‘Jolly Green Giant’? Greening Tax Systems For Sustainable Development

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The concept of sustainable development has become increasingly important to economics in recent years. Michael Jennings examines the role of ecological tax reform in resolving the conflict between continuing economic growth and environmental protection. In the long term he sees the costs associated with introducing such a tax as well worth while.

"*Woo ah, mercy mercy me. Ah, things ain’t what they used to be, no, no. Where did all the blue skies go? Poison is the wind that blows, from the north and south and east.*"

Marvin Gaye

"*...mountain high and river deep - stop it going on, - we gotta wake this world up from its sleep, - ah, people, stop it going on...*"

Jason Kay

"*It follows that the aggregate amount of economic satisfaction which people in fact enjoy is much less than it would be if their telescopic faculty were not perverted.*"

Arthur Cecil Pigou

In a world of fully rational consumers and producers, perfect information and complete, general equilibrium markets, any tax system deemed necessary in an economy could attempt to be ‘neutral’, claiming revenue necessary to provide goods and services in an efficient, non-distortionary manner. The market alone would support the spirit of the first two of the quotes above. Unfortunately, as the latter of the three states, this may not be a reasonable assumption. ‘Green tax reform’ may therefore have a part to play in correcting the imperfections of the use of the environment, in consumption and production. This essay presents some more theoretical components of a discussion that exemplifies one of the central tenets of economics: to allocate scarce resources between competing uses.

‘Setting the scene’ – the problem of Sustainable Development

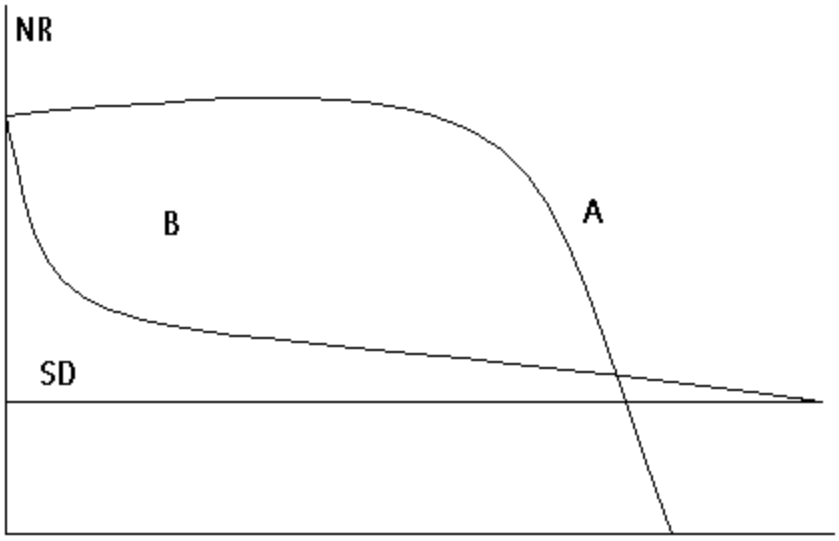
Understanding the concept of long term Sustainable Development is of central importance to the justification of ecological taxation. The argument in favour of some intergenerational redistribution of natural resources, as well as for preserving intact ecosystems, solidifies the case for taxing production and consumption in a non-neutral manner beyond myopic cost-benefit analysis. The following definition highlights the ambiguity of the term:

> "*Sustainable development ... is defined here as a process whereby future generations receive as much capital per capita as, or more than, the current generation has available [....]. This includes natural capital, physical (or produced) capital, and social (including human) capital*".

One of the most important problems in the above is whether the *composition* of capital that is passed on to future generations is of any importance. It is not generally agreed whether perfect substitution between different types of capital is possible if the goal of Sustainable Development is intergenerational welfare maximisation. Notably, the depletion of natural capital in favour of produced capital is questioned in

the ‘ecological economics’ approach. The most extreme form of this approach takes a strongly pessimistic, steady-state view of technological processes and economic growth. It advocates a decrease in the ‘throughput’ of primary resources in industry to reduce depletion and waste. Figure 1 below attempts to depict some of the logic of this view in a simple manner. On the horizontal axis, it depicts an undefined, although not infinite, amount of time. On the vertical axis, a measure termed simply ‘NR’ is used, which denotes the pressure that human, or anthropogenic, processes and emissions place on the environment. Its components are the use of *non-renewable* resources plus use of renewable resources *above their renewal rate*, plus the amount of pollution above the assimilation possibilities of the ecosystem. Therefore, moderate use of NR will be important for the retention of a functioning ecosystem.

