# Policy Analysis in a Second-Best World

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**Abstract**

This paper first describes the new literature in environmental economics on the so-called "double dividend" and then explores its implications for a broad range of economic issues. The basic finding in this literature is that in a second-best, general equilibrium setting, environmental measures raise costs and prices and thereby reduce the real wage. This rise in the cost of living reduces slightly the quantity of labor supplied in an already highly distorted labor market, giving rise to losses in social welfare that can be large relative to the basic welfare gains from improved environmental policy. These losses may be offset to some extent by using revenues (if any) from the environmental programs to reduce existing taxes on labor.

This same line of analysis applies to many programs and institutions in the economy that raise the cost of living: tariffs and quotas on imports, agricultural price-support programs, monopoly pricing, programs of occupational licensure that limit entry, and many others. The paper thus suggests that traditional, partial equilibrium benefit-cost analysis has, in many instances, unwittingly omitted a potentially quite significant class of social costs from the calculations.

Key Words: regulatory policies, welfare effects, pre-existing taxes, general equilibrium

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# POLICY ANALYSIS IN A SECOND-BEST WORLD

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There has appeared in the last few years a challenging new literature on the design of policy instruments in a second-best setting. Second-best considerations are obviously not a new issue in economics, but this recent round of research has produced some striking and, in certain respects, very troubling findings. Its primary source has been a body of work in environmental economics that has been re-examining the traditional case for Pigouvian taxes and various quantity instruments (like systems of tradable emission permits) for mitigating the distortions caused by environmental externalities.[1] The analysis focuses on pre-existing tax distortions in the economic system--particularly those in the labor market--and finds that the traditional measures can increase the costs stemming from these distortions. And this increase in costs can be large relative to the welfare gains from the environmental improvement. Indeed, it has been shown that for plausible values of the key parameters, a "perfectly" designed system of tradable emission rights--one that precisely internalizes the environmental externality in Pigouvian fashion--may actually result in an overall loss in social welfare (Parry et al., 1998)! How can this be?

Our purpose in this paper is to try to explain to the profession at large just what is going on here--and to explore its broader implications. Upon further reflection, it appears that the literature in environmental economics is really just the tip of the iceberg. As we shall see, the basic problem here is one that infects any policy measure or institutional structure with an impact on the price of consumer goods, including such things as tariffs and quotas in international trade, agricultural price-support and quota programs, airline safety regulations, occupational licensure measures, minimum-wage laws, monopoly pricing, and a host of other major features of the economic landscape. This body of findings presents us with some fundamental challenges to the design of a broad range of policy measures. In particular, it suggests that the scope of benefit-cost analysis should be expanded in some very basic ways. We suspect that we are just beginning to understand the full range of these implications: it is something that the profession needs to think hard about.

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[1] See, for example, Bovenberg and de Mooij (1994), Bovenberg and van der Ploeg (1994), Bovenberg and Goulder (1996 and 1997), Parry (1995, 1997), Goulder et al. (1997, 1998), Parry et al. (1998), and Fullerton and Metcalf (1997). For surveys of this literature, see Bovenberg and Goulder (1998) and Oates (1995).

To introduce the issue, it is useful to review briefly the way in which it has surfaced in the literature in environmental economics. We then turn to a closer treatment of the central matter and its broader implications for policy design.

## 1. THE DOUBLE-DIVIDEND DEBATE

The traditional treatment of externalities leads directly to the prescription for a Pigouvian tax (or, alternatively, for a system of tradable permits) to correct the allocative distortion. The familiar unit tax equal to marginal social damages serves to internalize the externality and redeploy economic activity in an efficient manner. In this literature, the issue of the revenues that such a tax generates was largely ignored. It was typically assumed that such revenues would be returned in some lump-sum fashion to the economic actors (e.g., Baumol and Oates, 1988, chap. 4).

But it then occurred to several observers that we should be able to do better than this (e.g., Pearce, 1991; Repetto et al., 1992; and Oates, 1993). Since the existing tax system is itself the source of some serious distortions in the economy, why not use the revenues from the environmental taxes (or auctioned permits) to reduce the rates on other distorting taxes (particularly taxes on labor and capital)? It seemed that this offered a way to kill two birds with one stone: we could, at the same time, protect the environment and reduce the economic costs of the tax system. Some referred to this as a potential "double dividend" from green taxes.

