Externalities and Distributive Taxation

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ABTRACT

The presence of externalities violates Pareto optimality. Various legal instruments can potentially control negative externalities and restore Pareto optimality. The double dividend hypothesis arguably renders the tax instrument superior. It suggests that not only do Pigouvian taxes induce an efficient externality-producing behavior (i.e., the first social dividend), similar to appropriately designed CAC regulations, but they also generate extra revenue to the government. The extra revenue comes at no social costs (i.e., deadweight loss), and hence a second social dividend. A significant economic literature holds that the double dividend comes at a "tax interaction" cost, while recent research doubts both the "tax interaction" argument as well as the double dividend hypothesis. This paper takes a somewhat different approach and argues that (i) no "tax interaction" is possible, (ii) that Pigouvian tax revenue cannot generate a second social dividend, (iii) that the only possible source of a second social dividend is the potential distributive character of Pigouvian taxes, and (iv) that even where a second social dividend arises, it is not unique to Pigouvian taxes, and hence does not render them superior to other externality-control mechanisms, such as quantity regulation.

Introduction

The presence of externalities violates Pareto efficiency. Controlling externalities can therefore restore optimality and potentially improve social welfare. A voluminous literature, of which a large part focuses on environmental externalities and protection, considers the choice of externality controls. Various instruments have been suggested, primarily, command and control (CAC) regulations, tradeable permits, taxes or subsidies, private law rules (such as property or liability rules). A large portion of the literature revolves around stating the conditions for the superiority of one instrument over another. This is also the theme of this study.

Pigou (1920) provided a first-best scheme for controlling externalities by setting marginal taxes (subsidies) equal to marginal external harms (benefits). Distribution considerations aside, Pigouvian taxes fully internalize negative externalities to the externality-producing party and accordingly induce Pareto efficient behavior. Internalization can be alternatively accomplished by appropriately designed and enforced tort rules (e.g., strict liability) or auctioned tradeable permits. CAC regulation – such as cap on activity – appropriately designed, can obviously also induce efficient behavior by an externality-producing party. The literature identifies various advantages of the Pigouvian scheme, in particular, when compared with CAC regulations. This paper focuses on one specific tax superiority claim: the double dividend hypothesis (Tullock 1967; Goulder 1995).

The double dividend hypothesis suggests that not only do Pigouvian taxes induce an efficient externality-producing behavior (i.e., the first social dividend), similar to appropriately designed CAC regulations, but they also generate extra revenue to the government. The extra revenue comes at no social costs (i.e., deadweight loss), and hence a second social dividend. The collected revenue can be used to further increase social welfare whether through lump-sum transfers ("revenue raising effect"), or preferably, reduction in distorting taxation ("revenue recycling effect") (Goulder et al. 1997). This form of the double dividend hypothesis has gained conclusive support in the economic literature (Fullerton et al. (2010, pp.15-19); Sandmo (2000)).

Starting with Bovenbrg and Mooij (1994) and Bovenberg and Poelg (1994), and based on Sandmo (1975), a significant literature examined second best general equilibrium model of externality control, and generally concluded that the double social dividend advantage of Pigouvian taxes should be supplemented with a typically negative "tax interaction" effect between Pigouvian taxes and distortive taxes. Recently, Kaplow (1996, 2006, 2008), Jacobs (2010), and Jacobs and Mooij (2011) argue that Pigouvian taxes exhibit a single dividend only.

This paper revisits the double dividend hypothesis, and hence the superiority of price instruments over quantity regulation on this account. It claims that the second dividend emerges from a lump-sum character of Pigouvian taxes, which can be replicated by other lump-sum schemes if indeed of social value. The paper shows that this this simple observation deduce a few results. First, Pigouvian tax revenue in and of itself cannot generate a second social dividend. Second, there can be no interaction between Pigouvian (lump sum) taxes and other distortive taxes. Third, a second social dividend is possible only to the extent that Pigouvian taxes are distributive. Forth, even where a second social dividend arises, it is not unique to Pigouvian taxes, and hence does not render them superior to other externality-control mechanisms, such as quantity regulation.

The paper is organized as follows. Section I shortly presents the double dividend hypothesis and its development through the pertinent economic literature. Section II adopts a simple general equilibrium model of an externality economy with consumption only. This section sets the framework for the analysis in the paper. Section III analyzes Pigouvian taxes in a first best world (i.e., no distortive taxes). Section IV moves into a second best world, characterized by distortive (distributive) taxes. Section V considers a few additional issues, and section VI concludes.

