taxes, for example on labour, to environmentally damaging activities, such as resource use or pollution. The burden of taxes should fall more on 'bads' than 'goods'.
(EEA, 2005)

ETR is associated with developed countries, particularly in Europe. In the quote above, the key word is 'shift'. ETR is designed to be revenue neutral, so that new environmental taxes should be offset by reductions in – or removals of – other forms of tax. As well as addressing environmental goals by taxing 'bads', ETR aims to reduce taxation on 'goods', such as labour and investment, thus generating higher employment and/or growth. This is known as the 'double-dividend' and is a core part of the case for ETR.

A closely related approach is Environmental Fiscal Reform (EFR), which is defined as; '[...] a range of taxation or pricing instruments that can raise revenue, while simultaneously furthering environmental goals' (World Bank, 2005).

The key distinction between these two concepts is that of revenue neutrality. As the term 'fiscal reform' suggests, EFR is a comprehensive set of measures of tax and subsidy designed to achieve specific environmental goals, and also to raise overall tax revenues rather than be revenue neutral. Both the OECD (2006) and World Bank (2005) have been strong advocates of EFR in developing countries.

Comparing EFR with orthodox fiscal reform (OFR) in developing countries, we can identify a number of similarities and differences. For similarities¹⁸:

- Tax policy of all kinds will be influenced by the structure of developing country economies – i.e. large informal and agrarian sectors, and prevalence of small and medium enterprises (SMEs).
- Issues of distributional impact can also be relevant for OFR.

¹⁸ See Brautigam et al (2008) for an overview of tax and development issues.

- Capacity constraints – not least the ability to monitor economic activity (and its environmental consequences) – restrict the options available to policy-makers.
- Reforming fiscal policy can be severely hampered by vested interests.
- Issues of accountability to citizens, and the influence of external parties (including donors) on policy is a shared feature.

And for differences:

- From an environmental perspective, what might be thought of as an ‘optimal’ tax is the opposite of its counterpart in standard tax theory. In the latter, ideal taxes are relatively low, applied to as broad a base as possible, and levied at a uniform rate. The idea is to raise the maximum amount of revenue while not reducing incentives, or distorting behaviour. In contrast, environmental taxes are explicitly designed to influence behaviour by altering relative prices, and are focused on a narrow base, such as a particular sector.
- While vested interests may seek to block reform in both cases, the parties are likely to differ. For example, EFR brings environmental ministries into potential conflict with finance and trade ministries, particularly where these have strong links to incumbent industries which stand to be negatively affected by EFR.
- Issues relating to the funding of national, local and global public goods discussed above have not arisen in OFR¹⁹ in the way that they do in EFR.

1.2. Current and planned practice

We consider subsidies to be a negative form of Pigouvian tax, PES to be an example of such a subsidy and user fees to be closely related. The taxation of renewable natural resources turns on questions of aligning private and social benefits. As a result, this section examines all of these phenomena within a Pigouvian framework, organised into first, second and third best mechanisms.

1.2.1. First best mechanisms

Because of difficulties in measuring marginal social benefits and costs, first best taxes remain an ideal rather than a reality. The concept is important, however, as it highlights and clarifies the trade-offs facing policy makers. In an idealised sense, the job of politicians is to ‘imagine’ the shape of the social benefit curve, propose policies that accord with this and – when in government – implement these in a way that balances the concerns of citizens. In practice, of course, policy formulation will be far messier than this, but it is often helpful to start with an idealised system, not least to identify the gap between this and existing practice.

For example, when considering the balance between environmental and other goals in developing countries, the interests of the poor need to be fully taken into account. As we have seen, the livelihoods of poor people are often inextricably linked with the flow of goods and services from the natural environment. Decisions on optimal resource use – and tax policy to foster this – need to be informed by these realities, rather than by the interests of elite groups alone.²⁰

¹⁹ The subject of global public goods has a large literature, some of which addresses issues of funding, including global taxes to fund global public goods (see Kaul et al, 1999, for example). The EFR distinction is made for two reasons. First, while there is literature on global taxation and global public goods, this is a long way from being orthodox. Second, through mechanisms such as REDD+, real world examples of these rather abstract concepts are beginning to emerge in the environmental sphere. There is no reason, in principle, why the same logic could not be extended to non-environmental public goods, however.

²⁰ Where tax policy is the outcome of bargaining between political and economic elites (Moore, 2008), and these groups have a relatively short-term extractive perspective, taxes may not be structured so as to foster sustainable long-term management, despite the fact that this may be in the interests of a significant group of citizens.

An 'idealised' framework designed to maximise total social welfare could help achieve this, and serve as an important reference point for actual policy measures.

1.2.2. Second best mechanisms

Second best taxes (and subsidies) target the activity to be discouraged (or encouraged) directly. We can identify three main categories.

a) Air- and water-borne pollutants

As well as CO₂, a number of air-borne emissions present environmental and health-related hazards, some of which can be quite localised in their effects.²¹ The UK's Department for Environment, Food and Rural Affairs (DEFRA) describes the relationship of localised air pollution to the process of development as follows:

Historically, the main air pollution problem in both developed and rapidly industrialising countries has typically been high levels of smoke and sulphur dioxide emitted following the combustion of sulphur-containing fossil fuels such as coal, used for domestic and industrial purposes. These days, the major threat to clean air is now posed by traffic emissions. Petrol and diesel-engined motor vehicles emit a wide variety of pollutants, principally carbon monoxide (CO), oxides of nitrogen (NO_x), volatile organic compounds (VOCs) and particulate matter (PM₁₀), which have an increasing impact on urban air quality.²²

In low-income countries (LICs), localised air pollution is unlikely to be a major problem, but this is not so in middle-income countries (MICs). Many face increasing problems in urban areas, and have set up monitoring systems,²³ and a range of pollutant taxes, to address the issue. One of the most cited examples in developing countries is China's sulphur tax. Introduced in 2006, energy production that has not been 'de-sulphurised' was subject to a tax. The proceeds were used to fund the cost of de-sulphurisation (\$350m per year), and the tax designed to spread these costs between consumers and producers. By 2008, the tax had already reduced emissions by 70 per cent of the 2006-10 target, and this target was duly achieved (GIZ, 2008).

Interestingly, a number of commentators have pointed out that China's pollution taxes were set at low levels for a long time, well below marginal abatement costs in most cases. In 2000, for example, the World Bank estimated that sulphur taxes would have to rise by a factor of 50 to equal marginal abatement costs (Wheeler et al, 2000). The subsequent increase in the tax rate was not of this magnitude, but did bring costs closer to marginal abatement levels.

While the experiences of developing countries with direct taxes on CO₂ emissions are limited,²⁴ a number of countries are considering the implementation of a carbon tax. This can be levied either directly according to the level of emissions, or indirectly, according to the carbon content of another good, usually a type of fuel (i.e. coal, gas, oil). Many middle-income countries considering second best carbon taxes of some form are located in Asia –

²¹ Acid rain, for example, is the result of sulphur dioxide and nitrogen oxide emissions, which react with water molecules in the atmosphere to create acids

²² <http://uk-air.defra.gov.uk/air-pollution/causes>

²³ For example, since 2008 China's State Environmental Protection Agency has monitored pollution levels in 86 cities on a daily basis. Measuring concentrations of sulphur dioxide (SO₂), nitrogen dioxide (NO₂), suspended particulates (PM₁₀), carbon monoxide (CO) and ozone (O₃), the resulting data are combined to form the Air Pollution Index.

²⁴ It is important to distinguish carbon taxes from fuel taxes at this point. As we shall see, many countries have implemented taxes on fuels, but this is not a second best Pigouvian tax as it is not levied on the pollutant directly.

China and Vietnam, for example. What these countries share is an experience of rapid growth and industrialisation, reflected in sharply increasing levels of CO₂ emissions.

Vietnam's Environmental Tax Law comes into force in January 2012, in keeping with the original commitment made in 2004 by the prime minister to implement a carbon tax by this date. GIZ (formerly GTZ) have been working with the Vietnamese finance ministry for some years to assist in the design of the tax. GIZ (2011) describe the outcome as follows:

The Vietnamese government will levy taxes not only on energy in terms of refined fuels and coal, but also on environmentally harmful substances, such as hydrochlorofluorocarbons (HCFCs), selected pesticides and soft plastic bags. The exact tax rates will be determined by the central government for each tax period. As an example, petrol will have tax rates ranging between VND 1,000 and 4,000 per litre – which corresponds at present to an ad valorem tax rate of between 5.9 % and 17.6 % – and will abolish the current petrol charge in the amount of VND 1,000.

The original framework would therefore have seen petrol prices rise, as much as fourfold. Public opposition may have triggered a rapid change in policy prior to implementation. In an interview with the Viet Nam Economic Times, Vu Thi Mai, deputy minister of finance, made clear that the tax would not affect petrol prices:

Under the law, petrol and diesel will be subject to an environmental tax. That tax is already levied on petrol and diesel under the existing environmental law, so service stations will not have to pay more tax, it's just now it will come under the new Environmental Protection Tax Law...the tariff levied on petroleum will in effect be unchanged. In other words, retailers will have to pay VND 1,000 per litre of petrol; VND500 per litre of diesel; VND300 per litre of kerosene, machine oil and lubricant oil; and VND300 per kilogram of grease. Once again I want to emphasise that the new law will not affect the petroleum price.

If implemented in this way, Vietnam's 'carbon tax' looks more like a third and a second best Pigouvian tax. Furthermore, given the rate will remain unchanged from the current level, it is difficult to see that it will result in additional behaviour change.

China's 12th 5-year plan was announced in 2011, and was heavily trailed as marking a shift towards a greater environmental focus. Upon release, the plan did indeed stress the importance of improving air and water quality. A range of second best, Pigouvian taxes are envisaged, though details remain sketchy at the time of writing. The possibility of a carbon tax was also floated in the plan, and in the Climate Change White Paper, published in November 2011, the prospect of a national Cap & Trade system was articulated.²⁵ In the first instance, these measures will be trialled in a number of provinces before country-wide implementation, it is suggested, by 2015.

As with all economic instruments to achieve environmental goals, the devil will be in the detail, and at present there is very little detail. However, it is highly significant that China – as the world's largest emitter of CO₂, in total rather than per capita – appears to be choosing instruments based on economic incentives rather than command and control (C&C) regulation.

²⁵ www.gov.cn/english/official/2011-11/22/content_2000272.htm

For countries considering implementing second best taxes, the experience of the Nordic countries,²⁶ all of which introduced a carbon tax of some form in the 1990s, may be informative. An important – if somewhat obvious – lesson is that carbon taxes can have very different effects:

- If set at very low rates, behavioural effects will be minimal;
- If introduced unilaterally at a high rate, carbon taxes can induce companies to relocate to countries without carbon taxes, rather than change their behaviour;
- If introduced at a high rate but with exemptions for heavy users, positive results will require complementary incentives as part of a long-term, strategic package;
- Where a sector is subject to significant international competition, agreements between countries will be far more effective than unilateral moves, which are likely to be eroded over time.

Water-borne pollutants (or effluents) are also subject to second best taxes, for which there is a strong case. Sources of pollutants are often difficult to trace and assess individually. As a result taxing final outflows incentivises firms to find the most cost-effective means of reducing effluents. Also, if the tax is set at the level of average marginal abatement costs, the cheapest forms of abatement will be incentivised most. As a result, reducing emissions to a given level will be achieved at the lowest possible costs. Unlike C&C regulations, effluent taxes also encourage innovation and raise tax revenues (Boyd, 2003).

Given these advantages, it is surprising that effluent taxes remain a relative rarity, with command and control regulation being by far the most common approach. In developed countries, France and Germany were early implementers of effluent taxes on industrial polluters, first introducing measures in the 1960s and 1970s respectively. For a long time, advocates pointed to France and Germany as exemplars. More recently, however, the consensus has changed so that the role of complementary regulations in reducing pollution in both countries is more recognised. Also, the French and German systems have come to be seen as primarily revenue-raising mechanisms, as they are set at too low a level²⁷ – i.e. well below marginal abatement costs – to induce behavioural change (Boyd, op cit)

In developed countries, the only ‘success story’ in terms of effluent taxes is the Netherlands. The Dutch system levies charges on biochemical oxygen and heavy metals, with proceeds used to subsidise industry improvements. Uniquely it seems, taxes are also high enough to trigger behaviour change, and studies have suggested that it is the taxes rather than regulation that have driven reductions in effluents (*ibid*). For Boyd (op cit: 15) ‘[...] the Dutch program stands as the single international example of a successful charge-based system’.

²⁶ The first to introduce a carbon tax was Finland in 1990. Originally the tax was specific to CO₂ emissions, but was subsequently reformed to become a part CO₂/part energy tax. In this respect, it is now a part second best/part third best form. Initially, there were few exemptions. In 1991 Sweden followed suit, introducing a tax on the CO₂ content of fossil fuels. Unlike in Finland, however, industrial emitters only paid half of the standard rate, and intensive users of energy were exempted entirely. Norway also introduced a carbon tax in 1991. As with Sweden, energy intensive industries were exempted so as not to adversely affect competition. Following the opening of the Nordic electricity market, the fact that Finnish energy companies were subject to the carbon tax, but their counterparts in the other countries were not, put them at a competitive disadvantage. Finland’s attempts to impose a tax on imported energy ran afoul of EU Single Market legislation, with the result that Finland decided to exempt its own companies (Vourc’h and Jimenez, 2000). While Norway and Sweden offered exemptions – or reduced rates – for industry, both the standard and reduced rates in Sweden are higher than in Norway, with the difference between the standard rates being particularly marked. While there are other factors to consider – not least the role played by oil in the Norwegian economy – this may go some way to explaining the difference in outcome. By 2008, per capita emissions had increased by 15 per cent in Norway, but had fallen by 9 per cent in Sweden (Abboud (2008) and Swedish Ministry of Environment (2008) respectively. Both quoted in Sumner et al (2009))

²⁷ See Glachant (2002) for a political economy analysis of why French rates have remained so low.