But more careful analysis has revealed that this treatment was too simplistic. Once we acknowledge the pre-existing distortions associated with the tax system, we must take fully into account the basic linkages between the new environmental measures and existing taxes. The insight provided in the new literature is that this interaction of environmental policies with the existing system of taxes is typically the source of additional excess burden, largely from the market for labor. The labor market is a significantly distorted market in the sense that there typically exists a large wedge between the gross wage paid by firms and the net wage received by workers. This implies that the value of the extra output produced by the last unit of labor is substantially higher than its social cost (i.e., the value of time foregone in non-market activities such as child rearing, leisure pursuits, etc.). A new environmental tax results in an increase in the costs of production. To the extent that this is passed on in higher prices of goods that consumers purchase, it will reduce the real wage received by households. In consequence, the return to work effort as compared with non-market activities falls, and there is typically a slight reduction in labor supply. To the extent that higher production costs reduce the net income received by producers, they will tend to reduce output and their demand for labor. We thus find that the environmental tax, by inducing a fall in the overall level of employment, generates a welfare loss in the labor market.

But surely a green tax on a polluting activity, operating only indirectly through a minor--indeed a tiny--impact on the real wage, cannot have a sufficiently large effect on labor-market decisions to offset much of the basic and direct welfare gains from internalizing the environmental externality. Wrong! Although the effect on labor supply may be a quite

small one, it does not take much of a response in such an enormously important market--and one that is significantly distorted at the margin--to generate significant welfare effects. Existing estimates suggest that the combined impact of income, payroll, and sales taxes effectively reduces the net wage at the margin to some 40 percent or so below the gross wage (Browning, 1987). Moreover, labor income accounts for some three-quarters of national income. So even a tiny movement from A to B along the horizontal axis in Figure 1 in the labor market generates a welfare-loss rectangle whose area can be quite sizeable. Making use of both simple analytical models and larger, more complex computable general-equilibrium (CGE) models, the new second-best literature makes it clear that this effect operating through labor market decisions cannot be dismissed as "second order" in magnitude.

## 2. A CLOSER LOOK

The approach used in the analytical models in this literature is fairly straightforward [see, for example, Bovenberg and de Mooij (1994) or Parry (1995)]. Households have utility functions that contain as arguments consumption goods, leisure, and environmental quality, and they supply labor. Firms produce goods and, in the process, generate pollution that reduces environmental quality. In the simple models, the government employs two taxes: a tax on labor and a tax on pollution. The models are then used to study cases of "revenue-neutral" environmental taxes, where the revenues raised from unit taxes on pollution are used to reduce the tax on labor.

It is instructive to characterize the findings from this kind of analysis in terms of three distinct effects on economic welfare: the "primary welfare gain," a "revenue-recycling effect," and a "tax-interaction effect." The first is simply the familiar welfare gain whose source is the benefits net of the (partial-equilibrium) costs from the environmental improvement. In terms of Figure 2, this gain is just the well-known triangle (OAB) that results from internalizing the external effect (or social cost) from waste emissions, in this case with a unit tax on emissions of Ot. In a first-best analysis, with environmental tax revenues returned in lump-sum fashion, this is all there is to the matter.

In the presence of pre-existing tax distortions, however, there is more to worry about. Now the revenues that are raised by the environmental tax (EBCF in Figure 2) can be used to reduce the rates on existing distorting taxes. In the simple analytical models, this means that they replace revenues from the tax on labor. Hence, there is a second source of welfare gain: the revenue-recycling effect. This gain comes from the small reduction in the wedge between the gross and net wage with a resulting increase in the level of employment.

But, as mentioned earlier, there is a third effect that involves the way in which the environmental tax interacts with the existing tax on labor. In the analytical models (which typically assume the demand for labor to be perfectly elastic) the environmental tax discourages work effort by reducing the real household wage. This is the tax-interaction effect--and it reduces welfare.