Figure 1.



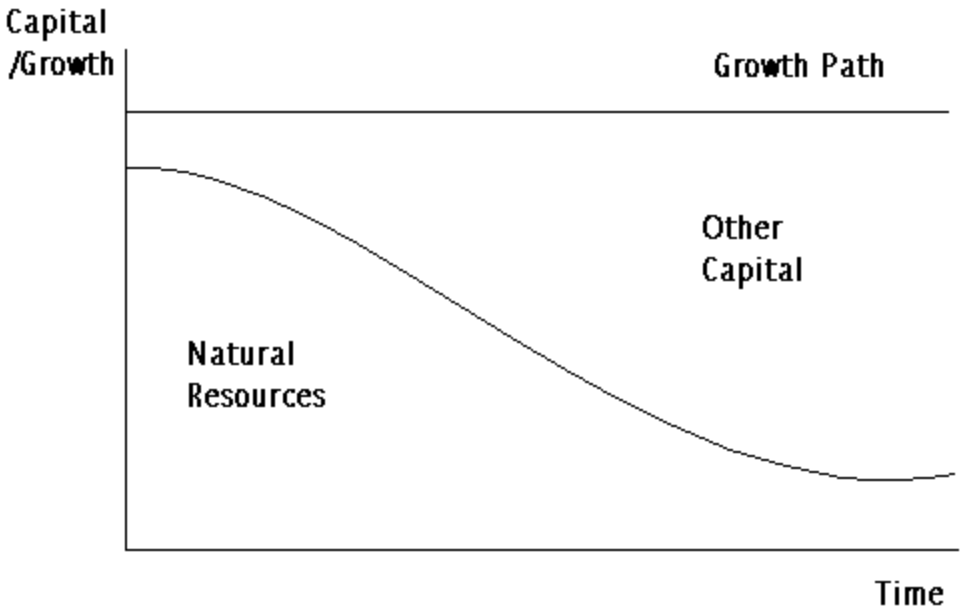
The three curves A, B, and SD then depict three separate consumption possibilities for NR, beginning from the origin, which shall be the current generation. SD denotes some level of consumption of NR that is close to optimal for ecological economists. A level of NR = 0 is hardly feasible, as some resource use is necessary even in a ‘steady state’ with current technology. Consumption would only need to be zero if the time span were indeed infinite, as we would then have to divide a finite amount of non-renewable natural resources by infinity, and any cumulative amount of non-assimilated pollution would eventually reach the critical level for ecosystem collapse.

In the extreme pessimistic view of the ecological economics ‘paradigm’, actual consumption of NR could be considered to follow the path of Curve A. Consumption of non-renewable and/or non-renewed resources, and pollution above assimilation levels, rise with economic growth, until the apex of the curve where NR can no longer be sustained. The most important aspect of this curve is that NR does not then simply drop to some low level, but actually drops to zero. Due to excessive consumption of natural resources as well as pollution above critical levels over a long time period, ecosystems collapse and natural resources are fully depleted. Although there will be negative external effects before Curve A goes to zero, the greatest problems will be experienced by those who have no more natural resources, and face collapsed ecosystems.

The solution above is to induce society to follow the consumption/production path dictated by Curve B. This involves an immediate slowing of over-consumption of

natural resources, primarily through command and control regulation of production and consumption, plus possible market-based instruments as described below, as well as hypothecation. It does not necessarily mean that economic growth must stop, as long as it can take place separate from the use of natural capital. The use of natural capital should then eventually approximate the SD line. Figure 2 shows the opposite case, where the composition of capital is of little importance:

Figure 2. 'Weak' Sustainable Development



As long as natural capital is soundly invested in the growth of other capital, the depletion of natural resources is not considered a problem. This is 'weak' sustainability as opposed to the 'strong' sustainability of the ecological economics approach. No explicit reference is made to pollution here, although it must be considered to be a negative factor to retaining welfare. However, as this 'environmental economics' approach does not explicitly value the ecosystem as such, but only what it provides to the consumers of that ecosystem. It is not intrinsic in itself, but a 'secondary' value based upon the consumer valuations that the environmental economics approach relies upon. Consumers of the environment reveal a willingness to pay for the security of future resource use for themselves and for future generations. This means that natural capital and ecosystems are considered, but as Turner et al point out, this may lead to an underestimation of the value of natural capital:

> "*Ecological economists, on the other hand, are less confident that private valuations arrived at in present market conditions can be expected to take account of all external costs* ".