While limited, there is some experience of effluent taxes in developing countries, with more countries planning to implement them. Colombia's experience is generally considered a success, being credited with reducing demand for biochemical oxygen by 27 per cent and suspended solids in total by 45 per cent between 1997 and 2002. The first phase of the process involved an agreement to reduce pollutants within a given watershed area by a specified amount. All stakeholders, including local communities, participated in this process. Those responsible for releasing pollutants within the area were then required to submit information on the quantity of different pollutants. The tax was then calculated to achieve the agreed reduction. Where the target was not met, a 'regional multiplier' was applied in the subsequent period (Castro, 2003)

While the tax succeeded in reducing effluents, the use of the regional multiplier led to considerable opposition. Regional targets were repeatedly missed so that the multiplier caused real tax rates to increase 'exponentially'. In part, this was because of a lack of appreciation of the difficulty – and cost – of reducing effluents, but also because insufficient work was done to assist companies in reducing pollution or time allowed for this to take place. On the positive side, a report by the Economic Commission for Latin America and the Caribbean (ECLAC, 2001) found little in the way of negative economic effects and even some examples of positive impacts due to higher productivity. Finally, transparency and revenue recycling were key:

One key point in CORNARE's success is the transparency with which the collected funds have been managed. From the start, CORNARE determined that 50% of the money would be used to co-finance projects designed to deal with municipal pollution, 30% for investment in industrial reengineering and cleaner production, 10% for environmental science and technology research, environmental education, and dissemination of information about the environmental tax, and an impressively low 10% for operating expenses.
(Castro, 2003: 67)

China's existing complex Pollution Levy System addresses water- and air-borne pollutants. Traditionally, a two-tier system has been used, with taxes only applying once a threshold was breached. As with air-borne pollutants, however, tax rates have been kept very low, well below marginal abatement cost levels (GIZ, 2008). When combined with China's rapid and sustained industrialisation, pollution levels have risen significantly. The 12th 5-year plan envisages a significant increase in tax rates, with behaviour change the clear goal.

b) Renewable resource taxes

In this section we consider Pigouvian forms of tax levied on natural resources, such as fisheries and forest. Following the discussion of national and global public goods, we also consider the issue of Pigouvian subsidies in the forestry sector (i.e. REDD+), and Payments for Ecosystem Services (PES) more generally. Finally, we examine the tax-like aspects of user fees.

As with non-renewables, it has generally proved difficult for governments to effectively extract resource rents from renewable resources, not least because it is hard to predict how much rent will be generated over time, and thus what rate of tax should be applied. Companies have also proved adroit at 'managing' their levels of reported profits in different jurisdictions.²⁸ An alternative to profit taxes are royalties, where a fee is charged in exchange

²⁸ Extractive sectors are characterised by high sunk costs, uncertainty over how much can be extracted and how easily, and long time frames before revenues accrue. Also, volatile international prices make future revenues extremely difficult to forecast (Daniel et al, 2010). In addition to these external factors, firms in the extractive industries are often large multinationals and so able to shift profits between the different jurisdictions they operate in. Combined with their

for permission to mine, or per unit extracted.²⁹ While uncertainty is transferred from the government to the company, the inherent information asymmetry³⁰ puts the government at a disadvantage. The company will have a far clearer idea on costs, and possibly an advantage in forecasting global prices when conducting negotiations, for example.³¹

Given these factors, revenues from natural resource taxes vary hugely. This is true between countries (because of the different systems used and agreements made), and over time (because of large fluctuations in market prices).³² One plausible solution to the problems of asymmetric information and uncertainty is to auction extraction rights³³, which should – under certain conditions³⁴ – generate the best returns for governments (Collier and Venables, 2008). A caveat is needed here: While competitive auctions can certainly increase government revenues, it does not necessarily follow that the resultant valuations are accurate. There are numerous examples of companies overbidding for rights as a result of competitive pressure and over-optimism about future prospects.³⁵ Auctions – if well designed – do have distinct advantages over other forms of rights allocation, however. Despite this, they remain the exception rather than the rule for both renewable and non-renewable rights (Karsenty, 2011).

1. Forest taxes

Long-term concessions have been the most common forest management arrangement, generally combining volume-based taxes on trees felled, with area-based taxes, based on the size of the area under the concession. The rationale for this combination is as follows:

In cases where...there are only volume-based taxes and no area-based charges, logging companies have an incentive to hold concession areas larger than they can actually harvest. They would do so in order to secure an expanded access to the resource in the future and to keep other players out. In this sense, the area-based charge represents the price logging companies pay to secure their access to future timber supplies. A long-term concession system without annual area-based fees practically 'sells' this security to loggers at no cost. Sufficiently high annual area-based charges on concession areas on the other hand, help ensure that logging companies do not hold concessions larger than what they can manage.
(GIZ, 2005: 5)

While the incorporation of area-fees has increased government revenues, they remain low in many cases.³⁶ ³⁷ Traditional concession systems have also proved ineffective in fostering

ability to negotiate favourable terms at the outset, this means that developing country tax authorities can find there are few profits to tax. (See Christian Aid, 2008, for a good – if understandably one-sided – take on these issues)

²⁹ See World Bank (2006) for a comprehensive – though again somewhat one-sided – overview of the role of royalties in the taxation of mining and energy companies.

³⁰ See Stiglitz and Weiss (1981).

³¹ They are also able to hedge price and foreign exchange risk, thus partially offsetting volatility and future uncertainty.

³² For example, the increase in tax takes in sub-Saharan Africa over the past ten years can be strongly linked with buoyant commodity prices over the same period (Keen and Mansour, 2010).

³³ See Cramton (2007) for a good discussion of the different options for auctioning oil rights, which has relevance for natural resource rights more generally.

³⁴ For example, a minimum number of bidders are required for the auction to function properly.

³⁵ The financial crisis of 2008 led to the collapse of world timber prices. As a result, companies that had agreed area fees based on pre-crisis price expectations faced severe economic difficulties. In Cameroon – one of the few countries to have auctioned area rights and obtained high fees in the process – payments were suspended to reflect changed economic circumstances (Karsenty et al, 2011).

³⁶ It is broadly accepted that natural resources are undertaxed in many developing countries. While some countries are able to extract resource rents successfully, this is the exception rather than the norm. For example, the World Bank (2005) estimates that taxes on fisheries, forests, mining and agricultural land in Mozambique could be increased to around 19 per cent of tax revenue by 2015, compared to 5 per cent in 2003 (cited in Slunge and Sterner, 2010)

sustainable management³⁸, as this is rarely if ever the most commercially viable approach. Managing forests to support biodiversity and ecosystem maintenance, for example, would require a very different approach than one which would maximise revenue streams. In the latter case, focusing on a limited number of fast-growing tree species, or even forest clearance and alternative land use, are likely to be considerably more profitable than sustainable management. In addition to these two forms of tax, many countries apply a tax to exports, which is designed to stimulate domestic industry, as well as raise revenue

In principle, a combination of these three forms of tax, calibrated at the right rates and linked to global prices to maintain constant incentives, would be capable of maintaining a given level (and form) of forest cover, and stimulating a sustainable domestic timber processing industry. In practice, however, experience with forest taxes has not been encouraging, not least as the enforcement of taxes and prevention of illegal logging has proved extremely difficult.

The experience of Tanzania is quite typical. The country has a standard set of forest taxes, in line with the model described above. The problem is not tax design, however, but compliance. A 2007 study estimated Tanzania was losing up to 96 per cent of potential tax revenues, or \$58 million per year. This is starkly demonstrated by the fact that trade figures show China importing ten times the level of timber products from Tanzania than was officially exported. Deforestation in Tanzania continues at a rate of 1 per cent per year on average. In some provinces the situation is far worse:

At the harvest rates experienced during 2003 and 2004, and based on official forest inventories, it is apparent that all harvestable Class I and II trees in Rufiji and Kilwa Districts will have been felled within 20 years.
(Milledge et al, 2007: 4)

This is not a phenomena restricted to the forestry sector. A review of 68 tax compliance studies estimated average compliance rates in Tanzania at 27 per cent (Kobb, 2001). Corruption is also widespread. Most countries award logging rights on an 'administrative' rather than a competitive basis. The lack of transparency is conducive to corrupt practices.

Some countries have been more successful. In Cameroon, for example, revenues grew from \$3 million to \$30 million between 1995 and 2001, accounting for a quarter of government revenues (OECD, 2008). As suggested above, one solution is to auction rights. Karsenty (2011) reports useful lessons from Cameroon in this respect:

- Bids for areas were higher than that charged on an administrative basis, suggesting companies are well-aware of latent value.
- Auction-based systems appear effective at capturing rents.
- Some concession holders responded to higher costs (i.e. fees) by diversifying their products and moving up to value chain into timber processing.
- Others responded by greater tax evasion, however.
- In practice most companies mixed both types of response, suggesting that tax incentives need to be accompanied by strictly enforced regulation to prevent evasion.

³⁷ See Whiteman (2003) for a good review of the difficulties of generating revenues from forests in both developed and developing countries.

³⁸ In efforts to promote long-term management through the granting of property rights, some forests have been turned over entirely to private ownership, particularly in Latin America. The hope was that the granting of property rights would ensure sustainable management of a valuable resource. But in slow-growing tropical forests, sustainable logging is generally not commercially viable, so that private ownership has often lead to rapid extraction of the resource and the introduction of a more economically viable land-use (GIZ, 2005).

- Irregularities in auctions are likely with only one bidder, where potential competitors have been screened out of the process on 'technical' grounds.

Thus while auctions can be an effective tool to capture rent, they are open to abuse and can have negative effects if not complemented by strong regulation. While higher taxes (and greater enforcement) may discourage over-logging, they also incentivise illegal logging. Similarly, higher taxes may encourage a focus on the more valuable hardwoods. As Karsenty (*ibid*) notes, this is not compatible with sustainable forest management, particularly with respect to biodiversity.

One proposed solution has been greater involvement of forest-based communities in managing resources sustainably. Numerous international agencies have been undertaking research into the ways that 'traditional knowledge' can inform sustainable forest management practices.³⁹ There is also a growing understanding of the commercial potential of timber and non-timber forest products and the role that forest-based communities can play. In the context of The Gambia, the FAO (2008: iii) describes the rationale as follows:

Experience in participatory forest management in the Gambia has shown that once local communities have recognized the value of trees and forests, they will develop a vested interest in their protection as permanent sources of income and/or livelihoods.

Clearly, there is potential to expand the range of (taxable) forest activity, and greater involvement of forest-based communities is an important part of this, from both an equity and sustainability perspective. Furthermore, addressing tax evasion through illegal logging is a prerequisite to progress of any kind. It is possible to imagine systems of best-practice tax and regulation that would facilitate this.

It is unlikely, however, that the quantity and quality of tropical forests needed globally (i.e. for carbon sinks and biodiversity) can be achieved as a by-product of their commercial exploitation. To address this, we need to consider the other side of the Pigouvian coin: subsidies.

2. Forest subsidies

While taxes can reduce the profitability – and so potentially the quantity – of logging, this will not necessarily encourage sustainable forest management. Indeed, given that taxes reduce profits, they may make it less likely that loggers will manage forests sustainably, as this would add to costs and reduce profits further.

To address this, landowners need to be compensated for undertaking sustainable management activities, with payments reflecting the value of the resulting positive externalities. If the desire to generate these externalities is domestic in source, the subsidy should be funded from national sources. If the aim is to contribute to global public goods (e.g. biodiversity or carbon sinks), the sources should be international.

An example of the former is Costa Rica. In 1997, Costa Rica implemented a carbon tax, with the proceeds being used to fund payments (i.e. PES) to landowners to manage forests sustainably. The fund now distributes around \$15 million per year, and has been credited with maintaining biodiversity, as well as significant reforestation, which is in stark contrast to the experience of other developing countries.

³⁹ See www.iufro.org/science/task-forces/traditional-forest-knowledge/, for example.

One problem with replicating this model is that other countries do not necessarily believe it is in their interests to expand forest cover and manage it sustainably. The Reducing Emissions from Deforestation and Forest Degradation (REDD)⁴⁰ programme was designed to address this by ascribing a value to the carbon content of forests. Payments would be made to developing countries to preserve their stock of forests and maintain them as carbon sinks. REDD+ extended the framework to include payments for 'sustainable forest management', forest conservation and afforestation.

One of the few successes to emerge from COP-15 at Copenhagen was the commitment of \$4.5 billion of 'fast start' funding to REDD+ for the 2010-12 period. It is estimated that up to \$30 billion per year may ultimately be transferred to developing countries through REDD+.

An important question is how PES through REDD+ should be integrated with national systems of forest taxation and regulation. Forests will still be exploited for commercial purposes – though hopefully in a sustainable way – and so arguments on extracting resource rents, and using Pigouvian taxes to align the private interests of logging companies with social interests of nations, retain their validity.

As well as the technical and administrative questions this raises, a final point is how combinations of national taxes and global subsidies will affect political dynamics, particularly the degree to which governments are responsive to their citizens (i.e. taxpayers) or to international actors (i.e. sources of REDD+ payments). The specifics of REDD+ transfer payments are likely to be important in this regard: who is paid; on what terms; and who are they accountable to, for example.

3. Fisheries taxation

Fisheries exhibit two important differences to the forestry sector. National jurisdictions account for a large proportion of the world's fishing grounds, the rest are in international waters. Also, unlike trees, fish move.

As international waters are outside any jurisdiction, there is no authority to levy a tax or control the size of catches using other means. As a result, deep-sea fishing is subject to classic 'tragedy of the commons' issues, with overfishing the result.⁴¹ The fact that deep-sea fishing is often subsidised only makes this worse.⁴² Also, while many of the richest remaining fishing grounds are in territorial waters it is not always feasible to police these areas. The size of areas relative to the capacity of the authorities' fleets creates ample scope to flout the restrictions that do exist.

Many African countries have signed fishing agreements⁴³ with the European Union, allowing EU trawlers to fish in their waters.⁴⁴ Historically, these have been widely criticized, with many arguing that overfishing has adversely affected local fishermen using traditional techniques, while governments often benefit little from tax revenues. Revenues from access agreements can be significant, however. The EU's agreement with Mauritania, for example, generates \$80 million annually, or 25 per cent of total government revenues. To the extent that these are a) genuinely 'surplus' fish stocks, b) the government receives a fair price, and c) the

⁴⁰ www.un-redd.org/

⁴¹ Hartin (1968)

⁴² See www.mcbi.org/what/what_pdfs/LastWildHuntPR_FinalFeb14_2007.pdf?ID=150

⁴³ In 2002 such agreements were renamed Fishing Partnership Agreements to reflect a greater focus on sustainable development.