Figure 1

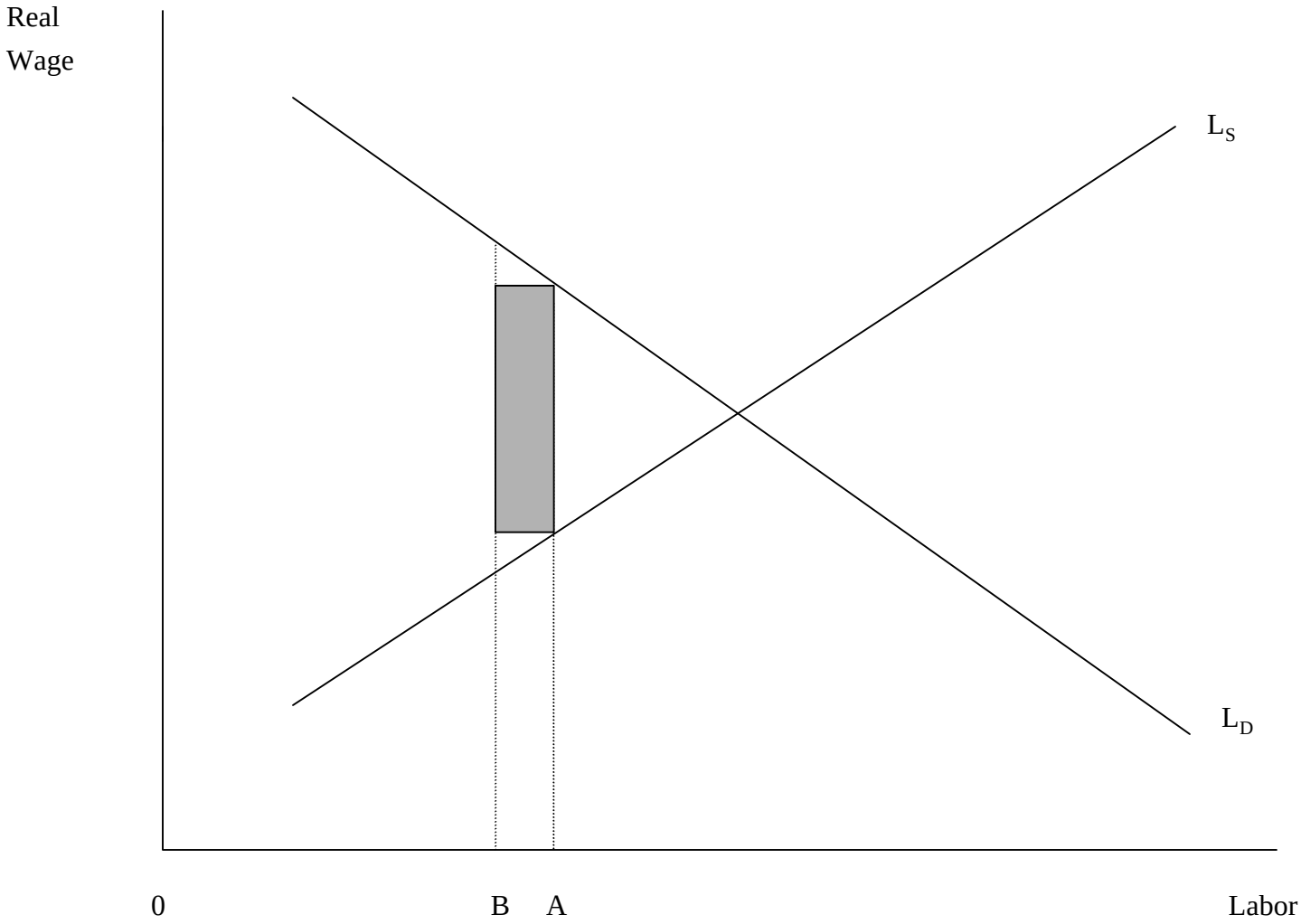
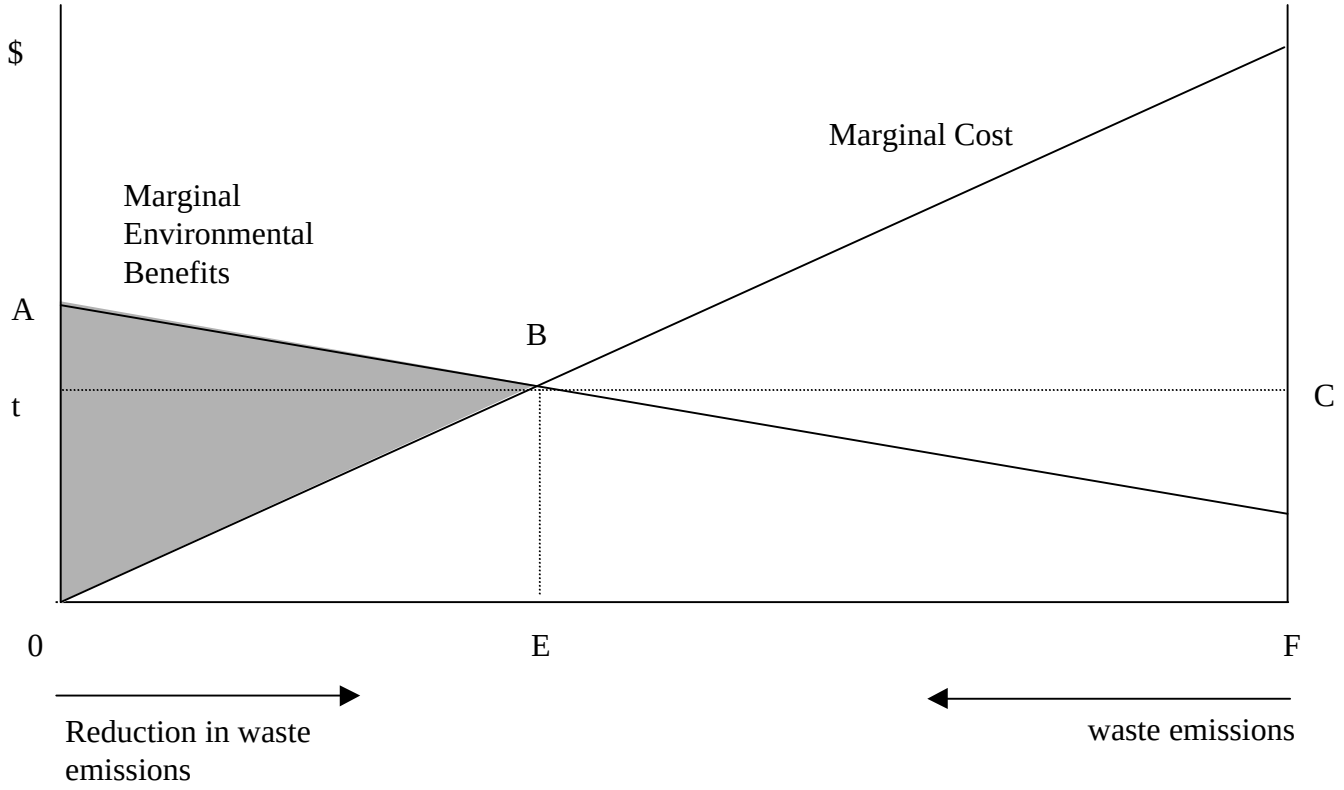


