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Multinational Taxation and International Emissions Trading

Carolyn Fischer

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Summary

Many studies have shown that the activities of multinational corporations are quite sensitive to differ-ences in income tax rates across countries. In this paper I explore the interaction between multinational taxation and abatement activities under an international emissions permit trading scheme. Four types of plans are considered: (1) a single domestic permit system with international offsets; (2) separate national permit systems without trade; (3) separate national permit systems with limited offsets; and (4) an inter-national permit trading system. For each plan, I model the incentives for the multinational firm to choose abatement activities at home and abroad and to transfer emissions credits between parent and subsidary.

Limits on trading across countries restrict efficiency gains from abatement, as is well known. But I show furthermore that if available offset opportunities are limited to actual abatement activities, those activities are more susceptible to distortions from incentives to shift taxable income. Transfer pricing rules can limit but not always eliminate these distortions. In a system of unlimited international trading, abatement is efficiently allocated across countries, but tax shifting can still be achieved through intra-firm transfer pricing. From the basis of efficiency for both environmental and tax policies, the best design is an international permit trading system with transparent, enforceable transfer pricing rules.

Address for correspondence:
Carolyn Fischer
Resources for the Future
1616 P. St., NW
Washington, DC 20036-1400
E-mail: fischer@rff.org

1   Introduction

In a world of international capital mobility, national tax policies matter. A large body of literature indicates that corporate income taxation does have significant influence on a wide range of activities, including foreign direct investment, corporate borrowing, transfer pricing, dividend and royalty payments, research and development activity, exports, bribe payments, and location choices (Hines 1996). A noticeable gap in the tax literature regards activities related to pollution abatement and multinational firms' responses to environmental policy.

While the environmental economics literature has grown to realize the importance of domestic income taxation as it interacts with environmental policy (the "double dividend" debate is a primary example), little attention has been paid to the role of international tax differences. As the idea of global environmental policies in general—and an international strategy for controlling greenhouse gases in particular—comes into serious consideration, the impact of international taxation must be understood. The interaction between environmental and tax policy will influence the location and efficiency of pollution abatement efforts, and it poses critical questions for policy design and enforcement.

In proceeding toward compliance with the Kyoto Protocol, participating countries are relying on the promise of some form of international exchange of greenhouse gas emissions reductions to keep costs in check. However, international trade in emissions allowances (permits) carries its own complications. A permit is not a traditional good, service or asset, but rather a license to emit that a government chooses to recognize in its territory. Consequently, traditional rules governing trade and accounting do not necessarily apply. Yet permits will have significant financial value, they and will carry many of the characteristics of property in the eyes of the firms trading them, whether or not the international trade and tax institutions formally recognize them as such.[1]

In this paper we explore how taxation by different countries of income generated by multinational corporations might impact an international program of emissions permit trading, and vice versa. Two questions are addressed: First, how can multinational taxation affect the location and efficiency of emissions reductions? Second, can one mitigate efficiency losses from multinational responses through judicious policy

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[1]Werksman (1999) explores some of the legal ambiguities and concerns for international emissions trading under the WTO rules.

design? In particular, we consider how emissions offsets arising from activities conducted abroad should be treated for environmental compliance and for tax purposes.

These questions are important when designing a domestic environmental policy to combat a global pollutant like greenhouse gases. If lower-cost opportunities for emissions abatement exist elsewhere, provisions for letting activities undertaken abroad offset domestic emissions requirements can create tremendous gains from trade if cheaper abatement. However, for multinational firms, allowing for international offsets can also create opportunities for tax avoidance. Such tax-related incentives may affect real decisions regarding environmental compliance and may diminish some of those efficiency gains from trade, not to mention affect public revenues.

The fundamental problem is that international tax rules are not completely neutral, and multinational corporations can save on their tax bills by realizing more of their profits in low-tax countries. This profit shifting can be achieved by relocating real activities like production or investment, or by transferring goods between a parent corporation and one of its subsidiaries at favorable prices. Most countries have designed tax rules for transfer pricing to limit some of this behavior. At issue here is, if a parent company can use the abatement activities of its subsidiary toward its own emissions obligations, how will those emissions offsets be treated for tax purposes? Will they be recognized as transfers of valuable property and subject to appropriate transfer pricing rules? Or will they be considered only a means of environmental compliance, without explicit, taxable value to the firm?

The potential for multinational tax shifting can be glimpsed by the scope of the emissions at stake. BP, a multinational energy products firm, has already implemented its own intra-firm greenhouse gas emissions trading program. It has operations in 91 countries and CO_2 equivalent emissions of 80 million tons annually. Even at permit prices in the low range of current estimates, the value of the emissions could represent a significant share of BP's annual profits ($13 billion in 2001) and tax payments ($5 billion in 2001).[2]

To understand how tax shifting might work, suppose firms can use abatement efforts in other countries to directly offset reduction requirements in the United States, without treating the transfer as a permit sale. A U.S. parent could then shift costly abatement activities to its subsidiary in a high-tax country, reducing the more heavily taxed foreign-source income; the offsets then allow less abatement at home, increasing profits

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[2]BP Annual Report 2001.

in the lower-tax country.

