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¹⁶ O. D. Hart and J. Moore, "On the Design of Hierarchies: Coordination versus Specialization," NBER Working Paper No. 7388, October 1999.

¹⁷ O. D. Hart and J. Moore, "Foundations of Incomplete Contracts," NBER Working Paper No. 6726, September 1998.

¹⁸ K. B. Kumar, R. G. Rajan, and L. G. Zingales, "What Determines Firm Size?" NBER Working Paper No. 7208, July 1999.

¹⁹ C. G. Holderness, R. S. Kroszner, and D. P. Sheehan, "Were the Good Old Days That Good? Changes in Managerial Stock Ownership since the Great Depression," NBER Working Paper No. 6550, May 1998.

²⁰ A. Shleifer, "State versus Private Ownership," NBER Working Paper No. 6665, July 1998.

²¹ L. A. Bebchuk, R. Kraakman, and G. Triantis, "Stock Pyramids, Cross-Ownership, and the Dual Class Equity: The Creation and Agency Costs of Separating

Control from Cash Flow Rights," NBER Working Paper No. 6951, February 1999.

²² T. Khanna and K. Palepu, "Emerging Market Business Groups, Foreign Investors, and Corporate Governance," NBER Working Paper No. 6955, February 1999.

²³ B. R. Holmstrom, "Managerial Incentive Problems—A Dynamic Perspective," NBER Working Paper No. 6875, January 1999.

²⁴ G. P. Baker and B. J. Hall, "CEO Incentives and Firm Size," NBER Working Paper No. 6868, December 1998.

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Research Summaries

Economic Impacts of Environmental Policies

Lawrence H. Goulder*

Over the last three decades in the United States and other nations, there has been a significant increase in the use of economic analysis to guide the design and evaluation of environmental policies. Economic analysis has played a key role in the evaluation of "green tax reform"—the re-

orienting of the tax system to concentrate taxes more on "bads" like pollution and less on "goods" like labor effort or capital formation (saving and investment). Economic analysis also has guided the design of innovative new approaches to environmental regulation that hold the promise of achieving environmental goals at lower cost than is possible under conventional regulations. And, it has been used to map out how the impacts of environmental policies are distributed across industries and household groups—a

consideration that is highly relevant to the political feasibility of environmental initiatives.

Much of my research focuses on these sorts of environmental policy issues. I often use a general equilibrium framework, an approach that considers how environmental policies affect not only the targeted firms or industries but the rest of the economy as well. General equilibrium analysis yields dramatically different results from what one would obtain from partial equilibrium, or sector-specific, analyses. In realistic, "sec-

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ond-best" economies with pre-existing distortionary taxes, such as income and sales taxes, the differences are striking. In some cases, policies that appear to improve efficiency in a partial equilibrium analysis emerge as reducing efficiency when researchers account for second-best, general equilibrium interactions. Moreover, general equilibrium interactions sometimes alter the relative costs of different environmental policy options, overturning the conventional wisdom that regulatory approaches are the most cost effective.¹

Environmental Tax Reform and the "Double Dividend"

Green tax reform usually involves substituting environmentally motivated ("green") taxes for existing distortionary ones, for instance income and sales taxes. One highly debated green tax reform is the introduction of a revenue-neutral carbon tax: levying taxes on fossil fuels according to their carbon content and using the additional tax revenues to finance reductions in income tax rates. The carbon tax would also confront the prospect of global climate change by discouraging combustion of fossil fuels and the associated emissions of carbon dioxide (CO₂), a principal contributor to the greenhouse effect.

The possibility of using green tax revenues to finance cuts in marginal rates of existing distortionary taxes is also attractive in terms of efficiency. This has prompted speculation as to whether the revenue-neutral substitution of environmental taxes for other taxes might offer a "double dividend": not only improving the environment but also reducing the overall cost of the tax system.

If the second "dividend" obtains, then the gross costs (that is, the costs apart from environmental benefits) of the reform are zero or negative. Proponents of revenue-neutral green

tax reforms would welcome this result, since it implies that policymakers must only establish that there are positive *benefits* to the environment from the reforms in order to justify them on efficiency grounds. This is especially important in regards to the carbon tax, given the vast uncertainties about the magnitudes of the environmental benefits (the avoided damages from climate change) that this policy generates.