Figure 2


$
Marginal Cost
Marginal
Environmental
Benefits
A
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C
0
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F
Reduction in waste
emissions
waste emissions

The effect of the environmental tax on economic welfare thus depends on the net impact of these three effects. The findings from the analytical models (and many of the CGE exercises as well) indicate that, in general, the cost of the tax-interaction effect dominates the benefits from the revenue-recycling effect. That is, the welfare loss from the reduction in work effort from a reduced real wage is larger than the welfare gain from a reduced tax rate on labor. The implication is that the overall welfare (or efficiency) gain from taxing waste emissions is something less than the primary welfare gain associated with a first-best analysis.[2] Of course, environmental taxes can produce important benefits in terms of improved environmental quality and incentives for the development of cleaner production methods. However, these benefits generally do not include a reduction in the overall economic costs of the tax system--the double-dividend hypothesis is typically invalid.

This result should not be so surprising from the perspective of the earlier literature in public finance on optimal (or Ramsey) taxation.[3] This literature has established the principle that broad-based taxes are to be generally preferred on efficiency grounds to more narrow ones. Excess burden results from individuals and firms shifting away from taxed activities. There is typically much greater scope for such substitution when the tax base is a narrow one (for example, a polluting input in a specific industry) than when it encompasses a broad range of activity (such as a tax on all labor income or a general consumption tax). When we replace revenues from labor taxes with revenues from more narrowly focused taxes, we open up a wider range of substitution possibilities for consumers and firms, and this typically raises the excess burden of the tax system.

