Environmental considerations in tax policy design

JOHN WHALLEY

Universities of Warwick and Western Ontario, and NBER

ABSTRACT. This paper discusses how environmental considerations will affect tax policy in the decades ahead. It argues that, in the future, interactions between tax and environmental policy are likely to go well beyond recent discussion of double divided issues, and that internalization of environmental externalities via tax policy will be the goal, which inevitably will involve the particular rather than the general. As a result, notions of neutrality which dominate current thinking on tax design will come under challenge; and in ways which will go well beyond current discussion of special treatment for particular goods and industries on environmental grounds. special treatment of environmentally harmful methods of production, more so than of goods and industries as under present tax policies, will be the name of the game. Moreover, the informational requirements of such an approach to tax policy are likely to be large. The paper concludes by pointing out that if environmental quality is a luxury good, as many suppose, with income elasticity of demand greater than one, then high income households will gain disproportionately from internalization of the externalities at issue. This may fuel pressures for more redistribution elsewhere in the tax system than is currently the case.

1. Introduction

In this paper I discuss how environmental considerations seem likely to have an impact on the design of tax policy in both developed and developing countries in the next few decades, especially if environmental considerations become more important in non-environmental policy design as many expect. I go beyond recent literature on environment and tax policy which stresses double dividend issues (see Goulder, 1985 and Bovenberg and Goulder, 1996), and wider environmental tax interactions (such as Smith, 1992 and McMorran and Neller, 1994) and argue that some of the basic tenets that have underpinned tax policy design for 30–40 years will be subject to challenge on environmental grounds. This may result in a substantial reconfiguration of tax structures around the world in the decades ahead.

More than anything else it is the tax design doctrine of neutrality that is likely to come under stress. Neutrality emphasizes that commodities,

industries, and production processes should all be equally treated for tax purposes, supported by the intuition that if this is not the case socially costly distortions are created. Neutrality doctrines at present dominate the design of corporate taxes, value added and other broadly based sales taxes (such s retail sales taxes), income taxes, and (within property) property taxes. Broadening the base of these taxes is seen as allowing lower tax rates, and operating them with one (or few) rates is thought to minimize distortionary costs. Although theoretical public finance literature has challenged this doctrine in developing optimal tax rules (such as Ramsey's (1927) optimal commodity tax structure, where leisure enters preferences and is non-taxed), public finance practice has been little affected by this work. Neutrality as an objective of tax policy has remained strongly entrenched, as evidenced by the drive to move to broadly based value added taxes around the world, and eliminate incentives and accelerated depreciation in corporate taxes.

Environmental considerations in policy design are largely reflected in uninternalized externalities, whose correction through a Pigouvian tax is what is called for. The essence of such policy concerns is that it is the particular rather than the general that is involved, with special tax treatment needed for certain externality generating production processes over others, activities of certain plants or industries (and their location) over others, and certain types of consumption activities over others, as much as if not more so than a different treatment for products and industries. I argue that not only will neutrality increasingly become an untenable working hypothesis for tax policy; special and new tax policies will need to be designed to deal with a range of considerations currently not covered by tax law.

In addition, I argue that the informational requirements for the implementation of any new tax schemes designed to internalize externalities are intimidating. In using the tax system to remedy environmental ills, not only will neutrality need to be breached in all of the present major taxes; new tax schemes which differentiate by production process, location, and other characteristics will be needed. The scope of this task is clearly large. Current national accounts data are collected on a product and industry basis, and does not include information on production processes. Evaluations of the welfare implications of uninternalized external effects are relatively few and far between. A data revolution on a large scale will be needed to provide an empirical basis for such a redirection in tax policy.

Finally, I argue that equity issues will also likely take on a new dimension as environmental considerations enter tax policy. If, as is often argued, environmental quality is a luxuriate good with income elasticity of demand greater than one, the benefits of internalization will accrue disproportionately to the rich. This will generate pressure for more redistribution in the non-environmental component of tax policy to offset the pro-rich redistribution generated through environmental taxes.

In what follows, I expand on these arguments, and as well as explore the environmental implications for other objectives of tax policy, including stabilization, and simplicity.