A FIRST GLIMPSE

Does the double dividend indeed arise? Using revenues from green taxes to finance cuts in distortionary taxes does avoid some of the distortions that these pre-existing taxes would generate otherwise. This implies an efficiency benefit, which is termed the "revenue-recycling effect." Because of the positive revenue-recycling effect, the costs of a green tax reform will be lower when the revenues from such a tax are used to finance cuts in distortionary taxes than when the revenues are returned to the economy in a lump-sum fashion—for example, through lump-sum transfers to households. However, this simply means that the costs of the former policy are lower than the costs of the latter policy; it does not mean that those costs are negative, which is the requirement for the second dividend to occur.

Are the costs of the green tax negative? Over the last decade, many researchers have addressed this question.² The simplest analytical models suggest that the answer is no.³ These models point out that green taxes usually are a relatively inefficient way to raise revenue: the economic cost of raising a dollar through green taxes tends to be higher than that of raising a dollar through ordinary income taxes. Intuitively, that is because green taxes have a much narrower base than income taxes. They focus on individual commodities (such as fossil fuels) or on emis-

sions from particular industries. As a result, they tend to imply larger "distortions"⁴ in markets for intermediate inputs, for consumer goods, and for labor and capital. Hence, swapping a green tax for part of the income tax augments the (nonenvironmental) distortions of the tax system, and there is an economic cost of this revenue-neutral tax reform.

A CLOSER LOOK

Separating out three components of the overall cost of a green tax reform makes it easier to understand the requirements for obtaining the second dividend. The first component is the "primary cost" of the environmental tax, that is the direct cost to the regulated sector associated with changes in production methods or installation of pollution-abatement equipment required to reduce pollution. The second component, which emerges in a general equilibrium analysis, is the revenue-recycling effect. As mentioned earlier, this component serves to lower the costs of the reform. The third component is an additional general equilibrium impact called the "tax-interaction effect," which can be explained as follows: to the extent that environmental taxes raise producers' costs, they imply higher prices of commodities. This effectively reduces the real returns to factors—a given nominal wage payment or given nominal distribution of profits has less purchasing power. When there are pre-existing taxes on these factors, the environmental tax functions like an increase in factor taxes, compounding the distortions in factor markets from prior taxes. This adverse impact on factor markets is the tax-interaction effect.

To get the double dividend, the (cost-reducing) revenue-recycling effect would have to outweigh both the primary cost and the (costly) tax-interaction effect. Under neutral conditions,⁵ theoretical models indicate

that the revenue-recycling effect is not strong enough to do this—the double dividend does not arise. Under these same circumstances, the revenue-recycling effect is weaker than the tax-interaction effect. Thus, the gross costs are not only positive but also turn out to be higher than they would be in a world without prior distortionary taxes, and thus without the revenue-recycling and tax-interaction effects. This reflects the fact that environmental taxes are implicit factor taxes that expand pre-existing distortions in factor markets.⁶

Still, there are some circumstances under which the double dividend can arise. Although the initial theoretical analyses tended to reject the double dividend, a second wave of models offered more scope for the double dividend by acknowledging additional potential channels for beneficial efficiency impacts from green taxes. One such channel is an improvement in the relative taxation of capital and labor. If, prior to introducing the environmental tax, capital is highly overtaxed (in efficiency terms) relative to labor, and if the revenue-neutral green tax reform shifts the burden of the overall tax system from capital to labor (a phenomenon that can be enhanced by using the green tax revenues exclusively to reduce capital income taxes), then the reform can improve (in efficiency terms) the relative taxation of these factors.⁷ If this beneficial impact is strong enough, it can overcome the inherent efficiency handicap that (narrow) environmental taxes have relative to income taxes as a source of revenue. Similarly, if the initial tax system is highly distorted in terms of consumer goods, and the green tax reform improves the system in that dimension, then the double dividend can occur after all.⁸

These examples illustrate a general principle. The double dividend arises if three conditions hold: 1) the initial

tax system is inefficient along some nonenvironmental dimension (that is, it fails to be second-best optimal even when environmental quality considerations are ignored); 2) the revenue-neutral environmental tax reduces this inefficiency, and; 3) the efficiency improvement along this dimension more than compensates for the inherent efficiency disadvantage of the environmental tax.