⁴⁴ The US, Japan, China, South Korea and Russia are the other main parties to have negotiated bilateral fishing access agreements.

revenues are invested wisely, there is a reasonable development case. Too often, however, these conditions have not held.⁴⁵

For countries with rich fishing waters, the long-term aim should be to develop a viable fish processing industry. From a value-chain perspective, this is where the benefits of this resource can be maximised. One of the few successful examples in this regard is Namibia. Following independence in 1990, a policy of 'Namibianisation' was pursued in combination with a focus on sustainable resource management.

First, limits were placed on the total allowable catch, (non-transferable) quotas allocated to a specified number of vessels, and catches taxed on a volume basis. The use of quota fees corresponds to that of area fees in the forestry sector and has been credited with enabling Namibia to capture resource rents effectively (Manning, 2000). Second, incentives were offered (in terms of tax rebates on the catch and the awarding of longer quota right periods) for the employment of Namibians, involvement of Namibian businesses and the establishment of fish processing industries within the country. Third, significant resources were devoted to monitoring and enforcement of the system.

The results have been impressive. From 1992 to 1998 the proportion of Namibians employed in the fishing sector grew from 55 per cent to 75 per cent. The onshore processing industry is the fastest growing in the economy and fish stocks – which were heavily depleted prior to independence – have returned to more sustainable levels. The costs of the policy are twofold. First, lower tax revenues from restricting the size of catches, and second, relatively high costs of monitoring and enforcement (Sumaila et al, 2005).

It is noteworthy that the gains to Namibia are relatively long-term, while the costs are short-term; implementing such an approach thus requires a government to have a relatively long-term view. The specific components of 'success' appear to be to:

- a) determine what is a sustainable level of resource use;
- b) put in place mechanisms to maintain stocks at that level;
- c) develop dynamic incentives to generate spillovers in terms of broader economic development;⁴⁶
- d) put in place supporting policies to facilitate these spillovers (e.g. incentives to establish local production facilities); and,
- e) enforce the system rigorously, using sufficient resources.

It is important to remember that these options do not apply to deep-sea fishing. In this the taxation of fisheries differs significantly from that of forests. In the forest sector, the existence of a national 'owner' of forests creates the potential for Pigouvian subsidies to maintain a globally optimal level of forestation. Outside of national waters, in contrast, there are no owners of fish stocks, and so nobody to whom subsidies could be paid to induce behaviour change. This 'tragedy of the commons' suggests that national regimes will work best in a controlled global environment where deep sea fish stocks are not over-exploited. Given the lack of an 'owner', such a framework would need to be created by international treaties and regulation rather than global taxes.

⁴⁵ See Mbithi (2006), for example.

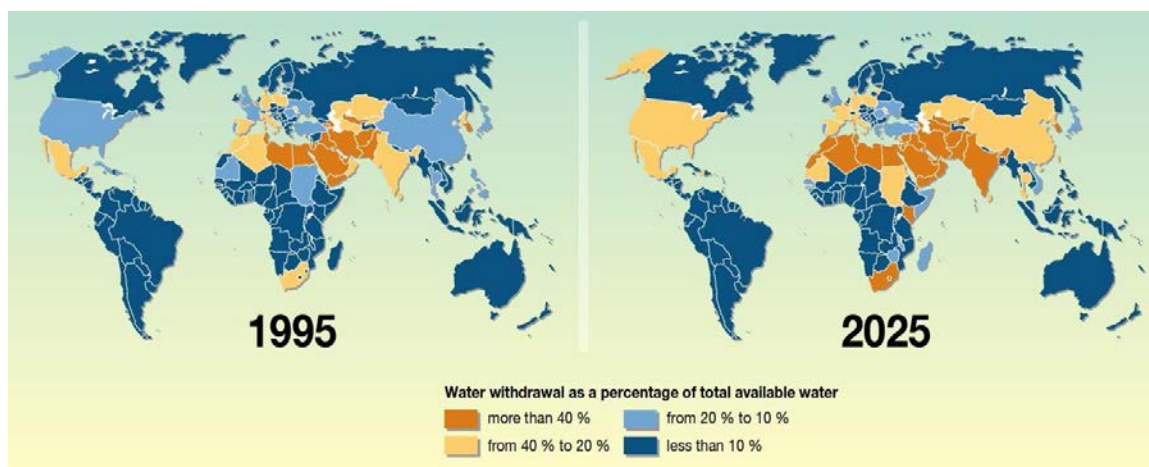
⁴⁶ The alternative is to use C&C regulation such as local content requirements. While there is a case for regulations of this form, it is also the case that economic instruments can provide dynamic incentives, potentially creating better long-term outcomes.

4. User Fees

User fees generate significant controversy, particularly in the health sector, where many developing countries were encouraged by international financial institutions to introduce fees. The rationale was one of cost recovery, but also of limiting demand to genuine need. A problem, however, was that the introduction of fees priced the poorest out of the work, thus often limiting demand by income rather than according to need.⁴⁷

While we are interested in fees on natural resource-related goods and services here, issues of affordability are similarly important, particularly with respect to water.

Figure 1 Increased global water stress



Reproduced with kind permission of GRID-Arendal
www.grida.no/graphicslib/detail/increased-global-water-stress_5694

The image above shows the increase in water stress predicted from 1995 to 2025. For the UNEP:

[...] more than 2.8 billion people in 48 countries will face water stress, or scarcity conditions by 2025. Of these countries, 40 are in West Asia, North Africa or sub-Saharan Africa. Over the next two decades, population increases and growing demands are projected to push all the West Asian countries into water scarcity conditions. By 2050, the number of countries facing water stress or scarcity could rise to 54, with a combined population of four billion people - about 40% of the projected global population of 9.4 billion (Gardner-Outlaw and Engleman, 1997; UNFPA, 1997).⁴⁸

The need to use water more sparingly is clear, but so is the fact that many people still do not have access to good quality water. The World Health Organisation (WHO) estimates that to expand access as envisaged in the Millennium Development Goals (MDGs) would cost \$18 billion per year, double the level currently spent.

⁴⁷ See Save the Children (2008: Appendix 1) for a review of studies estimating the impact of health service user fees on service utilisation. Evidence of a reduction in usage are uniform, with the magnitude ranging from 10 per cent to 50 per cent, with the figure rising as incomes fall.

⁴⁸ <http://maps.grida.no/go/graphic/increased-global-water-stress>

In most countries water services are provided by the state, with fees often subsidised and held below cost recovery rates. The maintenance of pipe networks can be poor, so that much water is wasted. The need for significant investment in water systems has led many to look towards the private sector. Experience with Public-Private-Investments (PPI) has been difficult, however.

For many, access to water is a right, which should be delivered free of charge. Similarly, many object to the involvement of private companies in the water sector, arguing that the profit motive has no place in water delivery. Opponents counter that the treatment and delivery of water is not free and that the cost must be met. Moreover, the benefits of water subsidies are often captured by the urban middle-classes, leaving the rural poor without access to piped water and reliant on – very expensive – water vendors.⁴⁹

A number of countries are planning to implement user fees for both Pigouvian and cost-recovery reasons. Issues of access and the impact on the poor remain important. South Africa, for example, has a two-tier structure, where up to 6,000 litres of water per month are provided free for subsistence use, with the costs met by high fees on water usage above this level and a subsidy from government (Gowlland-Gualtieri, 2007). Full cost recovery would require very high fees to be charged for usage above the subsistence level, but this would also be compatible with the Pigouvian function of user fees. Assuming subsistence levels of water use are sustainable in terms of resource use – and where this not the case solutions are not to be found in the world of tax – high and escalating rates beyond this could effectively deliver sustainability and equity. This approach is recommended by the World Water Council (2006).⁵⁰

1.2.3. Third best taxation

Third best taxes are levied on outputs or inputs, rather than directly on the pollutant in question. Fossil-fuels have a high carbon content, so that an output tax on petrol or diesel⁵¹ can be seen as an indirect tax on CO2 emissions. Other examples are output taxes on plastic bags, or used cars. For inputs, taxes may be levied at different rates on fuels due to their sulphur content, or on pesticides or fertilizers, for example.

These are the most common form of Pigouvian taxes. Third best taxes are easy to administer, often requiring little or no monitoring. They can be levied at the point of sale or further upstream with relative ease. Although they are also the least efficient, these characteristics can make third best taxes the best option in practice.

a) Fuel taxes and subsidies

The most common form of third best taxes are on fuel. Fuel taxes are by far the most important environmental tax in terms of revenues. In both developed and developing countries, fuel taxes account for 60 per cent-70 per cent of environmental tax revenues.

As can be seen from Chart 1 there are large variations in tax rates in developed economies. In European countries the average is \$1.19 per litre; outside of Europe, this falls to \$0.39. Demand for fuel is considered to be highly price inelastic. While this is true over the short term, elasticity increases significantly over the longer-term. Intuitively this makes sense: if you are reliant on a car and petrol prices rise, there is not much you can do about it. If they

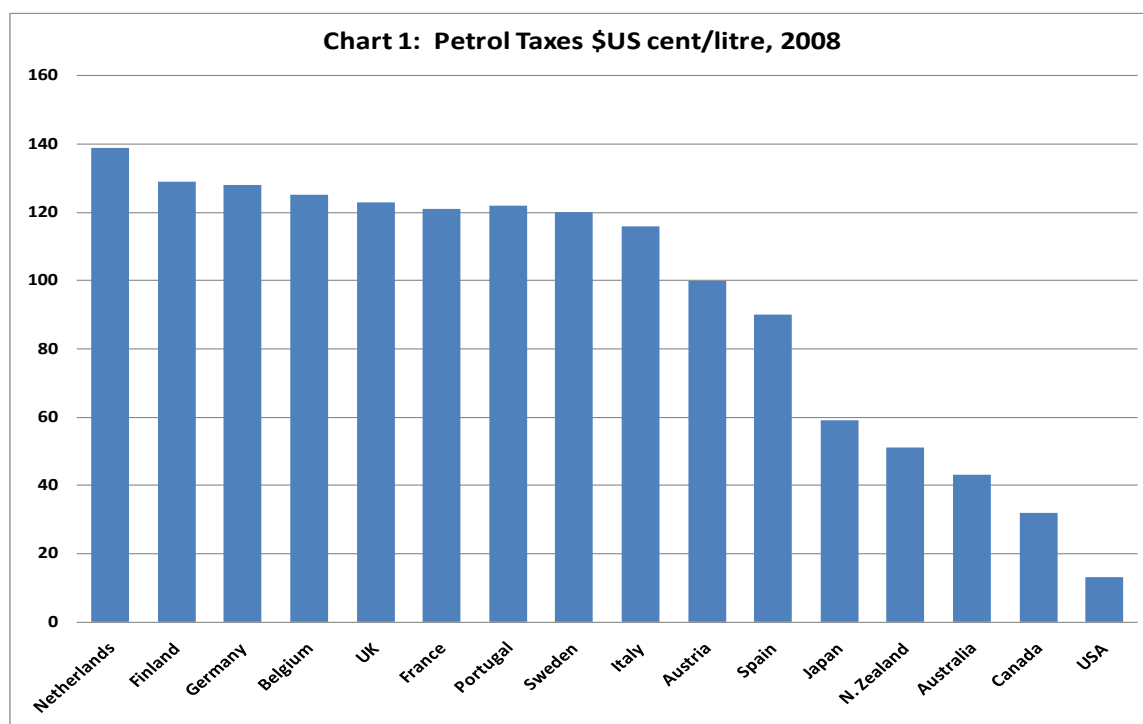
⁴⁹ See OECD (2010b) for a discussion of these issues.

⁵⁰ An obstacle to price structures of this kind is that they run counter to the structure of many utility companies. Generally, high fixed costs and relatively low marginal costs characterise such sectors, with the result that prices structures are high at first and then fall with greater use, the opposite of that described here.

⁵¹ As distinct to a tax on the carbon *content* of petrol or diesel, which would be a second best tax.

remain high for a sustained period, however, you may reconsider being so ‘reliant’ on your car. The availability of substitutes – particularly public transport – is also important here. As a result of this factors, Sterner (2007) estimates that fuel use in Europe would be double what it currently is if tax rates had been set at US levels.

Chart 1 Petrol taxes, 2008



Source: Sterner (2011)

Most developing countries impose fuel taxes to varying degrees. In Africa, for example, taxes are relatively high, above US levels in most instances and approaching European in some. Many have a lower tax rate, or even a subsidy, for Kerosene, given its importance to the poor (Slunge and Sterner, 2010).

Despite the revenue potential of fuel taxes, a number of developing countries do not impose taxes on fuels. The usual rationale is that this is for equity reasons, as fuel taxes are thought to disproportionately impact the poor. While fuel taxes can be regressive, this is often not the case; the poor do not drive in many countries.

Also, because of equity concerns, some countries have not only left fuel untaxed, but have subsidised its use. This is the precise opposite to a Pigouvian tax: instead of raising private costs to internalise the externalities associated with green house gas emissions, fuel subsidies lower these costs; rather than reducing activity to bring it into line what would be socially optimal, fuel subsidies increase activity, moving it further away from the ideal.

As well as encouraging usage, the evidence suggests that subsidies disproportionately benefit the middle classes. When looking at the distributional impact of subsidy reform across a group of developing countries, Granado et al (2010) conclude:

On average, the burden of subsidy reform is neutrally distributed across income groups; a \$0.25 decrease in the per litre subsidy results in a 6 percent decrease in

income for all groups. More than half of this impact arises from the indirect impact on prices of other goods and services consumed by households. Fuel subsidies are a costly approach to protecting the poor due to substantial benefit leakage to higher income groups. In absolute terms, the top income quintile captures six times more in subsidies than the bottom.

Sharp increases in fuel costs due to rising oil prices have put subsidising countries under significant fiscal pressure. For example, it is now estimated that a quarter of Indonesia's government spending goes on fuel subsidies. Coady et al (2010) describe how global food subsidies rose from \$60 billion in 2003 to \$250 billion in 2010. If the failure to tax fuels⁵² is included in the subsidy figure, it increases to \$750 billion.