Most thought regarding the environmental aspects of economic policy moves between these two opposing viewpoints. The 'ecological' standpoint informs us of the necessity for some basic level of sustainable natural resources, as well as emphasising the value of pollution thresholds. The environmental paradigm on the other hand allows us to modify the extreme reduction of natural resource use within finite time spans, and to use consumer valuation in a cost-benefit framework to assess the short term effects of ecological/environmental tax reform.

Within these borders, or paradigms, there are many possibilities for division. Three important stances that may inform policy are:

- *The 'economistic' view* is closest to the simple environmental paradigm, utilising the science of economics and ecological principles to decide on action. Without concrete proof, action is only called for when the likelihood is high that the precautionary principle must be enforced.
- *The developmental view* concentrates on bridging the North-South divide, whereby the developing world must be equipped to address environmental problems through aid from industrial nations.
- *The radical view* adopts the ecological economics focus on the 'planet' as such and on the people within it as part of an 'eco-justice' system in which all actors must be treated with equal care. The precautionary principle informs policy.

The discussion of concrete ecological tax reform should be informed by the scientific reasoning of the economistic approach as far as is possible, and therefore look to the environmental paradigm. However, with the current level of pollution and high burden on ecosystems, the precautionary principle of the radical view may also inform policy decisions. Building on a solid scientific foundation will be important for future decisions in ecotaxation, which will become ever more complex.

What is 'Ecotaxation'?

Definition

Eco(logical) tax, environmental tax and green tax amongst others are names given to the instrument characterised here. We shall ascertain only one definition and description which shall apply more or less equally to any of the terms used in the literature. The Commission of the European Union provides a useful initial definition:

> "*Environmental taxes are taxes with an environmental goal, i.e. taxes aimed at integrating external costs which derive from consumption of the good,* "*environment*"*, into the private costs of the economic agents. Environmental taxes can be levied directly on certain harmful emissions or on products if the use of or production of these products is environmentally harmful (e.g. because they lead to emissions or because in their production non-renewable resources are used)*" .

In another publication, it is further stated:

> "*Apart from the function of raising revenue, they also serve as an incentive for behavioural changes. They are thus often envisaged as an efficient economic instrument for environmental protection*" .

This definition may seem clear. However, we may question what exactly is meant when such measures as mineral oil taxation are not included. In 1995, Ireland gained six per cent of total tax revenue from excise duties on motor fuels alone. Eurostat however calculates figures for environmental taxes in Ireland of 4.0% of total taxation. Furthermore, taxation of petrol also cannot fall under taxes on energy, as these only make up 5.2% of total taxation. This simply shows that assigning various taxes a 'status' is not easy. In the above case, it is possible that Eurostat only include the differential in taxation between leaded and unleaded fuel. However, by the above definition of the tax base of environmental taxes it would be just as valid to include all motor fuel taxation, as consumption of all fuels creates some external effects by polluting.

Taxes vs. Charges?

After considering an initial definition such as the one above, an additional difficulty is the placement of environmental charges. Although these are often loosely named with environmental taxes, they are separate in their design and function:

- *Environmental taxes* are compulsory, *unrequited* payments, usually collected by

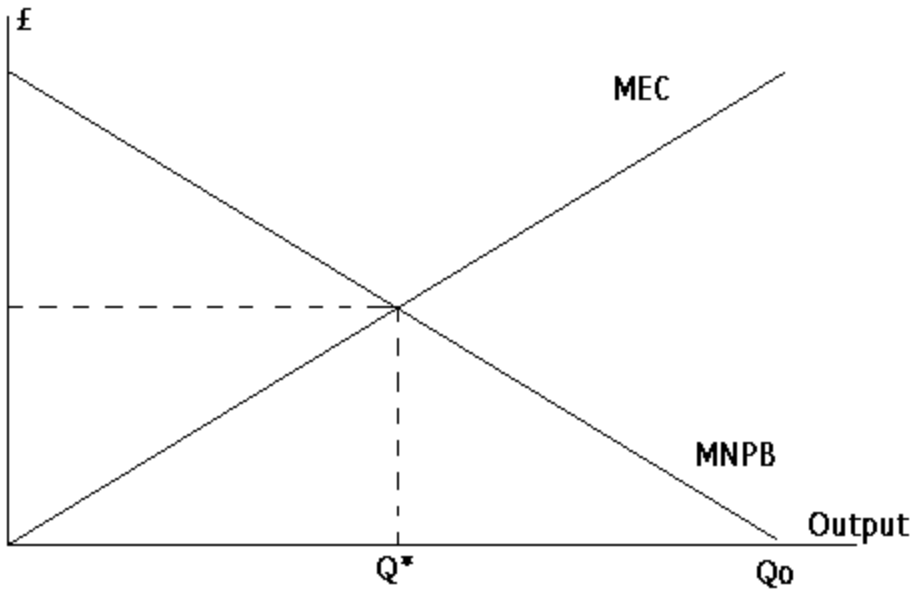
the central government. The benefits to each taxpayer or the collective are not necessarily equal or in proportion to the payment made.
- *Environmental charges* are compulsory *requited* payments, such as sewerage or water charges. They are quite often collected by local authorities, who then provide a service in direct proportion (although the service is usually subsidised by central government) Many services, are still free of charge in many countries, such as water and sewage services in Ireland.