I. Literature Review

A. The Rise of the Double Dividend Hypothesis

The term "double dividend" seems to be first termed by Pearce (1991) following an insight suggested by Tullock (1967). The double dividend hypothesis suggests that controlling externalities through Pigouvian taxes does not only benefit society by restoring Pareto optimality, but also functions as a non-distortive source of public funds Stiglitz (1999, p. 463). This revenue can be distributed lump-sum to the public in one way or another, and directly increase transferees' utility, and hence social welfare. This effect is nowadays commonly denoted a "revenue raising effect." Alternatively, a "revenue recycling effect" may be realized: given common sources of tax revenue are all distortive – i.e., generate deadweight loss – a Pigouvian tax revenue can be used to reduce such distortive taxes, and hence reduce deadweight loss, with a resulting improvement in social welfare.

In comparison, other externality controlling instruments commonly do not exhibit the second social dividend. Ignoring implementation costs[1] and political variables[2] in this paper,

[1] For discussion of implementation costs see, e.g., Kaplow and Shavell (2002); Weisbach (2009); ____.
[2] See, e.g., Buchanan and Tullock (1975); Oates (1995).

appropriately designed and enforced CAC regulation induces Pareto optimal behavior. Similarly, appropriately designed and (privately) enforced tort regime can do the job as well. Given low enough transaction costs, property allocation rules can also generate the Pareto optimum through Coasian bargaining. The same optimum may be reached by an appropriate amount of externality-producing permits that are provided for free and can be freely traded in the market.[3] Yet, none of these efficiency-inducing instruments raises revenue. Hence the superiority of corrective taxes, according to the "double dividend hypothesis." The hypothesis is well established in the literature and is embraced by most economists (Sandmo 2000; ___).

B. The Double Dividend Hypothesis vs. The Tax Interaction Effect

Sandmo (1975) was probably the first attempt to apply general equilibrium analysis to the externality control issue. Rather than focusing on the optimal control of externalities alone, Sandmo analytically acknowledged the common existence of other (distortive) taxes in the economy. That is, Sandmo examined corrective taxes in a second best, rather than first best, world.

More specifically, other scholars, following in Tullock's steps, did not ignore other non-externality-control taxes (e.g. income taxes); after all, the second dividend of corrective taxes, in its "revenue recycling effect" version, is based on pre-existing distortive taxes in the economy. But, Sandmo's main contribution was in taking these pre-existing taxes in account when optimizing the level of corrective taxes. Sandmo moved from a Tullock's style (first best) partial equilibrium analysis into a (second best) general equilibrium analysis. The important difference in the optimization analytics of these two approaches is the potential cross effect of corrective

[3] If tradeable permits are sold (e.g., auctioned) the result may become identical to Pigouvian taxes. See, e.g., ___.

taxes and other (non-externality-producing) taxed behavior, such as labor. A partial equilibrium analysis implicitly assumes no interaction between corrective taxes and other non-corrective taxes exists. Sandmo's general equilibrium analysis examined the importance of that artificial implicit assumption. His analysis represents a particular application of the second-best theory, and its conclusion is aligned with the general result of the second-best theory. That is, given existing distortions – e.g., second best taxes – completely eliminating any additional distortions – e.g., externalities – is not necessarily socially best.

Sandmo's contribution was followed by only few scholars for two decades.[4] Only since the mid-nineties a surge of second best general equilibrium analyses of corrective and general taxes flooded the economic scholarship.[5] Using various analytical approaches and different assumptions about the economy, economists analyzed the theoretical magnitude and extent of welfare reducing effects generated by corrective taxes; these were termed by Parry (1995), the "tax interaction effect." The general conclusion in most of this literature is that, given assumptions about individual behavior and the economy, not only that the Pigouvian prescription (i.e., taxes that equal marginal external harm) does not generate an additional, second social benefit, it may not even fully provide the first social dividend. That is, first best partial equilibrium Pigouvian taxes are non-optimal and most likely excessive in a second best general equilibrium world, which better fits reality.

The general thrust of the second best general equilibrium models is the social implications of the "tax interaction effect". Assume, for example, tax is levied on labor (e.g., wage tax or income tax system). The tax decreases real wages and hence distorts individual

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[4] See, e.g., ____.