Clearly, reform of subsidies would have to be carefully managed. Not all fuels are equally used by the poor, with kerosene being particularly important. Resolving these issues through a greater targeting of subsidies and/or exemptions or rebates for the poor would enable reform to be net progressive in distributional terms.

1.2.4. Other third best taxes

In 2010, India introduced a tax on coal, described as the 'first step to introduce a carbon tax'. Levied at 50 rupees (approximately US\$ 1) per ton, the tax is expected to raise more than \$600 million, which will form the basis of a National Clean Energy Fund to fund research and deployment of clean technologies.

A common third best tax is levied on plastic bags. Despite the relatively limited environmental impacts of plastic bag use, they have become increasingly common. The experience of Ireland, where the introduction of a small tax on bags led to an 80 per cent reduction in use in three months is often cited, not least because the tax was very popular (Convery et al, 2007).⁵³

It is interesting to contrast the popularity of plastic bag taxes with taxes on carbon emissions. There is something strange about an effective tax being implemented on a product with marginal environmental effects, while little is done about one which could threaten the future of human civilisation. While India's tax on coal may reduce coal usage from what would otherwise have occurred, there is no suggestion that it will eliminate it, or even reduce absolute usage over the longer-term.

It is easy to find an alternative to plastic bags, but not to fossil fuels. Also, developing and using a different bag is unlikely to have significant impacts on other aspects of life. This is not the case with many of the main sources of CO₂ emissions, particularly fossil fuels. Often, the alternative to not driving a vehicle from A to B is to not make the journey at all. Similarly, the alternative to using electricity generated using fossil-fuels is rarely to use power from renewable sources, but to not use the electricity.

The basic problem with switching to non-fossil fuel energy is cost: energy generated from renewable sources is more expensive, sometimes much more expensive. Also, unlike plastic bags, energy costs account for a substantial proportion of household budgets, so that these

⁵² This calculation is based on estimates of optimal rates of taxation in Coady et al (2010). At \$0.3 per litre, these remain very much at the bottom end of international rates. Were fuel to be taxed at levels common in Europe, the level of global subsidy + foregone tax would rise sharply.

⁵³ Numerous developing countries have either banned plastic bags or introduced taxes. For example, Botswana introduced a tax in 2007 which led to a significant reduction in usage (Dikgang and Visser, 2010). In contrast, South Africa's plastic bag tax has had little impact on usage. The difference in impact can be explained by the rate. In Botswana this was high enough to induce behaviour, while in South Africa it was kept low, and primarily used to generate revenues for recycling (Dikgang, Leiman and Visser, 2010).

price differences bite. Furthermore, as energy is the primary input into most production processes, a shift to renewables would raise costs across the economy, adversely affecting international competitiveness.

As a result, while any country can ban or tax plastic bags unilaterally, none has been willing or able to put in place regulatory or tax-based mechanisms to unilaterally eliminate the burning of fossil fuels.

1.2.5. Environmental Fiscal Reform

The case for EFR is compelling: climate change remains a daunting challenge; for other ecosystems, all countries have an incentive to manage their resources sustainably; any increase in tax revenues is to be welcomed, not least as it increases the scope for pro-poor expenditure; finally, while the overall tax take is designed to increase under EFR, if revenues from environmental sources outstrip those from existing areas, there may be scope to reduce taxes that negatively affect growth.

It is therefore possible to argue that a well-constructed process of EFR – where revenues are recycled in a pro-poor way, and the resultant tax structure is more efficient and supportive of growth – can lead to a ‘triple dividend’ of better environmental outcomes, reduced poverty and higher growth. Although this requires a confluence of factors that many may think unlikely, the fact that such a positive set of outcomes are even theoretically possible has created a high degree of support for EFR.

Despite this and the best efforts of the World Bank and the major donors of the OECD, however, examples of countries implementing wholesale EFR programmes are limited. In developed countries, a number of European countries have gone furthest in implementing a comprehensive package of Environmental Tax Reform (ETR).

Table 1 Environmental tax as share of total tax revenues

	1998		2009
Malta	15.37	Bulgaria	10.48
Slovenia	13.42	Netherlands	10.42
Portugal	11.16	Denmark	9.97
Denmark	10.7	Malta	9.77
Romania	10.61	Slovenia	9.47
Norway	9.74	Latvia	8.69
Netherlands	9.71	Ireland	8.39
Iceland	9.68	Estonia	8.31
Ireland	9.42	Cyprus	8.23
Cyprus	9.09	Portugal	8.07
Average	10.89	Average	9.18
<i>Source: Eurostat</i>			

These have stopped well short of a wholesale shift, however. Table 1 gives the share of total tax revenue accounted for by environmental tax in 1998 and 2009. In each case, the ten European countries with the highest share are listed. As we can see, the importance of environmental taxation has diminished over the past ten years. Roughly, ten per cent of total tax revenue is the now the upper bound, and the average has fallen from 10.98 to 9.18 per cent.

Energy taxes (particularly fuel related) account for more than 70 per cent of European environmental tax revenues, with transport taxes and resource & pollution taxes accounting for 23 per cent and 4.9 per cent respectively. Ninety five per cent of all environmental taxes in Europe are thus third best. Second best taxes on pollutants were less than 5 per cent of environmental taxes, or 0.28 per cent of total tax revenues in the European Union.

Given this context, it is unsurprising that the progress of EFR in developing countries has been slow. Despite the support of major bilateral and multilateral donors, the only country that has made significant progress on EFR is South Africa. Even there, however, many of the components of EFR remain planned rather than implemented.

South Africa has undergone a systematic assessment of EFR as a concept, reviewed its applicability to the South African economy in detail, and designed a suite of reform measures to slowly implement some key features of EFR

In some aspects, the South African tax system resembles that of developed countries. Consumption taxes are prominent, and trade taxes are negligible. In other ways, however, the resemblance is closer to developing country norms – particularly the relatively low tax take as a percentage of GDP. South Africa also has pressing environmental problems. In 2006, the priority issues were identified as:

- Water – availability and quality;
- Climate change;⁵⁴
- Human vulnerability;
- Loss of biodiversity and ecosystem functioning (DEAT, 2006).

It is within this context that the National Treasury published a discussion paper in 2006, detailing options for environmental fiscal reform measures (National Treasury, 2006). These distinguished between:

- Options for reforming existing environmentally related taxes and charges;
- Options for introducing new environmentally related taxes;
- Options for reforming non-environmentally related taxes with perverse environmental incentives; and
- (Tax) incentives to improve environmental outcomes.

To facilitate decision-making on policy options, the study developed a comprehensive framework (see Appendix 1), as well as a policy matrix for interventions with four components, each of which is designed to induce behaviour change: (i) the use of existing markets; (ii) the creation of new markets; (iii) C&C regulation; and (iv) the use of information to engage civil society to action.

⁵⁴ South Africa has relatively high carbon emissions, with power generation dominated by coal.

Table 2 Policy Matrix of Interventions

Using markets (using existing prices)	Creating markets (forming new markets and marketable goods)	Environmental regulations	Engaging civil society
Elimination of perverse subsidies	Property rights and decentralisation	Product and process standards	Public participation
Environmentally related taxes	Tradable Permits and rights	Bans / prohibitions;	Information disclosure
Deposit-refund systems	International offset systems	Non-tradable permits and quotas	Voluntary agreements
User charges		Zoning	
Targeted subsidies		Liability and performance bonds	
Source: National Treasury (2006)			

Despite the impressive conceptual and empirical work undertaken thus far, the process of EFR in South Africa remains in its infancy.⁵⁵ Fuel taxes continue to dominate, raising around 70 per cent of all environmental tax revenues.⁵⁶

The 2009/10 South African budget published by the South Africa Revenue Services (SARS, 2009) discusses a number of different EFR tax proposals including:

- Introducing incentives for cleaner production (energy efficiency)
- Increasing the levy on plastic bags
- Introducing taxation of incandescent light bulbs
- Proposing a tax incentive for carbon credits
- Linking motor vehicle ad valorem excise duties to CO2 emissions
- Increasing international air passenger departure tax
- Increasing fuel levies
- Diamond export levy
- Increase in excise duties on tobacco products and alcoholic beverages
- Providing Rand 45 million (US\$5.6m) to biomass electricity generation
- Providing R 30 million (US\$3.8m) to support research on climate change mitigation and adaptation to inform the development of a national climate change strategy
- Implementing the electricity levy announced in the 2008 Budget as the first step towards the introduction of a greenhouse gas emissions-based carbon tax⁵⁷
- Providing R 1 billion to the Department of Water Affairs and Forestry for 71 regional water and sanitation schemes

The estimated net effect of this tax switch away from income and corporation tax is a reduction of the overall tax burden of the economy by R 4,575 million. While South Africa is the most advanced, a number of countries are considering EFR packages and have worked with international agencies to develop programmes. The Republic of Moldova has recently received funding from the Global Environmental Facility (GEF) and UNDP to design and implement an EFR programme.⁵⁸ Similarly, the Rwanda Environment Management Authority (REMA) recently published a study of EFR potential, supported by the UNDP and UNEP (REMA, 2011).

⁵⁵ See Speck (2010) for a good account of EFR in South Africa.

⁵⁶ Although still at the low end of international practice, Akinboade et al (2008) conclude that raising taxes would not have a significant effect on demand due to unreliable and expensive public transport. This is in keeping with Sterner's (2011) argument about the determinants of long-term price elasticities with respect to fuel.

⁵⁷ This is a tax of R 0.02 per kWh levied on the sale of electricity generated from non-renewable sources, to be collected at sources by the producers/generators of electricity.

⁵⁸ www.thegef.org/gef/node/4735

It will be interesting to follow the experiences of South Africa and other countries with EFR over the next decade, but the carbon tax proposal is already proving highly controversial. As in Australia – which, like South Africa, has a large mining sector – a heated debate has begun. Lobbyists from energy intensive sectors such as steel argue that South African business will be put at a major competitive disadvantage,⁵⁹ and that there will be no impact on global emissions given the relatively small size of the economy, particularly compared to larger emitters, such as China. South African opponents also point out that, as a developing country, they are under no obligation to reduce emissions.

1.3. Lessons from the literature

In this section we first focus on two key potential consequences of a major shift to environmental taxation: positive and negative. From the positive side we review the literature on the possibility of a ‘double-dividend’, where a shift to environmental taxation (ETR) yields additional benefits beyond the environmental. From the negative side, we assess the evidence on the incidence of environmental tax, particularly the extent to which they are likely to be regressive in terms of incidence.

The second part of the section summarises the wider lessons that can be gleaned from the experience of both developed and developing countries.

1.3.1. Double dividend(s)

Perhaps the key argument in favour of environmental taxes, particularly packages such as EFR, is their potential to achieve multiple objectives. As well as environmental goals these may be revenue generation, poverty reduction or growth, or some combination of these. What is the evidence with respect to these claims?

a) Revenue

Environmental taxes will only generate meaningful levels of revenue and achieve environmental goals under certain conditions. Specifically, the aim must be to reduce but not eliminate the environmental activity, and the good must be relatively price inelastic.

The ideal type of good for generating revenue and meeting environmental goals will have a concave demand curve, which becomes more inelastic as prices rise and quantity falls. Some fuels have this form of demand curve. Following the introduction of a tax, such a good would see a significant reduction in quantity in the first instance, creating a positive environmental effect. As the demand curve became increasingly inelastic, however, further reductions become more difficult, and the tax would generate stable revenues with a lower quantity consumed.

b) Poverty

The poverty effects of an environmental tax depend on the interplay of two factors. First is the initial incidence of the tax, in terms of its progressiveness or regressiveness, and which is discussed below. Second, is the uses to which the taxes are put. If they go into government coffers, the poverty impact will reflect that of general government spending. If they are hypothecated for particular purposes, the impact will be driven by these.

Many would argue that tax proceeds should be used to complement the environmental aims of the tax, for example: using taxes on private motoring to fund public transport, or

⁵⁹ See this article from 2011 for a sense of the debate: www.reuters.com/article/2011/10/06/us-safrica-carbon-idUSTRE7953L020111006

reinvesting taxes on corporate pollution through subsidies for clean alternatives. From an environmental perspective, the success of a tax could hinge upon the provision of acceptable substitutes.

On the other hand, environmental taxes are often regressive in their incidence, which can be addressed in two ways. One way is through ex-ante mechanisms such as exemptions, subsidies or rebates for poor groups. While these may cushion the poor, they may also reduce the effectiveness of the tax, which is supposed to have an impact and so lead to behaviour change. Ex-ante mechanisms will also reduce revenues, thus reducing the possibility of a double dividend in this respect. There is no escaping these trade-offs.

The second approach to improving poverty outcomes is to use ex-ante measures via hypothecated spending. This can be general pro-poor spending, or a more targeted approach linked to the tax itself.

c) Growth

Double-dividend (DD) growth effects have long been at the core of arguments in favour of ETR in developed countries. The evidence is mixed, however. Early excitement about prospects of a DD was undermined by an influential study by Bovenberg and Goulder (1996). The key points were:

- It is wrong to assume that environmental taxes are not a tax on labour. Workers consume the products on which these taxes are levied, so that the impact on real incomes is the same as with any tax.
- Not only is it a tax on labour, but it is an inefficient tax. Because of its distortionary effects, welfare losses are higher than they would be with the labour taxes it was designed to replace.
- Rather than creating a DD, environmental taxes thus lead to worse welfare outcomes.

Slunge and Sterner (2010) contest this view, arguing that it makes no sense to assess ETR without considering the environmental issue that the tax is designed to address.

[...] this whole attack on the double-dividend neglects the fact that the environmental externality still has to be addressed. If it is addressed through regulations then even these environmental regulations will have tax interaction effects: if labour taxes are high, then environmental regulations distorting consumption choices will lead to a large welfare loss and a significant reduction in labour supply. Taking this effect into account changes the picture somewhat. The relevant comparison is not just between an environmental tax and a general tax, because a general tax leaves the environmental problem unresolved; instead an environmental tax should be compared with a combination of general tax and an environmental regulation. In this comparison, the environmental tax proceeds are indeed a positive rather than a negative factor.