The presence or absence of the double dividend thus depends on the nature of the prior tax system and on how environmental tax revenues are recycled. Empirical conditions are important. This does not mean that the double dividend is as likely to occur as not, however. The narrow base of green taxes constitutes an inherent efficiency handicap. The impact of the green tax reform on pre-existing inefficiencies in the tax system could offset this handicap, but it also could add to it. Numerical general equilibrium models aim to realistically incorporate the pre-existing inefficiencies of the tax system and to gauge how green taxes alter these inefficiencies. Although results vary, the bulk of existing research tends to indicate that even when revenues are recycled in ways conducive to a double dividend, the beneficial efficiency impact is not large enough to overcome the inherent handicap, and the double dividend does not arise.⁹

The difficulty of establishing the double dividend certainly makes it harder to garner political support for green taxes. Still, it is important to recognize that the absence of the double dividend does not mean that green taxes are a bad idea. To the contrary, even if the second dividend fails to occur, which means that the costs are positive, green taxes may produce benefits to the environment that more than compensate for such costs. Indeed, most analyses indicate that appropriately scaled green taxes will do just that.¹⁰

Prior Taxes and the Choice of Instrument for Environmental Regulation

General equilibrium tax interactions are also relevant to the cost impacts of other environmental policy instruments.¹¹ For example, they fundamentally affect the costs of tradeable emissions permits, and they indicate that a great deal is at stake in choosing whether to freely allocate or auction these permits.

Research by Ian W. H. Parry, Robertson C. Williams III, and Dallas Burtraw shows that, like environmental taxes, systems of tradeable permits lead to higher production costs, higher commodity prices, and lower real factor returns. As a result, regulating pollution through tradeable permits generates a tax-interaction effect similar to that produced by environmental taxes. If these permits are auctioned, and the revenues are used to finance cuts in prior distortionary taxes, then the tax-interaction effect will be partly offset by the revenue-recycling effect. On the other hand, if the permits are given out for free, there can be no such offset.¹²

The presence or absence of this offset has dramatic implications for the economic costs of tradeable emissions permits. Parry, Burtraw, and I show that the costs of reducing sulfur dioxide emissions under Title IV of the 1990 Clean Air Act could have been reduced by about 25 percent if the tradeable permits had been auctioned (and revenues recycled) rather than given out for free.¹³ In some cases, whether the overall efficiency impact is positive or negative depends on the decision to freely allocate or auction the permits. In this connection, we also show that while reducing CO₂ emissions through auctioned permits improves efficiency (provided that the revenues are recycled), a system of freely provided CO₂ permits is likely to reduce effi-

ciency. Under plausible values for the environmental benefits per ton of CO₂ abatement, any level of emissions reduction yields environmental benefits that fall short of society's costs of abatement.¹⁴

General equilibrium, second-best considerations also fundamentally change one's assessment of the costs of a range of alternative instruments for environmental regulations. Parry, Williams, Burtraw, and I have analyzed the costs of emissions taxes, tradeable permits, mandated technologies, and performance standards, taking into account the general equilibrium cost effects of a second-best setting with prior distortionary taxes.¹⁵ We find that the costs of achieving given amounts of abatement are higher if there are distortionary taxes than in an economy with no such taxes. The extra cost reflects the tax-interaction effect, which increases as pre-existing tax rates rise. For plausible tax rates and parameter values, the cost increase is substantial (20 percent or more).

Moreover, pre-existing taxes differentially affect policy costs, altering the rankings of policies. The cost impact of pre-existing taxes is particularly large for (nonauctioned) emissions permits, potentially as much as several hundred percent. This has important policy implications. Economists have long argued that tradeable emissions permits and emissions taxes are more cost effective than performance standards, technology mandates, and other traditional forms of regulation.¹⁶ Our results suggest that in the context of NO_x regulation, tradeable emissions permits will not yield cost savings over performance standards or technology mandates unless the permits are auctioned and the revenues used to cut other taxes.