Some environmental charges may fulfil the goals of and motivations for ecotaxation. However, they will only do this if they discourage consumption of the good in question and reflect the true cost of the consumption or production process.

Design

As was shown above, if the level of pollution and resource use is found to cause environmental degradation above a critical threshold, thereby endangering Sustainable Development, then it should be reduced. The classical model for the reduction of external effects through taxation, in this case environmental damage, was introduced by Arthur Pigou. His original idea may be depicted graphically in a number of ways, one of which is explained below:

Figure 3. Taxing for external effects



Source: Barrett (1997), pg.28

Figure 3 depicts the original output decision of a firm, Q^0. This point is chosen as the Marginal Net Personal Benefit (MNPB) goes to zero at that level of output, and the firm maximises profit (MC=P) However, each unit of output also produces an external effect, in our case pollution or excessive use of natural resources as described above. This is the Marginal External Cost (MEC), which increases with output, but is not included in the production decision of the firm. Therefore, a tax at level t* will change the cost structure of the firm, thereby reducing the amount of output where marginal net private benefit remains positive. The new output decision of the firm is Q*, where the benefits of production to the firm equal the costs to society.

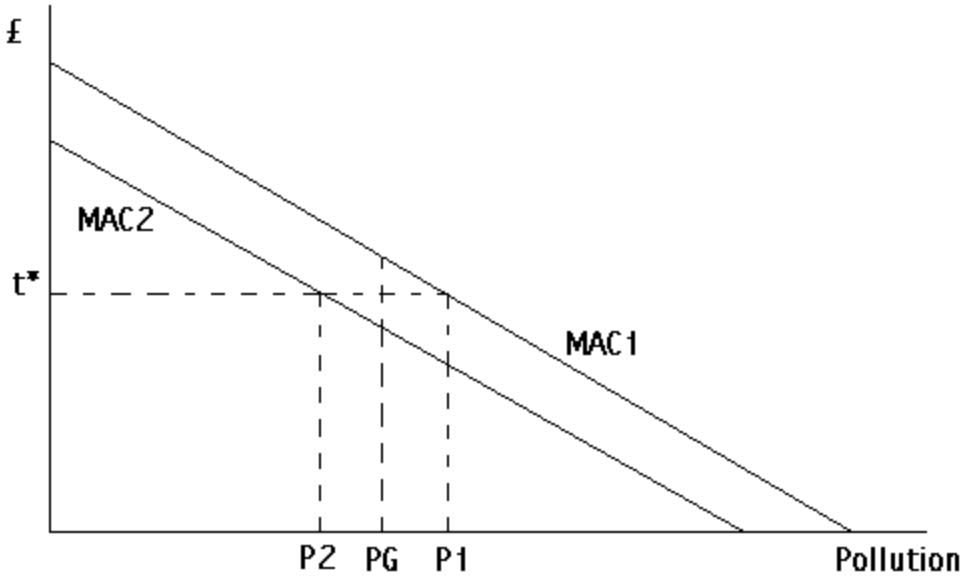
The obvious problem with the Pigouvian tax is how to value the externality, in this case pollution, in monetary terms. It is impossible to determine the exact marginal external costs of a unit of pollution/output, and therefore impossible to set the exact tax rate that will lead to output reduction towards the social optimum. Another problem that should be noted here is that a unit of output or emissions does not

always cause the same damage, depending on the location of the production site, and its assimilatory capabilities. This creates the difficulty of having to tax according to more than one parameter, and necessitates complicated measuring technologies and schemes.