If we readmit the possibility of a DD on this basis, what is the evidence in this area? Most of the work on the DD hypothesis is theoretical rather than empirical. The early thinking was that labour taxes are distortionary and that replacing them with environmental taxes would have positive welfare effects, through 'revenue-recycling'.⁶⁰

However, as pointed out by Bovenberg and Goulder (op cit), environmental taxes raise prices, reduce real wages and are thus also distortionary, more so in fact given their targeted nature. The question, therefore, is whether this 'tax-interaction' effect dominates the

⁶⁰ See Oates (1995), Pearce (1991), or Repetto et al. (1992), for example.

revenue-recycling effect. Theoretically, the answer depends on how close the existing tax structure was to being optimal, and whether the environmental tax shift brought it closer to optimality. For many, it was assumed that the pre-existing structure would be closer to optimality than that following ETR.⁶¹

Gimenez and Rodrigez (2010) point out, however, that this theoretical debate does not take sufficient account of the Pigouvian framework. Specifically, that it is incorrect to think of an environmental tax being distortionary as long as it remains below its Pigouvian level. This is a similar point to Slunge and Sterner (op cit), and does allow the theoretical possibility of a DD.

Studies to test the DD hypothesis are simulated models. Unsurprisingly perhaps, the results are inconclusive. Patuellia et al (2005) undertake a meta-analytical synthesis of simulation studies and find the results highly sensitive to the types of tax (removed and implemented), the use to which revenues are put (recycling) and the model of the economy that underpins the Computable General Equilibrium (CGE) model. DDs are certainly theoretically possible, but more so when the second 'D' is employment rather than GDP growth.

Van Heerden et al (2010: 1) developed a CGE model of the South African economy to test the DD – or 'triple dividend' – hypothesis, with different taxes and different forms of recycling:

Four environmental taxes and three revenue-recycling schemes are compared. The environmental taxes are (i) a tax on greenhouse gas emissions, (ii) a fuel tax, (iii) a tax on electricity use, and (iv) an energy tax. The four taxes are constructed such that they have a comparable effect on emissions. The revenue is recycled through either (i) a direct tax break on both labour and capital, (ii) an indirect tax break to all households, or (iii) a reduction in the price of food. A triple dividend is found – decreasing emissions, increasing GDP, and decreasing poverty – when any one of the environmental taxes is recycled through a reduction in food prices.

While this is encouraging to some extent, it remains highly abstract. The key point is that we have no empirical basis to decide on double-dividend effects. However, even if we accept the possibility of double-dividend growth effects in theory in developed countries, this does not mean we can transplant this seamlessly to developing countries. A core difference between ETR and EFR is that the former seeks to shift the tax burden so that more productive activities are encouraged – thus potentially raising growth – while the latter seeks to increase the overall tax take. While it is possible that new environmental taxes could enable other taxes to be reduced, this would require them to raise significantly more revenue than the taxes being replaced. Furthermore, for a double-dividend to occur, the new taxes would have to be more supportive of growth than those being replaced.

There is a lively debate, which remains ongoing, on the growth and welfare effects of replacing trade taxes on imports and exports with a broad-based VAT.⁶² As things stand, there is insufficient evidence to support a conclusion in one direction or another with respect to the growth effects of replacing existing taxes with environmental taxes in developing countries.

⁶¹ For example, see Bovenberg and Goulder (1996), Goulder (1996), Parry (1996), Christiansen (1996) and Goulder, Parry and Burtraw (1997)

⁶² The orthodox view is that, reducing import taxes raises welfare by providing consumers with cheaper products, and encourages greater productivity in local firms due to greater competition. At the same times, reducing export taxes further enhances the competitiveness of export firms. The replacing sales tax is non-distorting leading to a net-positive effect on growth (See Bird and Zolt, 2005). The opposing view is that this analysis fails to take account of the impact of a large, informal sector. A richer model that is able to do this finds growth and welfare effects are ambiguous and may be net negative under plausible assumptions. (See Emran and Stiglitz, 2005)

1.3.2. Distributional effects

In developed countries, the general presumption is that environmental taxes, on balance, will be slightly regressive. This does not hold across the board, however, but needs to be taken on a case-by-case basis. For example, while taxes on household energy use in the UK would be regressive, those on transport would not be, particularly on aviation (GFC, 2009). The UK's Green Fiscal Commission (GFC)⁶³ approach to measuring incidence exemplifies one of the two possible approaches. In their 2009 report, the GFC estimates incidence by examining the consumption patterns of different income deciles, and then examining how taxes would alter relative prices and differentially affect each decile. A tax that weighs heavier on lower income deciles is regressive, and vice versa.

Sterner (2007) take this approach to fuel tax measures in sub-Saharan Africa. This is interesting because, as we have seen, fuel taxes are by far the most important form of environmental taxation, but also because they are widely seen as regressive. Looking at Kenya, Ethiopia and South Africa, the authors conclude that:

[...] we find that transport fuel taxes in the regional context of low or middle income countries in Africa appear to be progressive and not regressive as often claimed. If indirect use through public transport and food transports is taken into account, this weakens but does not reverse the result that the fuel taxes are progressive. Similarly, if also fuels such as kerosene are simultaneously taxed (to avoid having unsustainable differences in consumer prices that might lead to fuel adulteration), the progressive result is again weakened but – at least in the case of Ethiopia – not removed or reversed.

An alternative means of estimating incidence is through simulated models. The first point to make is that most studies have looked exclusively at developed economies, and have also tended to focus on environmental and economic efficiency effects, rather than distribution. That said, Boccanfuso et al (2010) provide a useful survey of simulations that have examined the equity effects of environmental taxation, specifically in developed countries.⁶⁴

Surveying Partial Equilibrium models⁶⁵, Boccanfuso et al (*ibid*) caution that the models fail to capture indirect effects, but that direct effects suggest that taxes on energy or other environmental tax factors are likely to be regressive. Turning to CGE models, they note the lack of papers assessing the impact of environmental policies, with a larger literature exploring the distributional impacts of climate change itself. Labandeira et al (2006) analyse the effects of an energy tax on economic efficiency and household welfare, with slightly regressive results. Araar et al (2008) analyse distributional impact of policies in Canada with a two-step approach (CGE model for price effects and stochastic dominance approach for the distributional analysis) and again find regressive results. Boccanfuso et al (2009) perform a distributional analysis of energy taxes in Senegal using a CGE micro simulation. They too find very slight regressive results.

Thus, while limited, the modelling literature suggests that environmental taxes are likely to be slightly regressive. This is intuitively what would be expected, but it is important to judge environmental policies in the round. That is, what is the combined effect of environmental policy when tax and revenue use are assessed?

⁶³ www.greenfiscalcommission.org.uk/

⁶⁴ This section relies on this survey unless otherwise stated.

⁶⁵ For example: Poterba (1991); Shah and Larsen (1992); Dinan (2009).

There is no general answer: environmental tax can be regressive, but not always (e.g. fuel taxes in LICs and removal of fuel subsidies). Also, where the initial incidence is regressive, if revenues are used in a way that counteracts this, the net effect can be progressive.

1.3.3. Summary of lessons from the literature

This section summarises what we can take from the theoretical and empirical literature about the desirability and feasibility of environmental taxation in developing countries?

a) Lessons from developed countries

In most areas of policy it is unwise to transplant developed country experience to developing countries, and the same holds for environmental taxation. There are, however, a number of useful lessons that can be drawn.

- Comprehensive packages are difficult to implement. Groups that could 'lose' as part of a package of EFR will oppose it vociferously, and these groups are likely to have economic weight and political clout.
- In difficult economic times, it becomes increasingly hard to make the case for unilateral measures to implement environmental taxes that may adversely affect the competitiveness of the private sector.⁶⁶
- Exemptions undermine the effectiveness of environmental taxes, but may be essential if the tax is to be implemented at all – balancing acceptability with effectiveness is key; there is little point watering down a tax to the point where it is ineffective in order to make it acceptable.
- Even in countries with strong support for environmental policies, it has proved difficult to maintain support for environmental taxes, which often come to be seen as revenue-raising devices rather than environmental tools.
- Given low price elasticities of demand for some key products (e.g. fuel), tax rates have been maintained at a high level to induce behaviour change.
- Maintaining these rates in the short term may be difficult (for the reasons given above), but long-term viability will be enhanced by investment in substitutes (e.g. public transport vis-a-vis fuel taxes).
- Offsetting regressive impacts is important to maintaining support.
- Hypothecation may thus be an essential way of building and maintaining public support.⁶⁷

In the following sub-sections, we distil lessons from the experience of all countries, with a bias towards the experience of developing countries. This is organised according to the potential goals of the tax mechanism.

b) Environmental goals

Where the primary goal is environmental, the evidence suggests a number of factors are central to success or failure.

Determinants of success or failure:

- **Non-conflicting:** To achieve its goals, it is important that an environmental tax does not compromise other policy goals that are perceived as more important. While this seems

⁶⁶ The debate in Australia over the implementation of a carbon tax is a good example of this.

⁶⁷ It is interesting to observe the approach of the South African tax authorities in defending the case for a carbon tax. Speaking at a Parliamentary hearing on October 19, 2011, the National Treasury's Deputy Director General Ismail Momoniat stressed that the carbon tax was designed to change behaviour rather than raise revenue, and that revenues would be hypothecated for environmental initiatives.

obvious, it is often overlooked. For example, preserving economic competitiveness is central to most countries' economic policy. Where environmental taxes adversely affect internationally active businesses, particularly in energy intensive sectors such as steel⁶⁸, the business lobby will seek to undermine political support. Often taxes will be proposed and designed by environment ministries, which may find themselves in conflict with finance and trade ministries with different priorities. Environment ministries are unlikely to win such contests.

- **Non-controversial:** As well as commercial and political opposition, environmental taxes are unlikely to survive intact in the face of concerted public opposition.⁶⁹ Public support – or at least disinterest – needs to be built and maintained.
- **Complementary policies:** As well as the behavioural effects of a tax (to discourage some behaviours), targeted subsidies (to encourage other behaviours) can increase overall effectiveness. This may require some degree of revenue hypothecation.
- **Correct rate:** The impact of an environmental tax will be strongly influenced by the elasticity of the good concerned. Goods with high elasticities will see demand sharply reduced by a tax and little revenue⁷⁰, while those with very low elasticities (e.g. fuel) will see a smaller impact on demand but may generate high revenues. Where the goal is to achieve a given reduction in demand for environmental reasons, the rate of tax needs to be calibrated in the light of the good's price elasticity. Where a tax is designed to induce producers to reduce or cease environmentally damaging activity, the tax needs to be set equal to the costs of achieving this behaviour change – i.e. marginal abatement costs.
- **Make substitutes available:** A major determinant of price elasticity is the availability of substitutes. High fuel taxes will only significantly reduce driving if there are viable alternatives. If the goal is a reduction in use of a very inelastic good, measures to develop viable substitutes are needed to make this possible.
- **Easy to implement and enforce:** As with all policy measures, there is no point designing highly complex and elegant systems of environmental tax if there is insufficient capacity to implement and enforce them.
- **Equitable:** How equitable a tax is – and is seen to be – will have a strong influence on the feasibility of implementation and the ability to maintain public support. There are two features to this: the incidence of the tax itself; and the use to which the revenues are put (i.e. the degree and form of hypothecation).

c) Revenue goals

In some instances, taxes that are officially 'environmental' are primarily, or partly, revenue-raising mechanisms. As would be expected, different factors determine the likelihood of success or failure when the aim is to achieve revenue goals:

⁶⁸ See, for example, very similar comments made by steel producers in the UK and South Africa at the prospect of the imposition of carbon use charges.

⁶⁹ For example, Vietnam's carbon tax was originally designed to increase fuel taxes significantly for the fuels with the highest carbon content. Following widespread public opposition, the government gave an assurance that petrol taxes would not rise under the new measures.

⁷⁰ Plastic bag taxes, for example, can virtually eliminate usage if the rate is high enough – e.g. in Ireland. In South Africa, in contrast, the rate was set at a very low level and had little impact upon behaviour. The proceeds were used to fund recycling projects, however.

- Do not aim to eliminate use: Some environmental effects are so bad that the aim is to eliminate rather than reduce them. In such circumstances, a successful tax will yield no revenue, while one that does will be set too low. It is only appropriate to consider environmental taxes as revenue-generating where the aim is to reduce usage to a sustainable – but positive – level. If the aim is to eliminate an activity, it should be banned.
- Take account of elasticities: Inelastic goods will require high tax rates to have an impact on usage, but will also generate significant revenue. Fuel taxes are a good example, which explains why they dominate in revenue terms. It is important to note, however, that this feature also explains why it is so difficult to induce a sharp reduction in fuel use.⁷¹
- Difficult to evade/easy to enforce: Tax evasion is a problem for all forms of taxation, environmental taxes included. Where enforcement costs are too high, evasion will be widespread due to a lack of effective monitoring.
- Appropriate and dynamic rates: Rates set too high will encourage evasion, while those too low will generate less revenue than could be achieved. Again, price elasticities are key to calibrating rates correctly. To maintain incentives and revenues over time, tax rates need to change as circumstances change.⁷²
- Acceptability maintained: Revenues will only be maintained if taxes remain in place, and this requires a minimum level of public support (or absence of opposition). If the tax is primarily for revenue rather than environmental purposes, then pretending this is not the case fosters cynicism about government motives, undermining support. Also, the use of proceeds can be important in maintaining support, suggesting that hypothecation may have a role to play.

d) Multiple goals

- Environment + revenue: A double-dividend of this form will only be possible in particular circumstances. First, the aim should not be to eliminate an activity, but to reduce usage to a sustainable level. Second, for this to occur and yield significant revenue, relatively low price elasticities of demand are required. Third, to maintain long-term viability of the tax, investment in substitutes is needed, though this may ultimately erode the tax base if successful enough.
- Environment + poverty reduction: This depends on two things: first, the degree to which the tax is regressive or progressive in its first instance; and second, the use to which revenues are put. A progressive tax will have positive impacts on poverty, but the net impact of a regressive tax will be determined by a) the effectiveness of targeted exemptions or rebates, and b) the extent to which taxes are recycled to pro-poor spending.
- Environment + growth: The evidence on the growth effects of ETR is largely theoretical rather than empirical, and even this is mixed. In principle, a shift to environmental taxes away from taxes that weigh heavily on growth could have a positive effect, but it has proved difficult to observe – the fact that no country has actually implemented a full

⁷¹ It is not impossible, however. Sterner (2011) estimates that driving in the European Union would be a third higher if the EU had fuel taxes at levels seen in the United States.