2. Tax structures and non-environmental policy objectives

Structure of tax systems

Current tax systems in OECD countries comprise a number of taxes which differ in both structure and rationale (income, corporate, sales and excise, property, social security, resource). Tax revenues as a fraction of GDP range from (on the low side) 35 per cent to (on the high side) 55 per cent in some of the Northern European economies (such as Holland and Denmark). The relative importance of each tax also varies from country to country; Australia and New Zealand place heavy reliance on income tax, while France raises nearly three times as much revenue through social security tax as income tax.

Despite these differences, these countries' tax systems have evolved from common origins. Income tax, whose introduction was some 200 years ago, has progressively broadened itself beyond the original tax on cash income to include other items such as capital gains. Its rates steadily rose until the mid 1980s to become a major revenue source, when rate cuts became the politics order of the day in the OECD countries. In the sales and excise tax area, an even older patchwork quilt of commodity specific excises and duties, which remained the rule around the turn of the century, has progressively been replaced in the twentieth century by broadly based sales taxes (principally VAT) with three large excises remaining (e.g., fuel, drink, tobacco). Excise taxes on gasoline, tobacco and liquor are important revenue sources in most OECD countries, and especially so in Europe.

Countries have also tended to copy each other in tax design and especially so in the indirect tax field, with a progressive spread of VAT first from France into Europe in the elate 1950s, and subsequently beyond Europe in the 1970s and 1980s. In the social security, corporate and property tax fields, countries also use broadly similar structures. Social security taxes differ in level from country to country, while in most OECD countries property taxes are about the same size in revenue terms as corporate taxes. Trade taxes are small in most of the OECD while in some developing countries they are large. This is particularly so in Africa where trade taxes can account for as much as 70 per cent of revenues for low-income countries. Resource taxes differ from country to country depending upon how strong the resource base is in the economy, although in most countries these are quite small as a revenue source. There are also miscellaneous taxes and fees whose importance varies across countries. In Singapore, while admittedly an outlier, some 30 per cent of revenues are now related in one way or another to automobile use, including the process from the Certificate of Entitlement required of car purchasers.[1] Inflation taxes are another element in the revenue picture, even though they are not formally set up as taxes. In countries where the inflation rate has been high, Brazil used to be one example, such revenue sources matter.

Rationale for tax structures

This arrangement of taxes that makes up modern tax systems has been the subject of substantial investigation in recent decades in public finance

[1] See Chia and Phang (1994).

literature. Discussion has focused both on the impact of taxes on economic activity, and the associated question of appropriate tax design. I will discuss some of the key themes emerging from this work, suggesting a consensus position towards the end of the 1990s before public finance researchers begin to consider how environmental considerations change tax design.

The central part of tax evaluative literature deals with the efficiency and equity impacts of taxes; classic issues in public finance going back nearly 150 years. Efficiency considerations stress that taxes should distort the allocation of resources as little as possible, relative to a Pareto optimal allocation. Equity considerations focus on the impact of taxes on the income (or wealth) distribution. Economists working on tax design have witnessed something of a sea change in recent decades as far as their evaluation of how costly taxes actually are in distorting resource allocation, and what their impact is on the distribution of income; these changes have been a major driving force in refocusing tax policy over the same period.

Efficiency considerations in tax design
Much of the key work on measurement of the welfare costs of taxes originated in the late 1950s with Harberger (1959, 1962, 1964, 1996). Harberger produced so-called triangle measures of welfare loss, closely related to Hotelling's (1938) earlier work on public utility pricing. Importantly, Harberger also made calculations as to what the distorting costs of various taxes in the US economy actually were.

Harberger's results suggested the following arguments. Looking at some of key tax distortions, such as taxation of labour supply, literature at that time suggested that labour supply elasticities were small, if not zero. As simple Harberger triangle measures are linear in elasticities, the conclusion seemed to be that theses distortionary triangles due to taxes were small. If one also looked at tax distortions of savings, elasticities at that point in time again seemed to be small. An estimate of the overall cost of the tax system would therefore be small; somewhere in the region of 0.75 to 1 per cent of GDP, Harberger put forward these estimates as showing what could be harnessed through tax reform as a free lunch; but these estimates were viewed by others in a different way. James Tobin is the source of the remark that it takes 'a heap of Harberger triangles to fill an Okun gap',[2] taken at the time to suggest that the efficiency costs of taxes were insubstantial.