Despite the problems mentioned briefly above (and there are many more), the discussion of Sustainable Development informs us that some level of pollution abatement is necessary. The above suggests an ideal level, although the MEC curve is not explicitly intergenerational. If we adapted it to fit our discussion of SD across generations, then the MEC curve may shift upwards considerably, reducing the ideal amount of production/consumption with a given level of technology. Therefore, an increase in taxation would be necessary to keep intergenerational social costs and present private benefits equated. Obviously, this further reduces present private utility unless adequate means of compensation can be found.

Whatever reduction of pollution or waste is considered necessary, it remains the fact that taxation is the most efficient way to achieve it when different producers or consumers face different abatement costs. Figure 4 shows this clearly:

Figure 4. Cost-effective pollution abatement



Source: Barrett (1997), pg.30

If the government considers a pollution level per firm of P^G to be optimal, a regulation stipulating that both firms in the market, '1' and '2', should only be allowed to pollute up to this level, would not be efficient. As the two firms face different marginal abatement costs, MAC1 and MAC2, the most efficient outcome for a given level of pollution can be reached by firm 2 reducing its pollution to P^2, and firm 1 increasing to P^1. The amount of pollution remains at $2P^G = P^1 + P^2$, but at lower cost. Regulation to this effect would punish firm 2 for efficient abatement processes, and subsidies would not leave incentives in place to abate pollution at minimum cost, while at the same time sustaining marginal firms in the industry. Taxation on the other hand punishes Firm 1 for its higher MAC, and also best fulfils the *Polluter Pays Principle*, which seeks to make each instigator of negative environmental externalities pay for the same. In the above case of two polluting firms a system of tradeable permits to pollute will fulfil exactly the same goals, as Firm 2 can abate at lower cost, and will sell permits to Firm 1 priced just below their abatement costs, which is beneficial to both firms. However, other bases of ecotaxation will be unlikely to have markets for such permits. For instance, the transaction costs of a market for tradeable permits in automobile pollution would be very large in relation to the 'denomination' of these

permits, and therefore not viable. Besides this, enforcement of pollution permits for automobiles would be far too costly.

The ideal solution given our information constraints would then be to set some level of pollution that is compatible with Sustainable Development, and then use taxes (and possibly other market-based instruments also) to reach this level.

What price pollution?

Attempts at costing environmental damage usually involve contingent valuation of the environment and/or monetarising environmental and human capital loss at 'market prices'. Contingent valuation can be defined as:

> "*...a method of valuing the benefits of preserving or improving some asset (such as an environmental asset) on the basis of surveys in which people are asked how much they are prepared to pay to preserve, protect or restore the asset in question*" .

However, besides the usual problems of preference revelation in such questioning, there is the important case for the 'incommensurability' of environmental assets and the environment in general. Respondents may attach some special status to environmental issues, and they are then not easy to reduce to a value expressed in ordinary goods. One component of environmental degradation may be relatively easily valued, namely such things as the effect on crops or landscapes in general, from changes in climate, health risks through particulate matter and many more. The other component is the intrinsic moral and aesthetic value, as well as most importantly the intergenerational value of an intact environment in light of the Sustainable Development discussion. Relying solely on the first component may mean an underestimation of the optimal level of abatement. However, constructing a 'lower bound' through traditional valuation is a positive development, and shall be considered below for two examples. A final caveat here is that the responses to environmental questions are likely to be very emotive, leading to large preference revelation problems.

Climate change

Cost-benefit analysis of climate change is the best example of how difficult valuation actually is. The scenarios brought forward range from a certain *nonchalance*, welcoming increased plant growth and warmer weather in colder climate areas, to disaster scenarios of mass species extinction, flooding, tropical storms and uncomfortable temperature rises in middle latitudes. It is considered likely that over two billion people live in countries that may be subject to high decreases in potential yield due to climate changes. These countries often have low 'food security' and endangered coastal regions.

Maddison uses an economic output model in which Greenhouse Gas accumulation and therefore an amount of global warming occurs. If no abatement takes place then by 2100 global temperature will have risen to 3.6C above pre-industrial levels. The costs of this 'business as usual' strategy are estimated at US$ 8.9 trillion (present value). However, due to the fact that abatement policy is also very costly, pursuing an 'optimal cost-benefit' policy may not bring significant climate change reduction or benefit.