[5] The first notable contributions of the mid-nineties are probably Bovenberg and de Mooij (1994), Bovenberg and Ploeg (1994) and Parry (1995). References to the voluminous literature can be found in reviews such as Bovenberg and Goulder (2002).

labor-leisure choices. Now, add to the system a Pigouvian tax on a “dirty” good (or on its negative externality) that equals the negative external harm it generates. The Pigouvian tax is indeed socially beneficial in two ways: it constrains excessive (non-Pareto optimal) externality-producing behavior, and it generates revenue with no direct distortions in the “dirty” good market. These are Tullock’s double dividend. But, a Pigouvian tax increases the price of the “dirty” good, which is in turned consumed by individuals. Higher prices of (“dirty”) goods, reduce the real wage rate, since individuals can consume with the same nominal wage a smaller quantity of more expensive goods. An increase in real wage exacerbates the pre-existing labor-leisure distortion, which indicates a larger deadweight loss, or equivalently diminished social welfare. In social welfare terms, the “tax interaction effect” is counters the double dividend of corrective taxes. The first direct conclusion of the analysis is that the superiority of Pigouvian taxes is in doubt. The question is of relative magnitudes: does the “tax interaction effect” larger than the “revenue recycling effect”? As indicated, most theoretical studies answered this question in the affirmative. Accordingly, first best Pigouvian taxes are second best excessive taxes; the optimal externality control should then fall short of the Pigouvian prescription – i.e., lower than marginal external harm.[6] The difference between the corrective tax burden and external harm must be contingent on the actual design and level of other non-corrective second best taxes. Thus, although the double dividend hypothesis is correct, the Pigouvian prescription is inadequate – most likely excessive.

C. The Arguable Collapse of the Hypothesis

In a series of studies, Kaplow (1996, 2006, 2008) offered an ingenious framework for public economics analysis, which is simple, general, and robust. Kaplow’s innovative analytical

[6] See surveys by Bovenberg and Goulder (2002), Goulder and Parry (2008)

method applies to (optimal) tax and expenditure policies in general, including the control of externalities. In particular, Kaplow (2006) shows that under commonly acceptable (non-restrictive) assumptions, first-best Pigouvian taxes should be fully adopted in a second best general equilibrium world. That is, regardless of any pre-existing second best optimal income tax scheme, Pigouvian taxes should equal marginal external harm.

---to be completed (Kaplow's analysis)---

Kaplow (1996, 2006, 2008), Jacobs (2010), and Jacobs and Mooij (2011) argue that the MCF of optimal distortive taxes equals one (in particular, it is not larger than one), and hence recycling Pigouvian taxes offers no social benefit. Therefore, their conclusion is that the double dividend hypothesis is wrong.

II. The Lump-Sum Character of Pigouvian Taxes

The source of the second dividend of Pigouvian taxes is their non-distortive character. Only since such source of revenue is non-distortive, can it be used beneficially to recycle other distortive taxes or to be distributed back lump-sum. This non-distorting feature is equivalent to a lump-sum tax: a tax that causes no distortion – i.e., no deadweight loss. Indeed, a lump-sum tax is socially attractive because of its non-distortive character. Lump-sum taxes reduce social welfare only to the extent of their income effect, which is necessary under any tax system. The second social dividend of Pigouvain taxes, then, translates into a social benefit of collecting lump-sum taxes through taxation of externalities. But to a shrinking budget, the only change in individual behavior due to corrective taxes is socially beneficial (i.e., the first dividend): restoring Pareto efficiency.

Put differently, the double dividends of Pigouvian taxes can be easily replicated by a Pareto-equivalent (CAC) regulation supplemented by a lump-sum tax on (externality-producing) regulated entities. This can be easily, and more accurately, demonstrated using a simple general equilibrium model with externalities.[7] Following is a simple general equilibrium model (similar to Meyer (1971)) of pure exchange economy with consumption externalities. Assume a finite number of individuals, $i = 1, \dots, I$, and goods, $X_g, g = 1, \dots, G$, where the amount of the gth good consumed by the ith individual is denoted x_g^i, and the endowment of each individuals is denoted $x^i = \left(x_1^i, \dots, x_G^i\right)$, for all $g = 1, \dots, G$. Externalities are introduced through Arrowian artificial goods x_{jg}^i which denotes the consumption of good g by individual j, as view by individual i. Aggregate quantity of good g is defined by $X_g = \sum_{i=1}^{I} x_{ig}^i$. The production possibility constraints is given by $F(X_1, \dots, X_G) \leq 0$. Assume individual preferences are representable by a quasi-concave utility function U^i of the form $U^i = U^i(x_{11}^i, x_{21}^i, \dots, x_{I1}^i, x_{12}^i, \dots, x_{IG}^i)$.