Equity considerations in tax design
At the same time that these efficiency calculations were being made by Harberger, there were also a number of studies of tax incidence which were being undertaken. These again have a long history going back to the previous century, but in the 1950s and 1960s were associated with Pechman and Okner (1974) and Musgrave (1959). These studies made

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[2] The Okun gap is the idea, due to Arthur Okun of lost productive potential in the macro-economy due to less than full resource utilization.

various assumptions as to how individual taxes were shifted either forward or backward on to factors of production, and looked at the combined distributional impact of the tax system. The conclusion was that for the income tax, there was not as much redistribution in practice as appeared on paper, because of various elements of erosion in the income base (light taxation of capital gains, non-taxation of imputed income from home ownership), and sheltered capital income, (such as the build-up in pension funds). In turn, the limited redistribution in the income tax combined with seemingly regressive taxes, such as the sales tax and (depending on the shifting assumption) property and corporate taxes. The conclusion from this work at this time (the 1960s) was that the tax system did little to redistribute income; limited progression in the income tax was offset by regression elsewhere.

As the tax system did not seem to impose a significant social cost in terms of induced resource misallocation, the driving force behind tax policy became to produce a tax system that did indeed redistribute income. This was to be achieved by adding ever stronger redistributive measures to the tax system in the hope that some of it would stick (fully tax capital gains, eliminate loop holes and broaden the base of the income tax rates). No matter how much redistribution was geared up in the tax system, it was believed, there was no cause for serious concern about resource misallocation costs because they were small. The 1966 Carter Commission Report on Tax Reform in Canada represented perhaps the high point of this direction in tax policy.

Changes in perception in tax design
In the late 1970s, the perceptions of public finance researchers as to the efficiency and redistributional effects of taxes changed sharply, and with them the beliefs in the 1980s that drove new directions in tax policy. Researchers no longer believed that labour supply elasticities were zero; in fact research typically produced differential elasticities for primary and secondary workers, with the elasticities of secondary workers considerably higher. Revisions in elasticity estimates also reflected more sophisticated econometric work, which accommodated non-linear budget constraints.[3] As well, work on savings upwardly revised the relevant elasticities. A well-known calculation by Summers (1981) in the early 1980s of the efficiency costs of tax distortions of savings, for instance, was based on an aggregate elasticity of savings of two. Estimates of efficiency costs of taxes were thus raised because elasticity estimates increased.

In addition to increasing elasticity estimates, researchers also began to focus on the marginal (as against total) efficiency costs of taxes. This approach had its origins in a paper by Browning (1976) who argued that even if the average cost of taxes (in a Harberger sense) was small, the efficiency costs of taxes at the margin when raising additional revenues from taxes can still be large. This is because in a Harberger calculation of the welfare costs of taxes, the tax rate usually enters as a squared term. The

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[3] See Killingsworth (1983) who emphasizes the differences between first and second generation elasticity estimates which incorporate such features.

derivative if a simple Harberger tax welfare cost measure with respect to the tax rate, t, is approximately linear in t. As a result, if there is already a distorting tax in place at a high rate, the social costs of collecting an additional dollar of revenues from it will be high.

Research work appearing in the middle 1980s (Stuart, 1984)and Ballard, Shoven, and Whalley, 1985) went even further and suggested that for the US, the marginal efficiency costs of taxes could be as high as 35–50 cents for each additional dollar of revenues raised, depending on the tax. Given that there were contemporaneous general equilibrium estimates of the overall efficiency costs of taxes which incorporated higher elasticity estimates and looked at the combined (and compounding) effects of taxes and suggested that efficiency costs of taxes could be as high as ten per cent of GDP in OECD countries, the focus in tax design in the mid 1980s shifted more towards efficiency considerations and away from the tax equity concerns of the past.