The above results are indicative of a number of other such studies that have been performed. As with others, the author warns of the limitations and uncertainties of the model. Although most of these are considered to be statistical or informational, the Sustainable Development discussion above may also inform us of other shortcomings to look for. The main one is myopia. Although the short to medium term benefits of reductions might be small, indeed negative if we follow a strategy that reduces emissions by a very large amount, abatement may pay off in the long run.

However, this is impossible to estimate from our present day vantage point. Furthermore, even in the short run it is possible that many analyses may be regionally biased, not paying enough attention to the regions that are at the greatest risk from climate change.

Current Health Effects of Pollution

Studies of health effects seem to concentrate on the problems for humans, although depositions of emissions and acid rain will of course effect all flora and fauna. There are obviously indirect effects on health from global warming, which should be captured in estimates such as those mentioned above. However, the danger to health from pollution mainly arises through local substances that pollute water, air and soil, such as carbon monoxide, nitrogen oxides, volatile organic compounds and particulate matter. The two most important sources for pollutants are industrial production and transport, the latter of which is a particular problem for air quality in congested areas. Below is a list of potential effects of vehicle-generated pollutants:

Table 1: Vehicle-generated pollutants and their effects

Pollutant	Effects
Carbon dioxide	Greenhouse gas
Sulphur monoxide	Contributes to acid rain Induces breathing problems
Carbon monoxide	Toxic in confined spaces
Particulates	Soils buildings Heavy concentrations may be carcinogenic
Nitrogen oxides	Contributes to acid rain Can cause throat irritation Contributes to ozone and photochemical smog formation
Volatile organic compounds	Exacerbates respiratory problems Possible link to childhood leukemia Contributes to ozone and photochemical smog formation

Actually monetarising health problems is a different matter entirely. Pearce and

Crowards attempt to assess the number of deaths caused in urban areas of England and Wales by particulate matter (PM_{10}), and then monetarise these. With the two most important variables being the definition of urban population, and the 'dose response function' which measures the number of deaths attributable to a change in PM_{10} concentration, estimates of between 3000 and nearly 10000 deaths through particulate matter were calculated (mainly heart or lung disease). Based on a willingness to pay estimate, they value a 'statistical life' at £1.5m, and therefore estimate costs from mortality alone from anthropogenic PM_{10} particles at over £14bn per annum. To this we can add morbidity effects of illness like the loss of working hours and depletion of human capital, as well as health service costs.

There are many other problems on a local and global scale, for instance anthropogenic pollution of drinking water, which causes waterborne diseases that effect the macroeconomy, but these will not be further discussed here.

Time for action? Many questions...and few answers

It would seem that although it may be very difficult to place exact values on the costs of environmental degradation, these will be considerable. However, the costs of abatement of pollution are also quite considerable. It is indeed the case that a large amount of public and private money may need to be spent without much tangible immediate effect. However, in the long run the concept of Sustainable Development informs us of the need for action. For all but the most urgent problems, market based instruments may be considered to be the most efficient way to ensure that a reduction of environmental degradation by human production and consumption is achieved.

A further point of interest for ecotaxation is the 'double dividend' debate. If environmental taxes are used simply to influence behaviour rather than raise extra revenue for active abatement, then the government may remain close to revenue neutrality by compensating the economy – it can reduce distortionary taxes, such as those on labour. Also, higher taxation of goods such as petrol may create distributional problems, and this should be reflected in the use of extra revenue. The double dividend is then that the tax system sends correct signals to those who misuse the environment, and that distortionary effects in other areas are reduced.

Finally, it may be noted that no unilateral measures can succeed - as Scott Barrett points out that up to a certain point any country that does not participate in abatement will gain from free-riding, and 'leakage' to these countries may mean that abatement will be less effective. Agreements such as the Montreal Protocol on Substance that Deplete the Ozone Layer, or the UN Framework Convention on Climate Change are positive steps, but the degree of enforcement is weak, as with international agreements in any area.

Conclusion

Ecological tax reform can play an important part in correcting the current market imbalances regarding sustainable growth in the global economy. It offers the unique opportunity to collect revenue in a manner that may be considered morally acceptable, and away from distortionary and unpopular taxes such as on income. At the same time, any changes in production and consumption decisions that lessen pressure on the environment promise real medium to long term gains. Potential short term costs, as well as the actual design and multilateral implementation of such instruments present a plethora of difficulties, but rewards are just as plentiful.

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