The Pareto optimum for the economy assumed above is given by the solution to the maximization problem (Negishi 1960):

$$\max_{\{x_{11}^1, \dots, x_{IG}^i, X_1, \dots, X_G\}} \sum_{i=1}^{I} a^i U^i\left(x_{11}^i, x_{21}^i, \dots, x_{I1}^i, x_{12}^i, \dots, x_{IG}^i\right) \tag{1}$$

subject to

$$x_{ig}^i = x_{ig}^j \qquad g = 1, \dots, G \;;\; i, j = 1, \dots, I \;,\; i \neq j \tag{2}$$

$$\sum_{i=1}^{I} x_{ig}^i \leq X_g \qquad g = 1, \dots, G \tag{3}$$

[7] The following analysis will abstract from complexity (i.e., implementation costs) and political economy. Further, in order to focus on distribution through taxes only, public goods are ignored. See section V for an additional discussion.

$$F(X_1, \dots, X_G) \leq 0 \tag{4}$$

$$X_g \geq 0 \;\; ; \;\; x_g^i \geq 0 \;\; ; \;\; x_{jg}^i \geq 0 \tag{5}$$

Denote the following Lagrange multipliers: $\mu_{jg}^i \, , g = 1, \dots, G \, , i, j = 1, \dots, I$ are the multipliers on the first $I(I-1)G$ constraints; $\delta_g \, , g = 1, \dots, G$ are the multipliers on the next G constraints; and λ is the multiplier on the production possibility constraint.

The first order condition for a good $x_{jg}^i \, , i \neq j$ is

$$a^j \frac{\partial U^j}{\partial x_{ig}^j} + \mu_{ig}^j = 0 \tag{6}$$

and the first order condition for a good x_{ig}^i is

$$a^i \frac{\partial U^i}{\partial x_{ig}^i} - \delta_g - \sum_{i=1, i \neq j}^{I} \mu_{ig}^j = 0 \tag{7}$$

Dividing two of the first order conditions (7) for consumer i for goods g and $\bar{g}$, and using (6), provides a familiar condition for Pareto optimality under externalities:[8]

$$\frac{\frac{\partial U^i}{\partial x_{ig}^i}}{\frac{\partial U^i}{\partial x_{i\bar{g}}^i}} = \frac{\delta_g - \sum_{j=1, j \neq i}^{I} a^j \frac{\partial U^j}{\partial x_{ig}^j}}{\delta_{\bar{g}} - \sum_{j=1, j \neq i}^{I} a^j \frac{\partial U^j}{\partial x_{i\bar{g}}^j}} \tag{8}$$

This condition is clearer when compared to a no-externality economy. The above problem reduces to a basic no-externality Pareto optimum if $\forall i \neq j \, , g \, , x_{jg}^i = 0$. Then the first order conditions (6) vanish and so does the third factor in (7). Then, condition (8) becomes of the

[8] I ignore here the remaining first order conditions associated with the production possibility constraints, which derive marginal rates of transformation.

known form $\frac{\frac{\partial U^i}{\partial x_{ig}^i}}{\frac{\partial U^i}{\partial x_{i\bar{g}}^i}} = \frac{\delta_g}{\delta_{\bar{g}}}$, where the RHS can be replaced by decentralized equilibrium prices of goods (Varian 1992, pp.__). Thus, condition (8) of the externality economy requires an adjustment to market prices of goods that is proportional to the (aggregate) externality effect of consumption of goods by each individual.[9]

Starrett (1972) shows that given convexity of consumer indifference curves (which is implicitly assumed throughout this paper), such Pareto efficiency restoring adjustments to prices can be accomplished either through (competitive) markets for externality rights or through Pigouvian taxes of a per unit tax rate, $\sum_{j=1,j\neq i}^{I} a^j \frac{\partial U^j}{\partial x_{ig}^j}$.[10] Pareto optimality notwithstanding, the two mechanisms are not equivalent due to differences in income/goods distribution. Whereas under externality rights, payments are transferred across externality-producing and externality-affected consumers through a price mechanism, under a Pigouvian tax scheme, externality-producing consumers transfer tax payment to the government, which then uses them in one way or another. Therefore, the Pareto optimum is not identical.