⁷² With forest taxes, for example, benchmarking rates to global timber prices could have prevented the situation in Cameroon, where private actors overpaid for concessions in competitive auctions, which they were unable to honour when world timber prices fell sharply.

programme of ETR is relevant here, of course. In developing countries, EFR programmes are proposed as ways of increasing total revenue rather than being revenue neutral. The theoretical case is thus weaker, and is dependent upon new environmental tax revenues outstripping revenues from other sources, so that growth-restricting taxes can be removed while total tax revenues increase.

- Triple dividends: Simultaneously achieving environmental, revenue, poverty and growth effects is likely to be difficult. To increase the probability of achieving environmental goals, the targeted use of revenues to augment behaviour may be required. To avoid negative poverty effects or create positive impacts, exemptions, rebates and/or pro-poor spending may be required. Both of these require the hypothecation of revenues, which directly limits the possibility of achieving revenue goals. Similarly, to achieve environmental and growth effects, other taxes need to be reduced, again limiting potential gains on the revenue side. Being clear about the primary goal of an environmental tax is important, and it looks probable that aiming to achieve more than one other goal is unlikely to succeed, and may reduce the chances of achieving any goals.

2 Decision-making framework for policymakers

2.1 Questions for policy analysis and formulation

Given the literature reviewed, what questions should policy-makers consider when weighing the merits of environmental taxes? Here we propose five:

- (i) What should the policy goal be?

Different countries will have different environmental policy goals. The UK has set itself a goal of reducing CO₂ emissions by a specified amount by 2050, while China has committed to reducing the carbon intensity of output rather than the level of emissions. In time, China may also set a policy target for total emissions, and many would like it to do so now. While few argue that very low income countries should seek to reduce absolute carbon emissions, many do argue that LICs with tropical forests should preserve these as global carbon sinks or to maintain biodiversity.

Localised air pollution is a problem in some middle income countries, but less so in low and high income countries. Similarly, water quality in many high income countries has improved steadily in recent years, but remains a major problem in MICs and LICs.

On the other hand, the goal may not be environmental at all; the government may simply wish to raise revenue. The first question to ask, therefore, is whether the issue is a pressing one for the country concerned, and whether the goal is environmental or some other aspect of policy.

- (ii) Who would be the beneficiaries and who should bear the costs?

The second question applies to situations where the goal is environmental. If the benefits are international (e.g. mitigating climate change or maintaining biodiversity), this raises the question of who should bear the costs. It seems reasonable that costs should be fairly shared between beneficiaries.

Thus the benefits of maintaining enough tropical forest cover to function as effective carbon sinks are global, and the costs should be met globally on an equitable basis. In contrast, the benefits of improving local air or water quality will be captured by local people, who should therefore bear the costs of achieving this goal.

(iii) What forms of inputs are most likely to deliver the desired outcome?

Having decided that an environmental goal is appropriate, and determined who should bear the costs of achieving this, the third question is which tools are most likely to deliver the desired outcome? As well as economic instruments, various forms of regulation may be appropriate.

Just as countries will have different policy goals, those with the same goal may use different tools to achieve it. A country's administrative capacity is an important consideration, where options that are 'third best' in theory may be first best in practice.

This point refers to national environmental goals, rather than those with an international dimension. Here policy-makers are unlikely to be in a position to determine what tools be used. What they do need to consider, however, is how any external payments will interact with domestic policy goals and tools. For example, countries may wish to impose a range of taxes on logging companies to extract resource rents and maintain forest cover at an optimal national level. If they are also recipients of international payments under REDD+, they will need to design their domestic system to take account of this.

(iv) If taxes, how should they be structured?

Assuming that these analyses conclude that taxes are the most suitable tool, and that any international aspects have been factored into this decision, the next question is how these should be structured and calibrated in order to achieve the desired outcome.

An intervention (or input) does not lead directly to an outcome, but is designed to produce a behavioural change (i.e. an output) which does. For example, the goal may be to improve water quality in a river, which is being polluted by waste from factories upstream. A tax (i.e. the input) on this pollutant is designed to trigger a behaviour change (i.e. the output) in the sense of less polluted effluence leading to improved water quality (i.e. the desired outcome).

When examining these issues, policy-makers need to consider how 'outputs' will respond to a given input, and how this relates to the desired 'outcome'. To illustrate this, imagine that the goal is not to reduce pollution, but to maximise revenue. Here the optimal tax rate would be set below marginal abatement costs, so that industry continues to pollute, but pays a tax for doing so. A more realistic example might be fuel taxes. One objective could be to reduce consumption (i.e. the amount of driving that occurs) by a particular amount. Given the low price elasticity of demand, however, taxes would have to be set at a very high level to produce a significant change in behaviour. Alternatively, the goal might actually be to raise revenue, in which case a lower tax rate might be optimal, particularly in terms of avoiding damaging opposition to the tax.

Thus far this policy analysis has covered the efficiency and likely effectiveness of different policy options, but not their equity impacts. A final policy consideration is thus to examine the distributional impacts of potential policy tools.

(v) How to maintain support for environmental taxes

Environmental taxes are very unpopular. There appear to be three main reasons for this. First, to work (i.e. induce behaviour change) environmental taxes need to 'bite'. Unlike other forms of tax, they are designed to be noticeable. As a result, it is unsurprising that they often become unpopular. Second, when the perception is that environmental taxes are really revenue-raising devices, they will attract more opposition than orthodox taxes. Third, the strength of the opposition created by these two factors will be exacerbated where taxes are unilateral and can be presented as unfair with respect to other countries, particularly with regard to international competitiveness.

Where the goal is genuinely environmental, the first two points could be countered by information on the goals and limitations of the tax, transparency on its operation and the hypothecation of revenues. These may be used to support environmental goals, or further other policy goals, such as reducing poverty. Explaining clearly why a tax is needed, being transparent in its operation and then linking revenues directly to a (popular) policy goal may help to address this.

Where opposition is triggered by the effect of the tax, different approaches are needed. If the goal is to reduce a particular activity, the availability of acceptable substitutes needs to be increased. Complementary policies are needed to make it easier for individuals or businesses to respond to the incentives created by the tax.

Maximising the sense of a 'level playing field' internationally will be important to maintain a sense of 'fairness'. It is also important to effectively convey those aspects of the intended policy that are positive regardless of action, or inaction, in other countries.

2.2 A conceptual framework for decision-making

The stages of the policy analysis described above can be conceptualised as an Outcome-Input-Output-Recycle (OIOR) framework:

- Stage 1 determines the desired **outcome**;
- stage 2 determines which **inputs** are best suited to deliver these outcomes;
- where this is a tax, stage 3 structures and calibrates the tax so as to induce the desired **outputs** via behaviour change; and,
- stage 4 **recycles** the revenues to support the policy goal and/or other developmental goals, and to maintain public support for the tax.

The conceptual framework thus has four key decision-points. The first decision to make is on the desired outcome, which will vary depending on factors such as level of development, resource endowments and the relative priority given to environmental issues. There is also a national-international distinction to be drawn.

The second decision is what type of mechanism is best suited to achieve the agreed goal. This will vary by country, and be influenced by factors such as administrative capacity, existing tax and regulatory structures, and the nature of the problem.

Table 3. Possible Environmental Policy Instruments

<i>Price-based</i>	<i>Rights-based</i>	<i>Regulation</i>	<i>Information/voluntary</i>
Taxes	Property rights	Prohibition (ban)	Stakeholder participation/consultation
Subsidies	Tradable permits	Permits	Information disclosure
User fee/tariff	Tradable quotas	Technological standard	Voluntary agreement (industry)
Exemption/rebates	Common property	Performance standard	Certification (consumer)
Source: Adapted from Slunge and Sterner (2010)			

Table 3 describes the main policy options in four categories: price-based, rights-based, regulatory, or information-based and voluntary. When thinking about the most appropriate form of input, Slunge and Sterner (2010) suggest the following questions, where the first two relate to the nature of the problem, and the second two to the capacity of the country concerned:

- (i) Is this a competitive market?
- (ii) Is it an area of rapid technological progress?
- (iii) What are the informational requirements?
- (iv) How high would the costs of control and enforcement be?

Price and rights-based mechanisms are most suited to competitive markets that are relatively immature. In such markets, rapid technological progress is both likely and necessary, and innovation will be incentivised by the use of economic instruments. Contrast this with a mature market with (quasi) monopoly providers, such as many utility sectors in developed countries, where regulatory mechanism may be more suited. Information requirements for rights-based mechanisms (excluding common property, which has distinct characteristics) are likely to be high, as are those for 'second best' forms. Monitoring and enforcement costs are likely to be relatively high for these forms of mechanism. While this might suggest that these mechanisms are unsuited for many developing countries, this does not necessarily follow.⁷³ A case-by-case approach, based on careful analyses of long-term economic, social and environmental benefits is required.⁷⁴

The third decision concerns the behavioural response (or output) created by the input. Here, issues of tax rate and structure, distributional effects, price elasticities and marginal abatement costs are important. The relevant questions are: given the desired outcome, and the choice to use environmental taxes to achieve it, how should it be structured and calibrated – including any exemptions and rebates to address distributional issues – to produce the behaviour change required?

A final issue concerns the use of revenues. There are a number of aspects to this. First, it may be necessary to use revenues to support the environmental goal, by financing research and development or the installation of clean technologies, for example. Revenues may also be required to finance substitutes to the activity being 'discouraged,' such as investing revenues from fuel taxes in public transport. Second, revenues may be used to counter negative distributional effects resulting from the tax, either as exemptions or rebates for low-

⁷³ Even if a policy is expensive and difficult to implement, the benefits of doing so may justify this. A good example is Namibia's approach to fisheries taxation. A very expensive monitoring system was required to make the system work, and upfront research required to establish stock levels. By restricting catch size, significant revenue was foregone, with further losses resulting from incentives to develop the local fishing sector. In the short-term, this may not have seemed the optimal approach, but the positive long-term results suggest that it was. While the high-cost route will often not be the best policy option, sometimes it will.

⁷⁴ The framework developed by the South African government is potentially very useful (National Treasury, 2006)

income groups. For the policy intervention to be sustainable, it needs to work, be seen to work and maintain a minimal level of public support. For the tax to work well, it may be that (at least some) revenues will be needed to support the policy goal. For it to be seen to work, accurate and timely information needs to be provided by government. To maintain a sufficient level of support, however, people need to believe this information, support the original policy goal, believe that the tax is really designed to achieve this goal rather than just raise revenue and consider its equity impacts are fair.

In principle, a framework such as that sketched out here could enable good decision-making, and an iterative process for improving it. This will only be the case, however, if policy-makers have – or can obtain – the necessary information to reach these decisions. As things stand, much of the evidence-base is missing. These research gaps are considered in Part 3 of this report.

3 Research gaps and a research agenda

3.1 Research gaps and questions for future research

The research gaps can be divided into two parts: technical and political economy. The first focus on the information needed to inform an ‘idealised’ decision-making framework. Here an evidence-rich OIOR framework could be used to determine the ‘optimal’ policy intervention given the desired outcome, and the circumstances of the country concerned. In practice, however, policy is rarely the result of such rationalist principles, but results from negotiations between vested interests, or is imposed by actors powerful enough to do so. The political economy research gaps reflect this.

3.1.1 *Technical*

The technical research gaps are organised in line with the OIOR framework – i.e. what evidence would be needed to operationalise each stage of this decision-making tool? In each case, a primary research question is followed by a number of sub-questions, which would need to be addressed:

- (i) Given country specific factors what ideal **outcome(s)** are desirable?
 - What criteria should determine the priority given to different environmental goals (e.g. developmental impact; ability to unilaterally influence; responsibility for creating problem; capacity to address it)?
 - What mechanisms (e.g. democratic; consultative; participatory) could be developed to validate these priorities, and balance environmental and other economic and social objectives?
- (ii) When combined with supranational factors (e.g. global public goods), what additional outcomes may be desirable for least developed countries (LDCs), LICs or MICs?
 - With respect to the reduction of greenhouse gas (GHG) emissions?
 - With respect to the expansion of carbon sinks?
 - With respect to the preservation of biodiversity?
- (iii) How should these be financed?
 - What criteria should be used to determine responsibility to mitigate climate change (e.g. historical responsibility; current capacity; distribution of potential benefits)?

- Given this, to what extent should countries be responsible for bearing the costs of reducing GHG emissions, maintaining or expanding carbon sinks, or preserving biodiversity?
 - To the extent that this responsibility is not national, who should bear the costs and how should external payments be structured?
- (iv) Given a set of policy goals, the capacity of the country (as well as the nature of any external financing), what **inputs** (i.e. from Table 3 above) are best suited?
- How 'bad' is the environmental activity? (i.e. if too bad it should be prohibited or very strictly curtailed)
 - What are the potential impacts on other economic/social goals of different inputs?
 - Is the encouragement of dynamic efficiency important?
 - Is there a competitive market?
 - Is there scope/need for innovation and learning?
 - What are the administrative capacity and informational requirements?
 - What are the potential enforcement costs for different inputs?
 - Is it possible to think of the different policy 'returns' in the sense of the ratio of (positive) outcomes to inputs?
 - How are these questions affected by the possibility of external financial transfers in a closely related area of policy?
- (v) If a tax (or subsidy) instrument is chosen, how should it be structured and calibrated to produce the behavioural changes (i.e. **outputs**) needed to deliver the desired outcome?
- For consumers and producers, what are the elasticities of demand and supply with respect to price?
 - What are the marginal abatement costs associated with the activity?
 - To achieve a given reduction in activity, what level of tax is required?
 - How should this be structured (e.g. volume vs. area-based/ upstream or downstream/ fixed vs. variable rate)?
 - Given the consumption patterns of different income deciles, what will be the incidence of the tax?
 - Which of the complementary measures that could be adopted to counter a regressive effect (e.g. exemptions, rebates, tiered-pricing), would have the smallest impact upon the environmental goal?
- (vi) How should revenues be used to help achieve outcomes and build/maintain support?
- If revenues need to be hypothecated, how should this be done so as to mitigate the negative aspects of hypothecation?
 - Can environmental goals be achieved by the tax alone, or are complementary financial incentives required (e.g. is it necessary to subsidise the development of substitutes?)
 - Should surplus revenues be earmarked for particular forms of spending (e.g. environmental or pro-poor)?
 - How should government communicate the rationale behind its policy goals and policy tools?
 - What are the determinants of public opinion with respect to different forms of environmental taxation?