A formal international emissions permit trading program would make such transfer-pricing decisions transparent: the subsidiary could create or buy permits at the market price and sell them to the parent at a loss, effectively transferring profits from the high-tax to the low-tax country. A market-price rule for permit transfers then would limit (though not eliminate) such problems, particularly with the advent of a well developed market for emissions permits and a clear "spot" price for permits. On the other hand, any room for interpretation can create leeway for profit shifting. For example, if emissions permits are allocated gratis to firms in a particular country, a precedent for a zero price exists—a particular problem if cost basis (the initial price of acquisition) is allowed to represent market value.

Limitations on trade between separate permit systems can also interact with tax incentives. Having distinct market prices apparent at home and abroad can impose some limits on opportunistic transfer pricing, but to the extent that permit prices differ, leeway may still exist for the firm to exploit the price margin. The appropriate transfer-pricing rules to cut off such opportunism can differ according to the type of limitation imposed on trade among permit systems.

Current climate discussions envisage different potential international offset systems, including trading programs within the EU, joint implementation (JI) with other participating countries, and clean development mechanism (CDM) projects in developing countries. Concurrently, certain limitations on offsetting are also being discussed, to stem the use of "hot air" permits from the former Soviet Union and to ensure good-faith efforts by individual countries. These policies raise important design questions affecting the allocation of abatement effort within multinationals, across countries, and across firms in the presence of tax differentials.

The structure of the paper is as follows: Section 2 reviews the existing literature on national tax policies and multinational activities. Section 3 develops the theoretical framework for emissions abatement decisions in the presence of corporate income taxation for likely treatments of offsets and permits. Four different types of potential offset policies are considered, and the implications for tax revenues, trading program efficiency, and abatement location are discussed. The conclusion addresses the methods by which an international emissions trading policy, as well as its corresponding tax treatment, may be designed in order to minimize distortions.

2 Taxes and Multinationals

Almost every country levies tax on corporate income; in the United States, the rate is 35%.[3] Multinational corporations pay these taxes around the world on income generated by their subsidiaries and foreign branches. However, in their home country of operation, they are generally liable for domestic income tax on their worldwide income. To avoid double taxation, most countries give credits for income taxes paid abroad. The idea is to implement "residence-based taxation," where multinational corporations face the same tax rate, that of their country of incorporation, regardless of where their income is generated. In theory, they would then have no incentive to relocate profits and would equalize their marginal returns to capital around the world. However, in practice, two critical aspects keep corporate income taxation from being truly residence-based and neutral toward firms' production location decisions.

The first is a concern when the foreign country's tax rate is higher: the tax credits are generally not unlimited. In the case of the United States, foreign tax credits are capped by the domestic tax liability for that foreign income.[4] Multinational firms constrained by this cap are said to be in a position of "excess credits." While some countries, like the U.S. and Japan, use overall foreign income to calculate tax credits (so-called "worldwide averaging"), others like the United Kingdom determine credits on an activity-by-activity basis.[5]

A multinational firm in an excess-credit situation then has incentives to engage in nonproductive activities in order to reduce its tax burden. One response is to invest less in the foreign country, reflecting the lower after-tax rate of return. Another response is to move some of those foreign-source profits to lower-tax jurisdictions (either back to the parent in the home country or toward subsidiaries in lower-tax foreign countries), thereby lowering the tax bill.

The second aspect affects corporations with subsidiaries in foreign countries with lower tax rates. The theory of equalized returns under residence-based taxation requires that income from foreign sources be taxed as it accumulates. In actuality, home country taxation is not taxed on accrual, but rather deferred until profits are repatriated. Thus, if the host country tax rate is lower, the parent then has an incentive to transfer

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[3]Many individual states also tax corporate income at a rate up to 10.8%, which is deductible against Federal income taxes. However, it is the Federal government that grants the foreign income tax credits.

[4]Separate foreign tax credit limitations do exist for particular categories of income, such as passive income, high withholding tax income, financial services income, shipping income, and certain types of dividends and distributions.

[5]In the United States, from 1932 to 1976, per-country tax limitations were in force.

profits to the subsidiary, retaining and reinvesting them in the host country, and delaying home country taxes until a later or more advantageous time.