I would like to expand this observation further. First best Pareto efficiency can be restored for an externality economy by following the prescription in (8). A CAC mechanism may dictate the allowed amount of consumption of each good and for each individual in a manner that abides by condition (8). Denote the first best regulatory solution $\bar{x}^i = (\bar{x}_1^i, \dots, \bar{x}_G^i)$. The regulatory solution is necessarily different than the first best optimum induced by Pigouvian taxes, which transfer income/goods across consumers. Assume a personal Pigouvian tax (in the

[9] I assume throughout an inner solution; that is, all goods are consumed, $\forall g, X_g > 0$.

[10] Note that the possibility of negative Pigouvian taxes is not excluded.

form of goods) of t^i is collected from each individual. Assuming no public goods and no social preference for redistribution, it is not Pareto efficient for the government not to allocate the revenue lump-sum to consumers. So assume $\sum_{i=1}^{I} t^i$ is allocated lump-sum to consumers in any arbitrary manner, denoted $T^i(\sum t^i)$, such as divided equally across all consumers, $T^i = \frac{1}{I}\sum t^i$.[11] The collection of t^i induces efficiency, whereas the lump-sum transfer of $\sum_{i=1}^{I} t^i$ does not disturb it. Yet, both collection and transfer change individual endowments, x^i, and hence the resulting Pareto optimum will be different than under regulation. Denote the first best optimum under Pigouvain taxes $\tilde{x}^i = (\tilde{x}_1^i, \dots, \tilde{x}_G^i)$.

Notice that given initial individual endowments, $x^i = \left(x_1^i, \dots, x_G^i\right)$, the first best regulatory solution is unique and dictated by (8). Yet, there are multiple Pigouvian tax optima, contingent (at least) on the choice of lump-sum allocation of tax revenue, $T^i(\sum t^i)$. Further, notice that t^i is a lump-sum tax. Indeed, t^i is obviously used to induce efficient (consumption) behavior, but once such efficient behavior, $\tilde{x}^i$, is chosen by individuals, the Pigouvian tax becomes equivalent to a lump-sum tax. That is, any Pigouvian tax optimum can be replicated by a regulatory scheme supplemented by lump-sum individualized taxes, t^i, and a lump-sum transfer scheme; the regulatory scheme can be denoted $\langle \tilde{x}^i, \ t^i, T^i(\sum t^i)\rangle$. Put differently, setting aside the important difference between decentralized and centralized mechanisms (i.e., complexity), the difference between regulating and taxing externalities is lump-sum taxes and transfers. That is, the above regulatory solution, $\bar{x}^i = \left(\bar{x}_1^i, \dots, \bar{x}_G^i\right)$, is a member ($\langle \bar{x}^i, 0, 0\rangle$) of the set of Pareto efficient solutions to the externality problem, $\langle \tilde{x}^i, \ t^i, T^i\rangle$.

[11] Obviously, no portion of t^i can be transferred to individual i. That is, Pigouvian taxes should be transferred to non-externality-producing individuals. For a sufficiently large group of individuals, I, this consideration may be ignored.

Two important corollaries are worth emphasizing. One is that the set $\langle \tilde{x}^i, t^i, T^i \rangle$ obviously includes negative t^i, T^i.[12] Intuitively, it means that any redistribution of endowments can be supported by an appropriate regulation of consumption, so that the final allocation will be efficient.[13] Alternatively, it restates Starrett's (1972) observation of the arbitrariness of any benchmark for externality control. In Coasian terms, it means that externality rights may well be endowed with externality-producing entities.

A second important corollary is that accomplishing Pareto efficiency through Pigouvian taxes requires, and hence allows for, a limited *set* of *lump-sum* redistribution of individual endowments. Although redistribution through Pigouvian taxes is trivial, the emphasis here is on the lump-sum character of personal taxes, t^i, and there non-uniqueness. This observation becomes important once distribution of utilities becomes socially relevant, an issue to which we turn next.