3.1.2 Political economy

If answers could be produced for each of these questions, we would have the basis for rational decision-making with respect to environmental taxation. While a potentially important tool, this would need to function in the messy world that is real-world policy-making. Some important questions to address are as follows:

- (i) How do the vested interests of different parties, and the dynamics of (power) relations between them, affect what policy goals (i.e. **outcomes**) are determined?
 - External-domestic (e.g. donors vs. national vs. local politicians)?
 - Ministry-ministry (e.g. finance vs. environment)?
 - Politicians-civil servants/administrators?
 - Politicians-citizens?
 - Politicians-industries?
 - Politicians-politicians (i.e. incumbents vs. opposition)?
- (ii) Given the formulation of a particular policy goal, how are decisions on **inputs/outputs** negotiated by the same groups?
 - Tax vs. regulation vs. information?
 - Awarding vs. auctioning of rights?
 - Correct rate vs. incorrect rate (e.g. below, above or at marginal abatement costs)?
 - Sufficient vs. insufficient monitoring and enforcement?
- (iii) What are the implications of environmentally-driven external financial flows for state-building?
 - How do different financing mechanisms (REDD+; CDM; NAMA) influence government environmental policy?
 - To what extent does the presence of external finance cause government environmental policy to diverge from what might be considered optimal domestically?
 - Does this vary by mechanism (e.g. REDD+; CDM; NAMA⁷⁵)?
 - What impact does this have on governments' general tax strategy (e.g. does the presence of revenue reduce incentives to increase tax reform efforts)?
 - What impacts does this have on state-government relations (i.e. the 'social contract')?

3.2 Priority research areas

The gaps and questions identified above are deliberately comprehensive. In some areas, considerable progress has already been made. For example, a-c in the technical section are relatively well-researched. There is no shortage of frameworks for thinking about global public goods and how they should be financed, nor for determining how responsibility should be allocated between countries for issues such as climate change.

In practice, these frameworks remain largely theoretical. They are pertinent to the issues considered in this paper, however, because this is beginning to change. REDD+ is a reality, and is likely to become more rather than less important. The Clean Development Mechanism (CDM) continues, and will be increasingly applied to LICs, particularly in Africa. Payments

⁷⁵ For example, CDM payments are made to companies rather than governments. REDD+ payments may be made to governments or to private actors. It is envisaged that NAMA payments will be made to governments. These differences may lead to divergent impacts upon policy.

direct to governments as part of the Nationally Appropriate Mitigation Actions (NAMA) are also possible. It makes no sense to consider developing countries' approach to environmental policy in isolation from these initiatives. How these sources of finance interact with domestic policy is a clear priority area, particularly as it may enable a methodology to be developed and applied more widely in the future.

3.2.1 REDD+ and national forest revenue systems⁷⁶

- What criteria should be used to assess optimal forest cover (and form) for domestic reasons?
- Given national conditions, what system of taxes (volume/ area/ exports) will be best able to deliver these outcomes?
- How should each be structured to extract maximum resource rent while maintaining commercial viability (e.g. how should risks be allocated between companies and government, and how should this evolve over time)?
- How should each be structured to encourage sustainable forest management (or discourage unsustainable management)?
- How should external payments to encourage greater forest cover be integrated into the domestic framework?
- How should external payments to encourage biodiversity be integrated into the domestic framework?
- What institutional forms are required to intermediate external finance, delivering it locally so as to best achieve environmental goals?

A number of countries are in the process of implementing major environmental tax reforms. Understanding of the process through which these policies emerged, however, is limited. For those considering the merits of environmental taxation, gaining insights into how this occurred is important.

3.2.1.1 The determinants of environmental policy formation⁷⁷

- What constellations of actors (public, private, civil society – both national and external) were instrumental in producing recent policy initiatives?
- How have relative power relations (i.e. those for and against) changed over the past 10 years to create circumstances where this occurred?
- What were the determinants of these changes?
- What can other countries learn about the drivers of successful policy?

Much of the work that has been done on environmental taxation has been theoretical. The standard approach is to develop a model – usually a CGE model – and simulate the impact of environmental taxes on growth or equity. The increase in the planned use of environmental tax measures offers the possibility to address the lack of empirical evidence. Comparative longitudinal studies⁷⁸ – using a combination of quantitative and qualitative approaches – could begin to develop an evidence-base on the effectiveness of different environmental taxes, and the determinants of this effectiveness.

3.2.1.2 Tracking the impacts of environmental tax

- How do tax structures affect behavioural responses (i.e. outputs) in different sectors?
- How do tax rates affect behavioural responses?

⁷⁶ Possible case studies: Ghana, Madagascar, Bolivia, Costa Rica, Guyana, Laos.

⁷⁷ Possible case studies: China, South Africa, Vietnam, Brazil.

⁷⁸ Possible case studies: As above, plus Kenya, Tanzania, Ethiopia, Colombia.

- What are the determinants of short, medium and long-term elasticities of demand and how immutable are these? (e.g. the availability of substitutes)
- What are the non-environmental impacts of environmental taxes, and how do these differ according to factors such as different industrial structures?
- How does revenue use (i.e. recycling) influence the questions above?

A major obstacle to greater use of environmental taxes – even when they are best suited to achieving a particular policy goal – is the lack of public support. Again, comparative long term approaches – using longitudinal surveys – could be employed to further understanding of these phenomena.

3.2.1.3 Tracking public attitudes to environmental tax

- How important are the environmental problems being addressed?
- Are these the real reasons for the taxes?
- How effective are environmental taxes?
- How fair are environmental taxes?
- What are the unintended consequences?
- How do environmental taxes compare with other approaches?

As well as policy formulation, there is an important issue of policy inertia. Before taxes can be levied to have positive environmental effects, subsidies with negative impacts should first be removed. Particularly with respect to fuel subsidies, this has proven to be extremely difficult to achieve. The final priority area addresses this issue.

3.2.1.4 The economics and political economy⁷⁹ of fuel subsidies⁸⁰

- What would the distributional effects of subsidy removal be?
- What compensating measures could be put in place to mitigate any regressive impacts (e.g. more focused subsidies; targeted pro-poor spending using freed-up resources)?
- Through what channels are common perceptions (e.g. the progressive nature of subsidies) transmitted?
- How are the constellations of actors ‘for and against’ composed?
- How would the economic interests of these groups be differently affected by reform?
- What communication channels exist to inform these groups of the different impacts they would feel from reform.

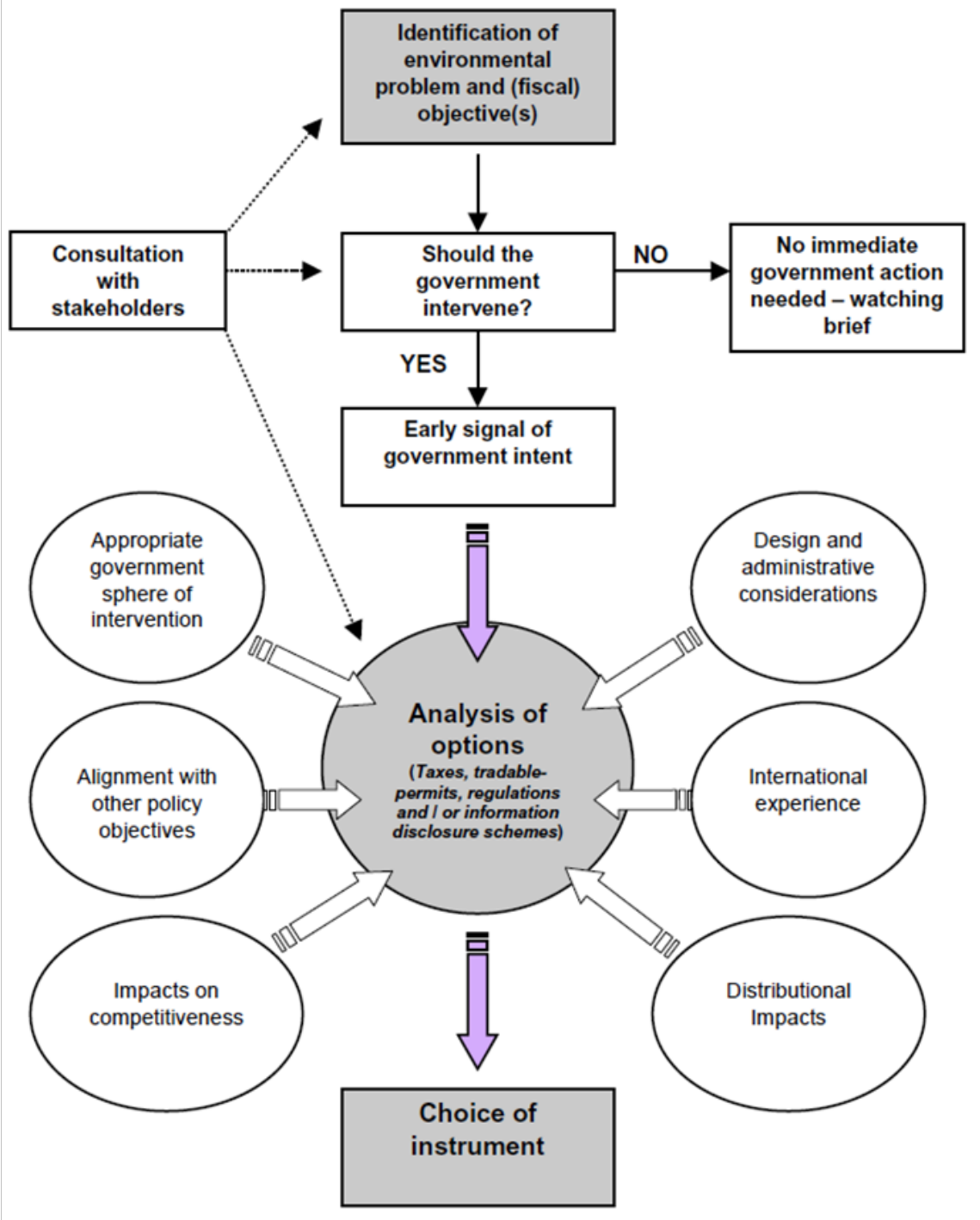
This is a major programme of work, which would require a network of international researchers to collaborate on over a sustained period. If policy is to be informed by evidence, and the true potential (and limitations) of environmental taxes properly understood, however, the development of a robust evidence base through such a process is an important area of research.

⁷⁹ Methodologically, this approach would combine some CGE type modelling with empirical work on income decile usage, followed by a political economy-focused research.

⁸⁰ Possible case studies: Indonesia, India, Ethiopia.

Appendix 1: South Africa's EFR Decision Framework

Figure 1: A process for considering different government interventions



References

- Abboud, L. (2008) 'An Exhausting War on Emissions: Norway's Efforts to Contain Greenhouse Gases Move Forward – and Backfire.' *Wall Street Journal*, 30 September
- Akinboade, O. A.; Ziramba, E. and Kumo, W. L (2008) 'The Demand for Gasoline in South Africa: An Empirical Analysis Using Co-Integration Techniques', *Energy Economics* 30: 3222–3229
- Araar, A.; Dissou, Y. and Duclos, J. (2008) 'Household Incidence of Pollution Control Policies: a Robust Welfare Analysis Using General Equilibrium Effects', *Cahier de recherche du CIRPEE*
- Arce, D. G. M. and Sandler, T. (2002) *Regional Public Goods: Typologies, Provision, Financing, and Development Assistance*, Expert Group on Development Issues (EGDI)
- Barbier, E. B. (2007) 'Valuing Ecosystem Services as Productive Inputs'. *Economic Policy* 22 (49): 177-229
- Bird, R. and Zolt, E. (2005) 'Rethinking Redistribution: Tax Policy in an Era of Rising Inequality', *UCLA Law Review* 52:1627-1695.
- Bläsi, A. and Requate, T. (2005) 'Learning-by-Doing with Spillovers in Competitive Industries, Free Entry, and Regulatory Policy', *Economics Working Paper No. 2005-09*, Kiel University, Department of Economics
- Bluffstone, R. (2003) 'Environmental Taxes in Developing and Transition Economies', *Public Finance and Management*, 3.1: 143-175
- Boccanfuso, D.; Estache, A.; and Savard, L. (2008) Impact Analysis of Electricity reforms in Senegal: A Macro-micro analysis, *Journal of Development Studies*.
- Boccanfuso, D.; Estache, A.; and Savard, L. (2010) 'The Intra-country Distributional Impact of Policies to Fight Climate Change: A Survey,' *ECARES working paper 2008_038*
- Boccanfuso, D., Estache, A. and Savard, L. (2009) 'Impact analysis of electricity reforms in Senegal: A Macro–Micro Analysis', *Journal of Development Studies*, 45(3): 351–375
- Bovenberg L. and Goulder, L. H. (1996) 'Optimal environmental taxation in the presence of other taxes: General equilibrium analysis', *American Economic Review* 86: 985-1000
- Boyd, W. (2003) 'Water Pollution Taxes: A Good Idea Doomed to Failure?' *Discussion Paper 03-20*, Resources for the Future
- Brautigam, D.; Fjeldstad, O.H. and Moore, M. (2008) *Taxation and State Building in Developing Countries*, Cambridge: Cambridge University Press
- Castro, Z. (2003) 'Case Study: The Colombian Water Tax', in *Economic Instruments for Water Management: Experiences from Europe and Implications for Latin America and the Caribbean*, Inter-American Development Bank Regional Policy Dialogue Study Series, IADB