Distributional Considerations and the Costs of Making Environmental Regulations More Attractive

The political resistance to environmental regulations may depend as much on the *distribution* of regulatory costs as on their aggregate level. Potential distributional impacts partly explain why a number of cost-effective policies for reducing U.S. emissions of CO₂ have failed to get off the ground politically. In particular, a revenue-neutral carbon tax would impose significant cost burdens on major energy industries. These industries are highly mobilized politically and can generate stiff opposition to policies that reduce their profits significantly.

Some policies avoid placing such large burdens on the energy industries—for example, a system of tradeable permits in which some of the permits are given out free. This is less costly to the regulated firms because it does not charge firms for every unit of fossil fuel (or carbon) introduced to the economy. But, as suggested earlier, the free provision of permits can imply much higher economy-wide costs of achieving given reductions in fossil fuel supply. Thus, there is an apparent trade-off between promoting efficiency and avoiding “undesirable” impacts on key industries (and enhancing political feasibility).

How serious is this trade-off? In recent work,¹⁷ A. Lans Bovenberg and I examine several alternative U.S. policies for CO₂ abatement designed to avoid adverse impacts on profits and equity values of major energy industries. We find that these distributional constraints can be met with just a small sacrifice of efficiency. The key element here is that the potential government revenue from CO₂ abatement policies is very large relative to the potential losses in profit to the major energy industries.

By designing policies that enable firms to retain even a small fraction of the potential revenues, the government can protect firm profits.¹⁸ Government revenue has an efficiency value because it can be used to finance cuts in pre-existing distortionary taxes. Because these abatement policies forgo little of this potential revenue, they involve only a small sacrifice of efficiency. It is also possible to insulate profits of other downstream industries that might otherwise experience significant profit losses. The revenue sacrifice (and thus the relative loss of efficiency) remains fairly small, even when petroleum refiners and electric utilities are brought into the “insulation net.”

General Equilibrium Considerations Are Important in Other Policy Domains

A recurring theme in this research is the importance of general equilibrium interactions in assessing the efficiency costs of environmental policies. Recognizing these interactions is crucial to understanding the costs of revenue-neutral tax reforms, calculating the overall efficiency impacts and cost rankings of a range of alternative policy instruments, and understanding the efficiency costs associated with compensation schemes intended to enhance political feasibility. In the United States, current environmental policy assessments usually disregard these general equilibrium issues, concentrating instead on firm-level costs or using only a partial equilibrium framework. However, there seems to be a gradual trend toward taking general equilibrium issues into account.

The significance of general equilibrium interactions is not confined to the domain of environmental economics. In public economics, these interactions are relevant to assess-

ments of the marginal excess burden (or deadweight loss) from taxes on commodities. Theorists have long recognized that tax interactions are relevant to the measurement of excess burden, but it has been difficult to ascertain the overall implication of these interactions. Faced with these difficulties, applied research has tended to assume that the net effect of these interactions is zero and to invoke, by default, the simple "excess burden triangle" to measure excess burden.

In a recent paper,¹⁹ Williams and I show that under neutral assumptions, tax interactions imply substantially higher excess burden than the simple excess-burden triangle would indicate. We derive a practical alternative formula that accounts for these interactions in approximating excess burden. In addition, we perform numerical simulations to illustrate the significance of tax interactions in this context. For realistic parameter values and a wide range of assumed rates for prior taxes, the usual formula captures less than half of the excess burden of taxes on commodities. In contrast, our alternative formula approximates excess burden quite closely.

The general equilibrium interactions I describe are relevant to the impacts of a wide range of government policies. To the extent that agricultural policies or international trade policies raise the costs of output and thereby reduce real factor returns, they exacerbate the distortions in factor markets from pre-existing taxes and imply higher social costs than would be indicated by partial equilibrium analyses. These issues deserve consideration in assessments of policy costs.

¹ A. L. Bovenberg and I offer a survey of the implications of general equilibrium interactions for environmental tax and regulatory policies in "Environmental Taxation and Regulation in a Second-

Best Setting," in *Handbook of Public Economics, Second Edition*, A. Auerbach and M. Feldstein, eds., forthcoming.

² I survey the issues in "Environmental Taxes and the 'Double Dividend': A Reader's Guide," *International Tax and Public Finance*, 2(2) (August 1995). More recent surveys include F. Bosello, C. Carraro, and M. Galeotti, "The Double Dividend Issue: Modeling Strategies and Empirical Findings," *FEEM Discussion Paper No. 81.98*, December 1998; and A. L. Bovenberg, "Environmental Taxation and the 'Double Dividend': An Updated Reader's Guide," *International Tax and Public Finance*, 6(3) (1999), pp. 421-43.