The recent literature suggests that in a second-best setting, the optimal tax on waste emissions is somewhat less than the marginal social damages to the environment. Just how much less depends on the level of environmental damages, the way in which the revenues are recycled, and various parameters (notably the elasticity of labor supply). In Table 1, we report some findings from a study by Lans Bovenberg and Lawrence Goulder (two of the major contributors to this literature). Using both an analytical model and a numerical CGE model, they have estimated the Pigouvian tax and optimal second-best taxes on carbon emissions for a variety of cases. We see in column 2 that the Pigouvian tax is (reassuringly) simply equal to the marginal environmental (social) damages in column 1. In column 3, we find that the optimal tax (as calculated from the analytical model) is somewhat less--on the order of 80 to 90 percent--of the Pigouvian levy, assuming that the revenues are recycled in the form of a reduction in the personal income tax (PIT). The results from the numerical model suggest a somewhat larger divergence of the optimal, from the Pigouvian, tax; here the extent of the difference depends on whether the recycling takes an "optimized" or more

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[2] There are some important qualifications to this result. For example, it can be reversed if output from the polluting industry is a sufficiently weaker substitute for leisure than other goods. In addition, the models in this literature typically assume that environmental effects are separable in the utility function from leisure. In consequence, they effectively abstract from any feedback effects from improved environmental quality on labor/leisure decisions (e.g., health effects).

[3] See Sandmo (1976) for a survey.

realistic form of replacement of personal income taxes. In the latter case, we see in column 5 that the optimal tax may fall far below the Pigouvian rate--in one case by over 50 percent. But most striking is column 4, where the revenues are recycled in the form of the lump-sum rebate that appears in the academic literature. For this case, the optimal tax is zero for marginal environmental damages of $50 per ton or less. A positive tax for this range of cases would actually reduce welfare; this occurs because there is effectively no revenue-recycling effect (i.e., reduction in the tax on labor) to offset any of the tax-interaction effect.

**Table 1. Differences between Pigouvian and Second-Best Taxes**
(All rates in dollars per ton)

| Assumed Marginal Environmental Damages ($/ton) | "Optimal" Pigouvian Tax | Optimal Tax Implied by Analytical Model (PIT Replacement) | Optimal Tax from Numerical Model | | |
|---|---|---|---|---|---|
| | | | Realistic Benchmark, Lump-Sum Replacement | Realistic Benchmark, PIT Replacement | Optimized Benchmark, PIT Replacement |
| 25 | 25 | 22 | 0 | 7 | 17 |
| 50 | 50 | 45 | 0 | 27 | 41 |
| 75 | 75 | 67 | 13 | 48 | 64 |
| 100 | 100 | 89 | 31 | 68 | 85 |

Source: Bovenberg and Goulder (1996).

This last result is of much more than purely academic interest. For it immediately calls to mind the use of quantity instruments where the emissions permits are simply given away to sources. Under the Clean Air Act Amendments of 1990, for example, we are cutting aggregate national sulfur emissions in the U.S. by 50 percent under a program where we simply distributed the initial emissions allowances free of charge to sources. A similar emissions permit program is being proposed as a means to meeting the U.S. pledge to limit future carbon emissions. The problem with these programs is that there is no revenue-recycling effect.[4] As recently shown by Parry et al. (1998) and Parry (1997), even for "ideal" systems that set the quantity of permits by a Pigouvian rule, it is possible that for reasonable values of the key parameters, the tax-interaction effect will be larger than the primary welfare gain from the program. Thus, the loss in welfare from reduced work effort can more than

[4] This is not quite accurate. Emissions permits create rents for firms. These are reflected in higher profits (subject to corporate income taxation) and in additional taxes when distributed to households in the form of dividends or capital gains. As a result, about a third of these rents may accrue to the government in the form of tax revenues. Grandfathered emissions permits can produce a complete revenue-recycling effect equivalent to that under an emissions tax only in the limiting case where rents are 100 percent taxed.

offset the gains from reduced pollution! Such a system of tradable allowances--a system strongly supported by environmental economists as a major step forward in the use of market incentives for environmental protection--could possibly reduce social welfare.