Other public finance research work in the taxation area underscored this shift. Saving and investment were areas focus on and calculated marginal effective tax rates affecting investment decisions (see King and Fullerton, 1984). This research showed a wide variation in effective tax rates by asset, by source of financing, and by investing agent, emphasizing the need to move to a more neutral tax regime across these margins. Such tax rates depend on financing assumptions, on the ownership structure of the underlying assets, and whether the investor is taxable or is in a special institutional or pension fund situation. The effective tax rate calculations which emanated from this work were used in policy discussion and policy debate in many of the OECD countries during the 1980s.

On the equity front, the earlier conclusions from the 1960s about offsetting redistributive impacts of taxes were challenged (once again) by Browning (1978), in a piece which argued that the sales tax, which for many years had been viewed as a regressive tax (and is still though of in that way in many policy circles) is in fact a progressive tax. The old view that the sales tax was regressive was based on the argument that high-income savers paid no sales tax on their savings, but Browning pointed out that in reality such taxes would be paid in the future when dissaving occurred. He combined this with the observation that low-income households are large recipients of indexed transfers to argue that the sales taxes was progressive. He then revised earlier calculations of the redistributive effects of the whole tax system to argue that the wider US tax system was also progressive in impact.

This change in view of the balance between efficiency and redistributive effects of taxes had clear impacts on policy from the mid 1980s on. The thrust of tax reform in the US and elsewhere from the mid 1980s onwards was towards efficiency not redistributive consideration. Policy initiatives to achieve tax neutrality by eliminating unnecessary distortions in the tax system flourished, and base broadening and tax cuts were used to harness efficiency gains. This shows the influence of public finance research on a policy in a period in which environmental issues were deemed less important. Later I indicate how a higher profile for environmental considerations may impact on tax policy directions in the future.

Other considerations

In addition to the work mentioned above on the redistributive effects of tax policy, there was also substantial academic work on Ramsey considerations in tax design in the 1970s and 1980s. This is to be found in the optimal tax literature,[4] of which there are two separate strands; optimal commodity tax and optimal income tax literature. The key element in the optimal commodity tax literature is that there is one non-taxed good, leisure, and the issue is what should be the structure of tax rates across non-leisure goods. The answer depends on the extent to which various commodities are either substitutes or complements of leisure; with the presumption being to tax more heavily any complements of leisure. Higher taxes on, say, beds over other goods, would, for example, be justified as a way of indirectly taxing leisure. What emerged from this literature was a stress on optimal tax design though different tax rates on commodities. The view of many practitioners at the time was, however, that, despite this literature, and in the face of ignorance as to what these substitutability/ complementability relationships actually are, the proposition of separability in preferences between leisure and non-leisure goods remains as good as any other. This implies a uniform tax structure across leisure and non-leisure goods;[5] namely, support for a neutrality based approach to tax policy, and for a broadly based VAT.

A further development related to the above discussion involved research on tax competition. This has accelerated in the last few years, and has been strongly emphasized by local public finance economists in their work on local public finance. In this area the thrust is on the need for policy coordination so as to prevent destructive competition taking place which erodes and eliminates tax bases. Tax competition between jurisdictions can result in tax bases which are too small, and in inappropriate levels of intervention in the public sector. Unless there is some cooperative arrangement jointly developed by competing levels of government, harm will be done. These issues are now coming up centrally at the international level, and I will draw some environmental implications from this work later.

3. Environmental considerations in tax policy design

Given the discussion above of the factors driving tax policy design in an era where environmental considerations were of limited concern, I now offer my sense of how earlier policy directions will come under re-evaluation because of the perception that environmental considerations are now more important.

Pigouvian taxes

Environmental considerations are not new to public finance, although their recent emphasis as something of quantitative importance is relatively

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[4] See the discussion of optimal tax rates and structures in Stiglitz and Dasgupta (1971) and in Atkinson and Stiglitz (1980).
[5] Sadka (1977) derives this as a necessary and sufficient condition for tax rate uniformity.

new. Economists equate most environmental issues with the more general analysis of externalities, initially developed by Pigou (1938). In Pigou's view of the world, externalities (or external effects) arose where some adverse effect of a production or consumption activity (such as smoke from an industrial factory) created a bad for some other agents or households in the surrounding area), and these costs were not borne by the agent responsible for the external effect. The external effect creates social costs not internalized by producers.