³ See, for example, A. L. Bovenberg and R. de Mooij, "Environmental Levies and Distortionary Taxation," *American Economic Review*, 94(4) (September 1994), pp. 1085-9; I. W. H. Parry, "Pollution Taxes and Revenue Recycling," *Journal of Environmental Economics and Management*, 29 (1995), pp. S64-S77; and A. L. Bovenberg and L. H. Goulder, "Costs of Environmentally Motivated Taxes in the Presence of Other Taxes: General Equilibrium Analyses," *National Tax Journal*, 50(1) (March 1997).

⁴ "Distortions" is in quotes to acknowledge the fact that, in keeping with the focus on the second dividend, the present discussion ignores the policy's impacts on environmental quality and associated implications for overall efficiency — that is, environment-related benefits net of the economic costs.

⁵ The key assumption is that the environmental tax falls on a good or activity that is "average" in terms of its substitutability with factors of production such as labor. For a discussion of this issue, see my survey with A. L. Bovenberg, "Environmental Taxation and Regulation in a Second-Best Setting."

⁶ Similar principles apply to the analysis of optimal environmental taxation in a second-best setting. Because the cost of a given environmental tax is greater in the presence of distortionary taxes, in the presence of such taxes the optimal environmental tax rate is lower as well. A. L. Bovenberg and I examine this issue in "Optimal Environmental Taxation in the Presence of Other Taxes," *American Economic Review*, 86(4), (September 1996).

⁷ A. L. Bovenberg and I examine this in detail in "Costs of Environmentally Motivated Taxes in the Presence of Other Taxes: General Equilibrium Analyses,"

National Tax Journal, 50(1) (March 1997).

⁸ See I. W. H. Parry and A. Bento, "Tax Deductions, Environmental Policy, and the 'Double Dividend' Hypothesis," *Journal of Environmental Economics and Management*, 39(1) (January 2000).

⁹ For an excellent review of results from numerical studies, see "The Double Dividend Issue: Modeling Strategies and Empirical Findings," op. cit. A small sampling of numerical general equilibrium studies in which "favorable" recycling fails to generate the double dividend includes A. L. Bovenberg and L. H. Goulder, "Costs of Environmentally Motivated Taxes in the Presence of Other Taxes: General Equilibrium Analyses," op. cit.; L. H. Goulder, "Effects of Carbon Taxes in an Economy with Prior Tax Distortions: An Intertemporal General Equilibrium Analysis," *Journal of Environmental Economics and Management*, (October 1995); and S. Proost and D. van Regermorter, "The Double Dividend and the Role of Inequality Aversion and Macroeconomic Regimes," *International Tax and Public Finance*, 2(2) (August 1995). Favorable recycling yields the double dividend in D. Jorgenson and P. Wilcoxon, "Reducing U.S. Carbon Emissions: An Econometric General Equilibrium Assessment," in *Reducing Global Carbon Dioxide Emissions: Costs and Policy Options*, D. Gaskins and J. Weyant, eds. *Energy Modeling Forum*, Stanford University, 1996.

¹⁰ See, for example, "Environmental Policymaking in a Second-Best Setting," in *Economics of the Environment, Selected Readings*, R. N. Stavins, ed. New York: W. W. Norton, 1999; and L. H. Goulder, "Energy Taxes: Traditional Efficiency Effects and Environmental Implications," in *Tax Policy and the Economy* 8, J. M. Poterba, ed. Cambridge: MIT Press, 1992.

¹¹ I survey these issues in "Environmental Policymaking in a Second-Best Setting," op. cit.

¹² D. Fullerton and G. Metcalf reach similar conclusions, but they explain the results in terms of whether policy-generated rents are collected by the government or retained by private firms. See "Environmental Controls, Scarcity Rents, and Pre-Existing Distortions," NBER Working Paper No. 6091, July 1997.

¹³ L. H. Goulder, I. W. H. Parry, and D. Burtraw, "Revenue-Raising versus Other Approaches to Environmental Protection: The Critical Significance of Pre-Existing

Tax Distortions," RAND Journal of Economics, Winter 1997.