One lesson that emerges from the new literature is the potential importance of revenue-recycling. From the second-best perspective, a system of tradable allowances set in motion by an auction of the permits to sources can be much preferred to one in which the permits are distributed to the sources without charge. The former generates revenues that can be used to reduce other distorting taxes, while the latter does not. This admittedly raises some tricky matters of political economy. One of the attractions of these quantity instruments in the policy arena has been the receptivity to them of polluting firms, who would much prefer to receive an allotment of tradable permits than to be subject to a tax on their emissions or, alternatively, to be forced to compete in an auction for the permits. But, in a second-best setting, such provisions for the free distribution of permits may compromise the welfare-improving potential of the system. Moreover, even if the program generates revenues through an auction of permits or some schedule of charges, there is no guarantee that the newly generated revenues will be employed to reduce rates on other distorting taxes.[5]

A further important point from the recent literature is that the relative importance of the tax-interaction effect is sensitive to the level of environmental regulation. When marginal environmental benefits (MEB) in Figure 2 are more modest relative to marginal control costs (MC) (as is thought to be the case for carbon emissions), then the Pigouvian level of emissions reductions will tend to be relatively small, and it becomes more likely that the welfare loss rectangle in Figure 1 outweighs the Pigouvian welfare gain triangle in Figure 2 [Parry et al. (1998)]. In contrast, where marginal environmental benefits are relatively large (as estimates suggest for the case of sulfur emissions), the tax-interaction effect is unlikely to reverse the sign of the welfare impact from positive to negative [see Goulder et al. (1997)].

## 3. SOME BROADER IMPLICATIONS

Although most of the new literature focuses on programs for environmental management, upon reflection it becomes clear that this is a very general issue. For any program or institution that influences the costs of production or in any other way affects the labor market is going to generate some social gains or losses of the kind that we have examined here. In fact, an independent discovery of the importance of this phenomenon arose in a very different kind of study. Edgar Browning (1997), re-examining the welfare losses associated with monopoly pricing, found (somewhat to his astonishment) that the welfare costs of monopoly distortions in a second-best framework were many times larger than those implied by the familiar Harberger triangles.

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[5] In fact, environmental programs that generate revenues often contain provisions that direct the revenues into some kind of trust fund that must be used for environmental enhancement. Of course such spending may produce a significant efficiency gain--but only if the social benefits per dollar of additional spending are well in excess of a dollar.

Some further thought suggests that programs like tariffs and quotas on imports or agricultural price-supports and quotas, which drive up prices and effectively reduce the real wage, are likely to have substantial welfare costs stemming from labor-market distortions in addition to the more traditional forms of welfare losses that economists have measured. Indeed, we suspect that as this second-best analytical framework is applied to a wide range of programs, we will find that the welfare losses associated with many of these programs are significantly larger than we previously thought.

To take one such case, Williams (1998) and Parry (1998) have recently shown that the presence of pre-existing taxes can raise the economic costs of tariffs and import quotas by a potentially substantial amount. Again, this arises because these policies raise the prices of consumer goods, thereby reducing the real wage and hence employment. In fact, interactions with the tax system can eliminate the well-known textbook case for an optimal tariff when a country has market power in trade, unless the tariff revenues are used to finance reductions in other distortionary taxes.

It is easy to extend the list of potential applications. It would appear, for example, that the costs of airline safety regulations, programs of occupational licensure that limit entry and increase prices, and minimum-wage laws can be much magnified in their impacts when pre-existing taxes are taken into account. It is not the case, incidentally, that such a second-best framework implies that public programs are inevitably more costly than a partial-equilibrium treatment would indicate. There may well be some important cases where there are some complementarities to work effort. One that comes to mind is traffic congestion. A (revenue-neutral) toll on a congested roadway for commuters that reduces travel time may, under certain circumstances, effectively raise the real wage and induce an increase in employment.[6]

## CONCLUDING REMARKS

This new literature thus raises a large red flag to those engaged in benefit-cost analysis: beware of partial-equilibrium studies. In a distorted economy, notably one with a wide spread between the gross and net wage, it is important to take into account the indirect welfare effects of public programs on the labor market (and perhaps other factor markets).[7]

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[6] The analysis also has some important implications for subsidy programs, such as those for child care. Here the tax-interaction effect results in a welfare gain where such subsidies reduce the price of goods and services. This implies that the tax-interaction effect may offset much of the cost of financing a subsidy by distortionary taxes.