In diagrammatic terms, the uninternalized supply function is given by the marginal private cost schedule (MPC). From a social point of view, both marginal private and marginal social costs (MSC) should be included in supply decisions, and socially appropriate allocation is where (MPC + MSC) equals the demand price (marginal utility). This is to be achieved by a production tax at rate T (a Pigouvian tax). With an uninternalized externality, output is too high (Q_u rather than Q_l) and price charged is too low (P_u rather than P_l).

Subsequently, Pigou's analysis was elaborated on by Coase (1960), who argued that there is typically some degree of arbitrariness in the assignment of property rights in an externality situation (should householders demanding clean air compensate factories for restrained production, or do households have rights to clear air over the factory's right to produce). Coase also argued that often side arrangements with implicit compensation were arrived at before any intervention through a Pigouvian tax was contemplated. In such situations, a Pigouvian tax could worsen resource allocation.

Until quite recently, however, most work on taxation and the environment was thought of in its original Pigouvian terms as dealing with special situations which required tinkering intervention, rather than pervasive economy-wide remedies. Environmental considerations in tax design, while dealing with the particular rather than the general, were thought to be quantitatively of second-order magnitude in aggregate; and in no way requiring any major rethinking on the overall directions for tax design economy-wide on efficiency and distributional grounds. It is this view that has changed in the last few years, and as environmental issues grow in prominence will change further.

New efficiency analysis
The first and most obvious of the new environmental factors affecting tax design is the role of environmental externalities when evaluating the efficiency costs of taxes. For instance, existing literature shows that specific excise taxes, such as on gasoline, have a large efficiency cost because of their high tax rate, making traditional calculations of Harberger triangles for these taxes large. The argument now, however, is that what is involved is an externality correcting tax, i.e., a Pigouvian tax, whether they be for local congestion related effects, or global impacts due to carbon emissions. High taxes on gasoline can thus be an appropriate response to uninternalized externalities, and if that is the case, both the efficiency costs of taxes, and the social costs of raising additional revenues will be much smaller than current literature suggests. Earlier work on the marginal costs of

public funds from the 1980s that I mentioned earlier has thus been subject to recent revision due to environmental considerations, including re-visions in recent work by Goulder (1995), Goulder and Bovenberg (1996), and Bovenberg and van der Ploeg (1996). The point is that what was earlier perceived as a bad tax because of large efficiency costs, can become a good tax once environmental considerations enter because, in effect, they are Pigouvian externality correcting taxes.

Implications for the size of the public sector
This same issue of how estimates of the efficiency cost of taxes may need revision because of environmental considerations also has implications for the wider design of the public sector. One important implication involves the optimal size of the public sector. Again, substantial literature has accumulated over the last ten or so years which evaluates the optimal size of the public sector in transitional public-good terms, as a Lindahl equilibrium supported by the Lindahl taxes[6] which meet the conditions needed to achieve Pareto optimality through public sector provision.[7] In the segment of this literature which deals with the influence of taxes on the size of the public sector, the additional assumption is that the government cannot use lump sum taxes since they are administratively infeasible. Only distortionary taxes which affect the optimal size of the public sector can be used.

Thus, in the literature, one can find examples where the size of the public sector can expand due to the use of distorting taxes, depending on the strength of complementarities between private and public goods, although most researchers believe distortionary taxes (compared to lump sum taxes) reduce the optimal size of the public sector, because it becomes ever more costly to raise the revenues needed to finance public good pro-vision. However, if the calculated marginal excess burden falls because some of the taxes being collected are Pigouvian externality-correcting taxes, the optimal size of the public sector will tend to expand again. So once again environmental considerations have a wider reach, changing the impact of overall efficiency considerations on public sector design.