III. Redistribution in A First Best World

The seemingly notational exercise at the end of the preceding section arguably provides an important understanding of the social benefit of externality control mechanisms.[14] In particular, whereas the choice of $\tilde{x}^i$ dictates the Pareto optimum, and hence offers a "first" social dividend, the related lump-sum tax and transfer choices $\langle t^i, T^i \rangle$ may offer a second social dividend. That is, the double dividend hypothesis can be now restated as hypothesizing that there is a subset of $\langle \tilde{x}^i, t^i, T^i \rangle$ with t^i, T^i that offers a social benefit. This section will examine such potential social

[12] For ease of exposition, t^i and T^i will be designated positive in the analysis.
[13] Note that the sign of t^i and T^i has nothing necessary to do with the kind of externalities – i.e., positive or negative.
[14] Other control mechanisms can be included in this set. See Section V.

benefit in a world with (i) no distortive taxes and transfers, and (ii) social preferences for redistribution – i.e., equity-informed social welfare function.

To the extent that distribution of utility is of no concern, a social policy $\langle \tilde{x}^i,\ t^i, T^i \rangle$ with non-zero t^i, T^i – i.e., with lump-sum taxes and transfers – can obviously offer no social benefit beyond efficiency. Yet, societies acknowledge a social preference for distributive justice, and hence, given social heterogeneity, a social preference for redistribution. Indeed, such distributive preferences are explicitly recognized under the welfaristic approach. A seemingly perfect social choice would take a lump-sum form: redistributive (or equity-informed) lump-sum taxes and transfers; that is, a non-distortive tax-transfer scheme that is responsive to individual heterogeneous characteristics – in particular, distributive-relevant characteristics (e.g., ability). The implicit power of the second theorem of welfare economics is based on the feasibility of such lump-sum taxes that are sensitive to social heterogeneity (Boadway and Bruce 1984). Philosophers and legal scholars use generic terms to describe these optional redistributive lump-sum tax schemes (or at least a certain version of them): "endowment tax," or "ability tax." For example, an expected utility (or well-being) tax is arguably a distributive lump-sum tax; an endowment tax (Chovart 2006). Better familiar are discussions of an ability tax base. If individuals' innate and unchangeable ability or faculty (however defined) is an acceptable distributive-relevant measure of social heterogeneity, then using it as a tax base is first best Pareto efficient; it is not contingent on individual choices, and hence does not affect them. Ignoring complexity issues, an ability tax will necessarily maximize social welfare, as social preferences for redistribution are accomplished with no efficiency costs.

Accordingly, the first inquiry is whether the components $t^i, T^i$of an externality control policy $\langle \tilde{x}^i,\ t^i, T^i \rangle$ comprise equity-informed features. The answer is generally negative.

Transfers of Pigouvian tax revenue (or taxes to finance Pigouvian subsidies), T^i, can be designed in any lump-sum fashion; yet making transfer (or taxes) contingent on immutable equity-informed characteristic – such as ability – is considered practically infeasible. Indeed, such infeasibility is the basis of the modern optimal taxation research (Mirrlees (1971)).

Yet, feasibility of equity-informed lump-sum transfers, T^i, is not a necessary condition for the social benefit of lump-sum Pigouvain schemes. Once equity-informed transfers are feasible, they can be exercised using any available source of revenue – whether corrective or not, whether lump-sum or not.[15] Thus, the potential social advantage of Pigouvian schemes in a first best world must be located in the character of Pigouvian taxes, t^i. A corollary of this conclusion is that the "revenue raising effect" (_____), which is arguably relevant to a first best world only, is nil.

Therefore, in a first best world with social preferences for redistribution, the only potential source of a second social dividend through an externality-control scheme, $\langle \tilde{x}^i, t^i, T^i \rangle$, is t^i. A necessary condition for redistribution via t^i is it being equity-informed. In the next section we will look further into this possibility.

IV. Redistribution in A Second Best World

Nowadays, perfectly distributive lump-sum taxes and transfers are infeasible, as distributive-relevant immutable characteristics – such as ability – are unobservable (i.e., prohibitively costly

[15] If equity-informed transfers are feasible, it is most likely that equity-informed taxes are also feasible, and then the whole discussion of the second social dividend of Pigouvian taxes becomes mute.

to implement).[16] Indeed, Mirrlees (1971) seminal project, and the immense (optimal taxation) literature that followed, was based on, and triggered by, the practical premise of such unobservability. The traditional goal of public economists has been to design a second best optimal ability tax, were ability is the heterogeneous distributive-relevant variable, yet unobservable. Therefore, a (re)distributive tax base can be designed only on the basis of observable mutable proxies of ability – commonly, consumption or income – which allow for behavioral reactions, and hence a second best tax scheme. This is the essence of the theory of optimal taxation. This section, then, assumes second best world in which distortive tax systems are in use for distributive purposes.