[7] Some of the numerical models are dynamic with capital accumulation and allow for tax distortions in the capital market [e.g., Bovenberg and Goulder (1997) and Jorgenson and Wilcoxen (1993)]. Tax interactions are more complex in this setting. To the extent that environmental regulations discourage investment by raising the cost of producing output in future periods, they tend to compound the welfare costs of taxes on capital. Bovenberg and Goulder (1997) show that incorporating capital can either strengthen or weaken the results from static one-factor models, depending on whether the revenue-neutral environmental tax reform expands or reduces inefficiencies associated with the uneven taxation of labor and capital. However, given that the capital market is only around one-third the size of the labor market, we would expect the results from the static models to be reasonably robust to incorporating capital.

In certain cases, these indirect effects (although seemingly small) can outweigh the primary welfare effects of the program.

This is a troubling and sobering finding, because it complicates the task of policy analysis and can undermine the case for certain programs that have long been dear to economists working in a first-best setting. At the same time, the results from the recent literature are preliminary in a number of respects. We surely have much more to learn about the properties and applicability of this analysis to the evaluation of public policy.

One issue, in particular, stands out: the structure and workings of the labor market. For, as we have seen, it is the indirect impact of these programs on levels of employment that is the source of most of the "secondary," but large, welfare effects in a general-equilibrium setting. The labor market, as we are all well aware, is a very complex institution with many facets. The analyses we have described here simply treat it as a single, integrated and competitive market. But, in truth, it is difficult to estimate the overall employment effects caused by policies that affect the real wage, because these effects depend on a diverse set of decisions involving labor-market participation and hours worked for a variety of different groups in varying settings. There exists in the labor literature a substantial range of estimates of the relevant labor supply elasticities so that any projections of the effects of changes in the real wage on employment are subject to a fair amount of uncertainty. Our point here is simply that given the importance of the labor-market responses to the bottom line in benefit-cost studies of public programs, it is crucial that we have a sound understanding and reliable estimates of labor-market behavior.

This is likely to be even more complicated and important outside the United States. It may be reasonable to characterize the U.S. labor market as a competitive market, but this seems less true in, say, Europe, where there are many more regulations (including more generous unemployment benefits, provisions for retirement, higher minimum wages, higher taxes on labor, etc.) and much stronger labor unions that impinge on (and distort) the workings of the market. The high levels of unemployment that are plaguing many of the European nations appear, at least in part, to stem from these provisions. Perhaps the revenue-recycling effects that result in lower taxes on labor and the tax-interaction effects from a reduced real wage operate a bit differently in the context of some of these institutional features of European labor markets.

Finally, we want to return to environmental economics long enough to say that we do not see these new findings as grounds for abandoning the economist's case for pricing incentives for environmental protection. The argument here has been limited to an essentially static framework. And, as economists have long argued, one of the most important properties (in fact, perhaps the most important) of incentive-based instruments for environmental management is the inducement that such instruments provide for the development and adoption of new techniques for pollution control. The welfare gains from such technical advances may well dominate the static gains from the more efficient deployment of resources within a given technological context.

Our central, and more general, point is that there exists a potentially major element of social costs that has been systematically overlooked in the analysis of a wide class of public programs and economic institutions. It is tempting simply to dismiss such findings on the grounds that "We know that anything can happen in a second-best setting." But this really misses the point. The contribution of this new literature is to show specifically what can happen under certain, well-defined and realistic circumstances; it reduces the ambiguity. And the results seem quite robust: there is now a large body of work, encompassing both analytical and numerical studies, that has firmly established the potential importance of these indirect effects operating through factor markets. Moreover, as we have seen, this work generates some valuable insights into the design of policy measures (most notably the importance of revenue recycling). The new second-best literature, as we read it, presents a serious challenge to much of the traditional policy analysis. There is much to digest and to try to understand here.

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