¹⁴ I. W. H. Parry, R. C. Williams III, and L. H. Goulder, "When Can CO₂ Abatement Policies Increase Welfare? The Fundamental Role of Pre-Existing Factor Market Distortions," Journal of Environmental Economics and Management, 37 (January 1999), pp. 52–84.

¹⁵ L. H. Goulder, I. W. H. Parry, R. C. Williams III, and D. Burtraw, "The Cost-Effectiveness of Alternative Instruments for Environmental Protection in a

Second-Best Setting," Journal of Public Economics, 72(3) (1999), pp. 329–360.

¹⁶ See, for example, M. Cropper and W. Oates, "Environmental Economics: A Survey," Journal of Economic Literature, 30 (1992), pp. 675–92.

¹⁷ A. L. Bovenberg and L. H. Goulder, "Neutralizing Adverse Industry Impacts of CO₂ Abatement Policies: What Does It Cost?" in Distributional and Behavioral Effects of Environmental Policy: Evidence and Controversies, C. Carraro and G. Metcalf, eds., forthcoming.

¹⁸ Specifically, under policies involving CO₂ emissions reductions of up to 30 percent, the government needs to freely offer (rather than auction) only a small fraction (less than 10 percent) of CO₂ emissions permits or, similarly, must exempt only a small share (less than 10 percent) of emissions from the base of a carbon tax, to protect the profits of domestic fossil fuel (coal, oil, and natural gas) firms.

¹⁹ L. H. Goulder and R. C. Williams III, "The Usual Excess Burden Approximation Usually Doesn't Come Close," NBER Working Paper No. 7034, March 1999.

International Taxation

James R. Hines Jr.*

The ability and evident willingness of taxpayers to relocate activity, to shift taxable income between jurisdictions, and to respond to incentives created by the interaction of domestic and foreign tax rules, mean that the tax policies of other countries obviously must be considered in the formulation of domestic policy. In the current environment, almost every U.S. tax provision influences foreign direct investment (FDI) or provides incentives for international tax avoidance.

Research in the field of public finance reflects a growing awareness of the importance of foreign tax policies; over the last ten years, there have been many new quantitative studies of the impact of taxation in open economies.¹ This research considers how tax policies affect three aspects of economic activity: FDI, international tax avoidance, and economic efficiency.

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Foreign Direct Investment

Tax rate differences over time and between countries can be very large, thereby significantly affecting aftertax returns to FDI. By now there is ample evidence that countries with lower tax rates receive much more FDI than do countries with higher tax rates. And, for a given country, FDI is greater in years in which associated tax burdens are lighter.² To be sure, there are important complications to this otherwise very simple story. The ability of taxpayers to adjust the financing of FDI, and the repatriation of profits to home countries, also can affect the magnitude of FDI.³ Furthermore, one of the stumbling blocks confronting efforts to estimate the impact of taxes on FDI is the importance of other nontax considerations—such as market size and proximity, local factor prices, and local infrastructure—and the possibility that they are correlated with tax rates.

There have been several efforts to identify the impact of tax rates on FDI in a way that removes as much as possible of the effect of correlated omitted variables. The U.S. Tax Reform Act of 1986 (TRA) provides one such opportunity, since it was a major tax change with important international repercussions, and it af-

fected certain firms and industries differently than it did others. Firm- and industry-level evidence suggests that American companies concentrating in assets not favored by the TRA reacted by increasing their foreign investment after 1986; furthermore, foreign investors in the United States (for whom the TRA provisions had relatively smaller impact) may have concentrated in these more heavily taxed assets in the years after 1986.⁴

Mihir Desai and I evaluate the impact of the TRA by comparing its effect on FDI undertaken by joint ventures and FDI undertaken by majority-owned foreign affiliates.⁵ The TRA introduced an important distinction between income received from these two foreign sources by requiring Americans to calculate foreign tax credit limits separately for each joint venture. This change greatly reduced the attractiveness of joint ventures, particularly those in low-tax foreign countries. We find that American participation in international joint ventures fell sharply after 1986, while international joint venture activity by non-American firms rose. The drop in American joint ventures was most pronounced in low-tax countries, which is consistent with the incentives created by