The ("traditional") double dividend hypothesis (Tullock 1967) – taking the verbal form of the "revenue recycling effect" (Goulder 1995; Parry 1995) – is based on the existence of second best tax systems. As reviewed in section I, the chief basis of the double dividend literature is the potential recycling of Pigouvian taxes where distortive taxes can be reduced, and hence inefficiency (i.e., deadweight loss) decreased. The main argument in this section is that the "revenue recycling effect" argument is wrong. That is, Pigouvian tax revenue provides no social dividend through recycling of distortive taxes, and hence cannot support a double dividend hypothesis.

As explained above, the revenue effect of Pigouvian taxes is of a lump-sum character. If the revenue collected through Pigouvian taxes, $\sum t^i$, is positive, it can be used to recycle distortive taxes, and accordingly decrease the deadweight loss. But any lump-sum tax can do this trick. The revenue collected through a head tax, DNA tax, or eye-color tax can be used to recycle

[16] For example, it has long been suggested that a DNA-based tax is a potential candidate for an ability tax scheme. (For a recent discussion of this issue, see Logue and Slemrod (2008).) If future scientific advancements will facilitate sufficiently accurate predictions of distributive-relevant human characteristics (say, innate ability or lifetime enjoyment of earned income) based on DNA, then first best optimal tax scheme will be achievable.

distortive taxes and accordingly generate social benefit. Lump-sum Pigouvian tax revenue is not unique, and hence cannot be considered, on this basis, superior to other externality-control instruments. For example, controlling externalities through Pigouvain taxes generate identical "revenue recycling effect" as a regulatory externality-control scheme supplemented by an equal-revenue head tax.

The argument is actually stronger. It is not only that Pigouvian taxes do not generate a *unique* socially beneficial recycling effect, but it should be clear that recycling distortive taxes through distributive-arbitrary lump-sum taxes can never increase social welfare. That is, if the lump-sum character of Pigouvian tax revenue allows for a social benefit through recycling, why not recycle distortive taxes further using other lump-sum taxes? Second best taxes could be entirely abolished by adopting a head. The "revenue recycling effect" is erroneous. It should be clear that the only welfaristic justification for lump-sum taxation is redistribution. Non-distributive lump-sum taxes are redundant.

Put somewhat differently, the whole point of second best taxes is redistribution. A necessary condition for their recycling, then, is that the substituting tax system is distributive as well, at least to some minimal extent. Recycling distortive taxes is socially beneficial if replaced by a sufficiently distributive and less distortive (such as lump-sum) mechanism.

Therefore, similarly to the analysis of a first best world, Pigouvian taxes – or any policy scheme, $\langle \tilde{x}^i,\ t^i, T^i \rangle$, with $t^i, T^i \neq 0$ – offer a second social dividend only to the extent that the lump-sum taxes they implicitly maintain are equity-informed. Actually, once we have recognized that any first best taxes and transfers beyond regulatory control of externalities are of a lump-sum character, this conclusion should have been obvious. Since Pigouvian taxes are lump-sum, the analysis is identical, whether distorting taxes exist (second best) or not (first best); in both scenarios, only distributive features of such lump-sum taxes can offer a social dividend.

So, the question is whether Pigouvian taxes are indeed equity-informed? Pigouvian taxes are generally unrelated to ability or endowment (or even commonly acceptable second best proxies, such as income or consumption). Although ultimately an empirical question, it is difficult to see how externality-producing (and externality-affected) entities possess a distinguishable ability (or income).[17] If Pigouvian taxes are not equity-informed, then they can offer no second social dividend. They function as arbitrary lump-sum redistribution.

If Pigouvian taxes are indeed correlated with distributive-relevant characteristics, then they may facilitate, to a certain extent, a second social dividend. It means that externality-related characteristics (i.e., production or absorption of externalities) function as "tags" (Zeckhauser 1971; Akerlof 1978), such as age (Blomquist and Micheletto 2008; Weinzierl 2011) or height (Musgrave 1959, p.__; Mankiw and Weinzierl 2010). This empirical possibility raises a few problems for Pigouvian taxes.