Tax neutrality
Another implication of environmental considerations in tax design involves the Ramsey considerations I mentioned earlier. Policy economists have generally argued over the years that despite Ramsey considerations it is desirable to move to a broadly based non-distorting tax, such as a VAT; a simple broad-based tax with a uniform rate. This is, however, clearly inconsistent with an approach to tax design which incorporates externality correcting objectives, and uses an array of Pigouvian taxes.

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[6] A Lindahl equilibrium is one where the sum of the marginal rates of substitution between public and private goods equals the rate of transformation between them on the production side; and lump sum taxes calculated as the product of the agent specific marginal rate of substitution and the quantity of pubic goods exactly finance the public goods provision.
[7] See Atkinson and Stiglitz (1980).

Green considerations now have to be weighed alongside Ramsey considerations. Some goods which are complementary to leisure may have few externality effects (e.g., pyjamas), while other leisure complements may account for significant externalities (e.g. cars). Such product-specific external effects will thus raise or lower conventional Ramsey optimal taxes, and as environmental considerations grow in tax design, they will come to dominate conventional Ramsey considerations. Overall, externality considerations imply that while one may want to follow a broadly based tax approach of old, it needs to be combined with concentrated taxes on narrow bases at high rates, reflecting Pigouvian considerations.

Process-based taxes

Such considerations, however, also introduce a new element into tax design; namely, that it is often the method of production (or process) which has adverse environmental effects, as much as it is the good that is produced or the sector in which it originates. Thus tax incentives to car pool rather than drive alone (to reduce congestion); to use solar rather than fossil-fuel-based energy conversion technologies, to use production processes which have end-of-pipe waste treatment may all be defensible on Pigouvian grounds. In none of these cases is it a sector or product that is involved, but instead a production process. Externality correcting taxes will thus also need to be process based, rather than product or industry based as in the past.

   Indeed, conventional tax policies do not differentiate between production processes, instead between industries where production occurs, or between particular goods produced. This will raise all manner of new issues for tax policy in the next few years; how to design and administer process based tax policies, how to estimate the substitution effects between taxed and non-taxed processes; how to gather data to be used in designing process-method-based taxes; and how the externality benefits will be internalized and actually computed. The challenges for future tax policy these developments raise are therefore large.

Changes to broad-based taxation

These changes towards a Pigouvian orientation in tax design are also likely to shift debate away from the desirability of broadly based tax design towards more specificity in tax policy. This change in policy orientation will be especially important for World Bank fiscal operations in developing countries. Under their present approach, in a typical structural adjustment package the Bank, on becoming involved in a country, first of all advocates devaluation and a move towards full convertibility, followed by trade policy reform, and the introduction of a value added tax (VAT). VAT is often the central part of the tax reform component which, in turn, is seen as the tax mechanism to contribute to a reduction in the public sector deficit. Environmental considerations typically do not enter deliberations on the design of these policy packages in any major way. If, for the reasons given above, environmental considerations grow in profile, this suggests that this situation is also going to change over the next five to ten years, and in a major way.

Taxes and marginal incentives

There are also implications of these discussions of environmental considerations for marginal effective tax rate calculations; and these, in turn, relate to the choice of instrument to be used in environmental policy making. Also, research work on appropriate mechanisms for internalization of various externalities tends to focus on internalization design at an aggregate production level. In recent carbon tax literature, there is discussion as to whether or not one wants to design new tax instruments which encourage use of carbon-saving technologies of various kinds. There is also discussion of whether one wants to use a time structure in tax rates which forces installation of emission-reducing equipment as early as possible because of the beneficial impact it may have. Some recent work (see Parry, 1993) argues that there is no welfare gain to be had from doing this, because costs are incurred earlier, and in the context of optimal policy, marginal benefits equal marginal costs; an equivalence proposition in terms of intertemporal carbon tax rates.

International dimensions

Many of the tax related externality situations discussed above also reflect environmental concerns which have international dimensions. Attempts to internalize externalities though various kinds of externality correcting taxes will increase costs in the countries using such policies with international competitiveness effects which erode trade performance. There will thus be a reluctance of countries to adopt go-it-alone policies of environmental internalization , and particularly so if they affect their trade performance. International policy coordination of environmental considerations in tax design will thus become ever more important. I would even suggest that some of the higher profile environmental situations currently confronting policy makers around the world, such as the problems within China over inefficient coal burning, will have related interjurisdictional dimensions which will be crucial in the decades ahead.