- Christian Aid (2008) *Death and Taxes: The True Toll of Tax Dodging*
- Christiansen, V. (1996) *Green Taxes: a Note on the Double Dividend and the Optimum Tax Rate*, CES Working Paper 107, University of Munich
- Coady, D.; Gillingham, R.; Ossowski, R.; Piotrowski, J.; Tareq, S. and Tyson, J. (2010) 'Petroleum Product Subsidies: Costly, Inequitable, and Rising,' *IMF Staff Position Note*, 10/05, Washington: IMF
- Collier, P. and Venables, A. J. (2008) *Managing the Exploitation of Natural Assets: Lessons for Low Income Countries*, Paper written for the African Economic Research Consortium 2008 Annual Conference, Nairobi
- Convery, F.; McDonnell, S. and Ferreira, S. (2007) 'The Most Popular Tax in Europe? Lessons from the Irish Plastic Bags Levy', *Environmental Resource Economics* 38: 1–11
- Costanza, R.; d'Arge, R.; de Groot, R.; Farber, S.; Grasso, M.; Hannon, B.; Limburg, K.; Naeem, S.; O'Neill, R.V.; Paruelo, J.; Raskin, R.G.; Sutton, P. and van den Belt, M. (1997) 'The Value of the World's Ecosystem Services and Natural Capital', *Nature* 387: 253-260
- Costanza, R. (2008) 'Stewardship for a "Full" World', *Current History* 107:30-35
- Cramton, P. (2007) 'How Best to Auction Oil Rights', in Humphreys, M.; Sachs, J. and J.E. Stiglitz (eds) *Escaping the Resource Curse*, Initiative for Policy Dialogue, Columbia University
- Daniel, P.; Keen, M. and McPherson, C. (eds) (2010) *The Taxation of Petroleum and Minerals: Principles, Problems And Practice*, New York: Routledge
- Dasgupta, P. and Heal, G. (1979) *Economic Theory and Exhaustible Resources*
- DEAT (2006) *South Africa Environment Outlook: A Report on the State Of Environment*, Department of Environmental Affairs and Tourism, Pretoria
- Dikgang, J. and Visser, M. (2010) *Behavioral Response to Plastic Bag Legislation in Botswana*, Environment for Development Discussion Paper Series, 10-13
- Dikgang, J.; Leiman, A. and Visser, M. (2010) 'Analysis of the Plastic Bag Levy in South Africa', *Policy Paper* 18, University of Cape Town
- Dinan, T. M. (2009) 'The Distributional Consequences of a Cap-And-Trade Program for CO2 Emissions', *Testimony Before the Subcommittee On Income Security And Family Support*, Committee on Ways and Means, U.S. House of Representatives
- ECLAC (2001) *Aplicación del Principio Contaminador-Pagador en América Latina Evaluación de la Efectividad Ambiental y Eficiencia Económica de la Tasa Por Contaminación Hídrica en el Sector Industrial Colombiano*
- European Environment Agency (2005) *Market based Instruments in Environmental Policy in Europe*, EEA Technical Report, No8, Copenhagen, Denmark

- Emran, S. and Stiglitz, J. (2005) 'On Selective Indirect Tax Reform in Developing Countries', *Journal of Public Economics* 89: 599-623
- Estache, A. (2006) *Infrastructure: A Survey of Recent and Upcoming Issues*, World Bank
- FAO (2008) 'Empowering Communities through Forestry: Community-Based Enterprise Development In The Gambia,' *Forestry Policy and Institutions Working Paper*
- Giménez, E. L. and Rodríguez, M. (2010) 'Reevaluating the First and the Second Dividends of Environmental Tax Reforms', *Energy Policy* 38.11: 654-6661
- GIZ (2010) Mission Report: Environmental Tax Reform in Vietnam. 'Macroeconomic Reforms' Component 2 - Public Finance
- GIZ (2008) *Environmental Fiscal Reform for Sustainable Development and Poverty Reduction*. Workshop Proceedings and Country Case Studies, www.oecd.org/dataoecd/15/42/36309072.pdf
- GIZ (2005) *Environmental Fiscal Reform and National Forest Policies: An Overview Of Forest Fiscal Revenue Systems in 18 Countries*, Environment and Resource Management Unit
- Glachant, M. (2002) The Political Economy of Water Effluent Charges in France: Why Are Rates kept Low? *European Journal of Law and Economics* 14.1: 27-43
- Goulder L.G. (1996) 'Environmental Taxation and the Double Dividend: A Reader's Guide', *International Tax and Public Finance* 2: 157-183
- Goulder L.G., Parry, I., and Burtaw, D. (1997) 'Revenue Raising vs. Other Approaches to Environmental Protection: The Critical Significance of Pre-Existing Tax Distortions', *RAND Journal of Economics* 28. 4: 708-731
- Gowlland-Gualtieri, A. (2007) *South Africa's Water Law and Policy Framework Implication to the Right to Water*. IELRC Working Paper 2007-03, Geneva: International Environmental Law Research Centre
- Granado, J.; Coady, D., and Gillingham, R. (2010) *The Unequal Benefits of Fuel Subsidies: A Review of Evidence for Developing Countries*, IMF Working Paper 10/02, Washington: IMF
- Green Fiscal Commission (2009) *The Case for Green Fiscal Reform: Final Report of the UK Green Fiscal Commission*, www.greenfiscalcommission.org.uk/images/uploads/GFC_FinalReport.pdf
- Hartin, J. (1968) 'The Tragedy of the Commons', *Science* 162.3859: 1243–1248
- Hartwick, J. M. (1977) 'Intergenerational Equity and the Investment of Rents from Exhaustible Resources', *American Economic Review*, 67: 972-74
- Hotelling, H. (1931) 'The Economics of Exhaustible Resources', *Journal of Political Economy*, 39:137-175
- Humphreys, M.; Sachs, J. and Stiglitz, J.E. (2008) *Escaping the Resource Curse*, Initiative for Policy Dialogue, Columbia University

- IMF (2011) *Revenue Mobilization in Developing Countries*, Fiscal Affairs Department.
- Karsenty, A. (2011) 'Forest Taxation Regime for Tropical Forests: Lessons From Central Africa', *International Forestry Review* 12.2
- Karsenty, A.; Bayol, N.; Cerutti, P.; De Blas, D. and Forni, E. (2011) 'The 2008-2009 Timber Sector Crisis in Africa and Some Lessons For The Forest Taxation Regime', *International Forestry Review* 12.2
- Kaul, I.; Grunberg, I. and Stern, M. A. (1999) *Global Public Goods: International Cooperation in the 21st Century*, New York: Oxford University Press
- Keen, M. (2011) *Taxation and Development – Again*, Fiscal Affairs Department, International Monetary Fund, Washington D.C.
- Keen, M. and Mansour, M. (2010) 'Revenue Mobilisation in Sub-Saharan Africa: Challenges from Globalisation I - Trade Reform', *Development Policy Review*, Overseas Development Institute 28.5: 553-571
- Kobb, D. (2001) *Corruption in Tanzania: An Application of Tax Farming*, K-Konsult USA, Tanga, Tanzania
- Labandeira X.; Labeaga, J. and Rodríguez, M. (2006) *A Macro and Microeconomic Integrated Approach to Assessing the Effects of Public Policies*, Documento de Trabajo 02-2006, FEDEA; Working Paper 22, ECINEQ
- Manning, P. (2000) *Review of the Distributive Aspects of Namibia's Fisheries Policy*, NEPRU Research Report 21
- Milledge, S.; Gelvas, I. and Ahrends, A. (2007) *Forestry, Governance and National Development: Lessons from a Logging Boom in Southern Tanzania*. TRAFFIC
- Millennium Ecosystem Assessment (2005) *Ecosystems and Human Well-being: Synthesis*. Washington, D.C.: Island Press
- Mbithi Mwikya, S. (2006) *Fisheries Access Agreements: Trade and Development Issues, ICSTD Natural Resources*, International Trade and Sustainable Development Series Issue Paper 2, Geneva, Switzerland: ICSTD
- Moore, M. (2008) 'Between Coercion and Contract: Competing Narratives on Taxation and Governance', in D. Brautigam.; Fjeldstad, O.H., and Moore, M. (2008) *Taxation and State Building in Developing Countries*, Cambridge: Cambridge University Press
- Muller, B.; Hoehne, N. and Ellerman, C. (2007) *Differentiating (Historic) Responsibilities for Climate Change: Summary Report*, OIES Energy and Environment Paper
- National Treasury (2006) *A Framework for Considering Market-Based Instrument to Support Environmental Fiscal Reform in South Africa*, Draft Policy Paper, Tax Policy Chief Directorate, South Africa.
- Oates, W. (1995) 'Green taxes: Can we Protect the Environment and Improve the Tax System at the Same Time?', *Southern Economic Journal* 61: 914-22

- OECD (2006) 'Environmental Fiscal Reform for Poverty Reduction', *DAC Guidelines and Reference Series*
- OECD (2008) *Africa Economic Outlook*, Paris: OECD
- OECD (2009) *Managing Water for All: An OECD Perspective on Pricing and Financing*, Paris: OECD
- OECD (2010a) *Taxation, Innovation and the Environment*, Paris: OECD
- OECD (2010b) 'The Price of Saving Water', *The OECD Observer*, July 2010
- OECD (2011) *Glossary of Statistical Term*, Paris: OECD
- Parry, I. (1996) 'Environmental Taxes and Quota in the Presence of Distorting Taxes in Factor Markets,' *Resource and Energy Economics* 19: 203-20
- Patuellia R.; Nijkamp, P. and Pels, E. (2005) 'Environmental Tax Reform and the Double Dividend: a Metaanalytical Performance Assessment', *Ecological Economics* 55.4: 564-83
- Pearce, D. (1991) 'The Role of Carbon Taxes in Adjusting to Global Warming', *Economic Journal*, 101: 938-48
- Petrakis, E.; Rasmusen, E. and Roy, S. (1997) 'The Learning Curve in a Competitive Industry', *RAND Journal of Economics*, 28: 248-68
- Poterba, J. M. (1991) *Tax policy to Combat Global Warming: On Designing a Carbon Tax*, NBER Working Paper No. 3649, Cambridge, MA: National Bureau of Economic Research
- REMA (2011) *A Review of Existing and Potential Environmental Fiscal Reforms and Other Economic Instruments in Rwanda*. www.unpei.org/PDF/rwanda-RESULT5-EFRREPORT.pdf
- Repetto R., Dower, R., Jenkins, J., and Geoghegan, J. (1992), *Green Fees: How a Tax Shift Can Work for the Environment and the Economy*, Working Paper, Washington: World Resource Institute
- Samuelson, P. (1954) 'The Pure Theory of Public Expenditure', *Review of Economics and Statistics* 36.4: 387-9
- Sandler, T. (2002) 'Assessing the Optimal Provision of Public Goods: In Search of the Holy Grail', in UNDP *Providing Public Goods*
- SARS, South Africa Revenue Service (2009) *Tax Proposal 2009/2010*
- Save the Children (2008) *Freeing up Healthcare: A Guide to Removing User Fees*
- Shah, A. and Larsen, B. (1992) *Carbon Taxes, the Greenhouse Effect, and Developing Countries*, Policy Research Working Paper Series No.957, Washington DC: The World Bank

- Slunge, D. and Sterner, T. (2010) 'Environmental Fiscal Reform in East and Southern Africa and its Effects on Income Distribution', *Rivista di Politica Economica*
- Speck, S. (2010) 'South Africa Case Study', in K. Schlegelmilch, S. Speck, and M. Pendo (eds), *Options for Promoting Environmental Fiscal Reform in EC Development Cooperation*, Soges Consortium
- Sterner, T. (2011) *Fuel Taxes and the Poor: The Distributional Effects of Gasoline Taxation and Their Implication for Climate Policy*, RFF Press
- Sterner, T. (2007) 'Fuel Taxes: An Important Instrument for Climate Policy', *Energy Policy* 35.6: 3194-202
- Stiglitz, J. and Weiss, A. (1981) 'Credit Rationing in Markets with Imperfect Information,' *American Economic Review*, 71.3: 393-410
- Sumaila, U.; Boyer, D.; Skogen, M. and Steinshamn, S. (2005) *Namibia's Fisheries: Ecological, Economic, and Social Aspects*, Chicago: Chicago University Press
- Sumner, J.; Bird, L. and Smith, H. (2009) *Carbon Taxes: A Review of Experience and Policy Design Considerations*, National Renewable Energy Laboratory
- Swedish Ministry of the Environment (2008) *Towards a Low Carbon Society*
- UNEP (2011) *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*, United Nations Environment Programme
- Vincent, J.; and Farrow, R. S. (1997) 'A Survey of Pollution Charge Systems and Key Issues in Policy Design.' in R. Bluffstone and B. A. Larson, (eds) *Controlling Pollution in Transition Economies: Theories and Methods*, Edward Elgar
- van Heerden, J.; Gerlagh, R.; Blignaut, J.; Horridge, M.; Hess, S.; Mabugu, R. and Mabugu, M. (2010) *Searching for Triple Dividends in South Africa: Fighting CO2 Pollution and Poverty While Promoting Growth*, PREM Working Paper Series, Amsterdam: PREM
- von Haldenwang, C. (2011) *Taxation of Non-Renewable Natural Resources: What are the Key Issues?*, Briefing Paper 5, Bonn: German Development Institute
- Vourc'h, A. and Jimenez, M. (2000) *Enhancing Environmentally Sustainable Growth in Finland*, Economics Department Working Papers No. 229
- Wheeler, D. et al. (2000), *Greening Industry: New Roles for Communities, Markets and Governments*, New York: Oxford University Press for the World Bank
- Whiteman, A. (2003) *Money Doesn't Grow On Trees: a Perspective on Prospects for Making Forestry Pay*, Rome : FAO
- World Bank (2005) *Environmental Fiscal Reform: What Should Be Done and How to Achieve it*, Washington: World Bank
- World Bank (2006) *Mining Royalties: A Global Study of Their Impact on Investors, Government and Civil Society*, Washington: World Bank

World Water Council (2006) *The Right to Water: From Concept to Implementation*,
Marseilles: World Water Council