First, if Pigouvian taxes function as tags, it is socially beneficial to determine the benchmark for externality control – i.e., a policy scheme $\langle \tilde{x}^i,\ t^i, T^i \rangle$ – appropriately: positive high (negative low) t^i for positive (negative) correlations. It should be clear at this point that although such social policy can be considered Pigouvian taxes, it is no different than any other non-tax externality-control mechanism that fits $\langle \tilde{x}^i,\ t^i, T^i \rangle$ (complexity issues aside). In particular, such policy will most likely be different than the common Pigouvian prescription of a

[17] But see, e.g., Fullerton (2009).

zero externality benchmark. Put differently, given distributive-relevant characteristics of Pigouvian taxes, t^i, a wrong choice of externality benchmark – such as the commonly adopted zero externality benchmark – may prove socially detrimental.

Second, since distributive-related immutable individual characteristics are unobservable, the social benefit of "tags" can be, and practically is, evaluated against mutable proxies of such characteristics – commonly, income. Therefore, "tags" must be incentive compatible. In cases where "tags" are immutable – such as height, age, DNA, and maybe gender – they are obviously incentive compatible by structure. But mutable tags, such as effort level (Akerlof 1978), are of a second best nature and of non-trivial design and implementation. "Pigouvian tags" are of the second best kind since the extent of externality-production is mutable – e.g., a polluter of any income level can choose how much to pollute.

Two conclusions can be deduced: One, the mere correlation between externality and income levels as in Kaplow (2006; 2008, pp.__) is obviously insufficient. It is not necessarily incentive compatible. The second, and more interesting conclusion, is that to the extent that lump-sum Pigouvian taxes are distributive, they are of a second best nature. That is, they are not necessarily superior to "common" second best tax systems, such as income or consumption tax. Notice, that there is no contradiction here. Although Pigouvian taxes are of lump-sum character, they become distortive once utilized to redistribute along a mutable feature such as income. The reason is that redistributing income through Pigouvian taxes necessarily requires a complementary change in income taxes, which in turn affects incentives of externality-producing individuals. Imagine, for example, a high income earner who is also a high level polluter. If due to his redistributive payment of Pigouvian taxes, his income taxes are lower, he might well pollute more.

V. Tax Interaction, MCF, Externality-Control Mechanisms, and Public Goods

Section I reviewed the second best general equilibrium literature which supposedly discovered a "tax interaction" effect between Pigouvian taxes and distortive taxes, which detrimentally affect social welfare. Kaplow (2006, 2008) explains that this effect actually describes a distortion to additional distributive effects. The conclusion here is somewhat similar to Kaplow. First, as Pigouvian taxes are of a lump-sum character, no interaction with distortive taxes is possible (but to income effects). It seems that the reported "tax interaction" is not with Pigouvian taxes, but with the changed behavior due to control of externalities. Second, a certain "interaction" between Pigouvian and distortive taxes may arise due to a social attempt to use distributive Pigouvian taxes as mutable tags.

Kaplow (1996, 2006, 2008) and Jacobs (2010) and Jacobs and Mooij (2011) argue that the double dividend hypothesis is wrong since the marginal costs of funds of optimal distortive taxes equals one. This paper argues differently: whether the MCF equals one or not, the double dividend is contingent on the distributive character of lump-sum Pigouvian taxes.

The externality control mechanism, denoted $\langle \tilde{x}^i, t^i, T^i \rangle$ was described in regulatory and tax terms. This mechanism is obviously more general. It includes Coasian-Arrowian markets for externality rights, where t^i and T^i stand for market prices. It also encompasses tort rules. The analysis in this paper should be applicable to these alternative interpretations of $\langle \tilde{x}^i, t^i, T^i \rangle$.

Public goods where ignored so far. Public goods require public resources that can be acquired through taxes. The Pigouvian tax revenue, like any other kind of revenue, can be used for such purpose. The use of Pigouvina tax revenue for public goods (or any other kind of public expenditure) is subject to the same analysis and conclusions. That is, financing public expenditures through Pigouvian taxes substitute other sources of revenue which are probably distortive.

V. Concluding Remarks

---to be completed---

Conclusions:

(i) The "revenue raising effect" as well as the "revenue recycling effect" are erroneous, and hence cannot support the double dividend hypothesis.

(ii) The only potential source for double social dividend is a distributive character of Pigouvian taxes, which then function as a mutable tag.

(iii) If empirical evidence supports the conclusion that certain Pigouvian taxes generate double social dividend, then:

a. The benchmark for defining externality should be contingent the distributive character of Pigouvian taxes.

b. It still does not render them superior to other externality-control mechanisms. In particular, regulation supplemented by lump-sum taxes is equivalent.

(iv) There is no "tax interaction".

(v) The MCF is irrelevant.

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