Developing-country considerations

A few comments on some special developing-country considerations in dealing with environmental factors in tax design are also in order. As already mentioned, a move to a broadly based VAT may no longer be so clearly supportable as the World Bank, in particular, has argued in the past, and this direction for tax policy in developing countries seems likely to come under challenge. But it is also the case that as environmental considerations enter other policy areas, such as trade, policy directions will again change, in both countries and the agencies themselves. An extreme scenario suggests arguments using environmental considerations may even be used to support the maintenance of various kinds of policy interventions that the Bank has argued against in recent years, such as in the trade area; and this would run opposite to current thinking.

Equity issues

Environmental considerations will also tend to change the equity efficiency trade-off in tax design in developing countries compared to that

seen in the developed world. If environmental quality is a luxury good, environmental internalization will be seen as a pro-rich policy; presumably to be partially offset by heightened progressivity elsewhere in the tax system. Also, many developing countries have further policy interventions which go beyond that of tax systems, and, in a range of countries, it is even hard to define exactly what the tax system is because of these. If there are quota-based and other kinds of quantity restraints, all things being equal, supply elasticities are substantially reduced by them. This means that the efficiency gains from tax reform, given these other instruments remaining in place, are sharply reduced. On the other hand, the redistributive effects of taxes are larger, because of the large price effects which accompany the low elasticities, and hence the role of environmental implications in modifying tax design will be different between the two groups of countries.

4. Concluding remarks

I will conclude with a few remarks on quantification and environmental tax reform and how quantitative work in this area will also be important to the social policy debate

The first concerns the revenue implications of green taxes. The idea that environmental-externality-correcting taxes not only improve resource allocation, but can also raise significant revenues, is one that has been put forward prominently in some circles. Recent pieces by Repetto *et al*. (1993) and Corders *et al*. (1990), claim that by various kinds of environmentally desirable interventions (primarily congestion taxes on roads) and other measures, there is a potential to raise large amounts of new revenues for the federal government in the US which would more than balance the budget. The thrust of the argument is that the US should anyway improve resource allocation through internalization, but can now move towards even more substantial deficit reduction by using green fees of various kinds.

Secondly, in Europe, the focus has been on the so-called double dividend hypothesis associated with environmental tax reform. The double dividend argument, now emanating from the European Commission and elsewhere, is that if you substitute appropriate environmental taxes for other taxes (such as payroll taxes), you can get both environmental benefits and lower unemployment if net revenues remain constant. As noted earlier, recent pieces by Bovenberg and Goulder (1996, 1997) have discussed these issues.

Finally, in the carbon tax area, there are a number of modelling efforts[8] in the last few years which have come to the conclusion that if one examines the kinds of interventions which have been called for to stabilize global carbon emissions at 1990 levels, the impacts are large (see Whalley and Wigle, 1991). There are some calculations suggesting that revenues from such taxes could be as large as 10 per cent of gross world product, and if these revenues were recycled on a per capita basis, the amount going to developing countries would be two or three times their annual aid

[8] Also see the recent analysis of the Clinton proposal for a BTU tax in Krutilla *et al*. (1995).

flows. World trade flows would likely change (in direction as well as level), there would be a substantial reduction in trade in manufactured goods, and probably a larger impact on trade than from all the trade liberalization in the GATT since 1947. Social engineering on this scale will likely not happen soon; but the size of the potential effects involved is sobering.

The lesson from this early quantification is that unlike in the past abstract generalization will not carry the day with policy where environmental considerations enter, because the particular rather than the general is what is at issue. Quantitative work will be at the forefront of policy direction. Tax policy, like other policy areas, will become more complicated because of environmental intrusions, and harder to implement well as environmental considerations affect policy dialogue. But these are developments which probably cannot be resisted, and the earlier that tax designs and practitioners accept the new world the easier will be their task.

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