Thus, some incentive usually exists to shift taxable income to the lower tax country, regardless of whether it is the home or the host country of the multinational corporation. The effects of these incentives are wide ranging. Hines (1996) provides an excellent and extensive overview of the literature on multinational taxation. One vein of research investigated the effect of host-country taxation on foreign direct investment (FDI), finding a significant effect on the scope and location of FDI. Overall, investment seems to display roughly unit elasticity with respect to after-tax returns. Another vein of research focuses on the issue of transfer pricing and finds significant evidence of profit shifting, although much of the evidence is indirect (Grubert and Mutti 1991).

Some literature shows that capital allocation is still distorted by residence-based (home-country) taxation. For example, since profits are only taxed at distribution, the timing of repatriation may be affected (Altshuler, Newlon, and Randolph 1995). Furthermore, multinational corporations based in different countries face different costs of capital, which can affect relative competitiveness for investment in different tax jurisdictions (Jun 1995).

Multinational taxation has been found to affect other activities like the location of and expenditures for research and development (Hines 1993, 1995), export activities (Kemsley 1995), and financing choice (Hines 1996). Given these pervasive impacts, it seems likely that multinational taxation can have a significant impact on the location of environmental compliance activities. With global pollutants coming to the fore of environmental policy concerns, it seems important to account for multinational tax issues in concert with the design of international emissions reduction strategies.

3   Taxes and Emissions Permit Systems

The effects of global pollutants, like the prospective damages from greenhouse gases, are the same regardless of the precise location of the emissions source. Since the advantages of abatement are the same wherever they are undertaken, they should ideally be reduced where the cost of abatement is lowest. However, any international effort to combat greenhouse gases is inevitably going to consist of individual national

environmental policies, or perhaps some regional policies, rather than a single international policy. Each set of domestic policymakers will have a range of choices to consider: Will policies be regulatory or market based? Will national actors be allowed to use abatement activities in foreign countries to offset their domestic requirements? If so, to what extent?

The current effort to reduce greenhouse gases provides a case in point. The Kyoto Protocol is an international agreement to reduce worldwide emissions of greenhouse gases, struck by 159 nations attending the Third Conference of Parties to the United Nations Framework Convention on Climate Change (held in December 1997 in Kyoto, Japan). In the protocol, the parties enumerated in Annex B (primarily the developed nations and the countries in transition to market economies) each committed to a cap on their greenhouse gas emissions, on average 5% below their 1990 emissions levels. The protocol leaves the methods of compliance up to the parties, but it allows for joint implementation and for international emissions reduction projects to help satisfy domestic requirements. The transfer of emissions reductions between Annex B parties through jointly implemented activities is explicitly allowed (Article 6), and the establishment of the Clean Development Mechanism provides for abatement projects in non-Annex B countries (primarily developing countries) to count toward domestic efforts (Article 12). Formal trading of "assigned amounts" among Annex B countries can occur as well (Article 17).

How these international offsets are accounted for in the domestic compliance system is important in determining how susceptible the environmental policies are to manipulation for tax purposes. Most policies, even forms of command-and-control regulation, are potentially compatible with allowing international offsets; however, for the purposes of this paper, the focus is on permit systems. In keeping with that focus, we assume that environmental compliance decisions are decentralized, with offsetting actions taken by individual firms rather than national governments.

Four types of plans are considered in this section:

1. a single domestic permit system with international offsets;

2. two separate national permit systems without trade;

3. two national permit systems with unlimited international permit trading; and

4. two separate national permit systems with limited offsets.

The interaction of corporate income tax regimes with each plan will be analyzed using the following model and assumptions. To simplify the analysis, we will compare the emissions and profit-shifting activities to a baseline where profits are maximized in the absense of any emissions policy. Let E_i represent baseline emissions in country i, while the cost of a permit is P_i. Abatement activity A_i reduces net emissions in i at a cost of $C(A_i)$. Those costs can be thought of as encompassing both direct costs, like investment in new, energy-saving equipment, and the indirect costs of forgone profits, such as those from reduced activity. We assume it becomes costlier to find more opportunities for emissions reduction the more abatement is being conducted.

Corporate income tax rates in country i are τ_i. Since the relevant excess-credit situation only occurs when the foreign subsidiary faces higher tax rates by the host than does the parent by the home country, we will assume throughout the paper that $\tau_F > \tau_H$.

Let π_H and π_F denote baseline pretax profits in the home and foreign countries, respectively. These profits form a natural constraint on the multinational firm's ability to conduct tax arbitrage. In our example, the firm wants to shift profits from the subsidiary to the parent; the limit to this transfer is the profits of the subsidiary. Once the profits are nonpositive, the effective marginal tax rate is that of the home country.[6]

Although the world is simplified to two countries here, the intuition still holds for the shifting of income between tax jurisdictions in worldwide averaging. Deferral incentives are also similar; if the host country had a lower tax rate, the incentives for shifting would be reversed. Their scale would also be smaller, since the tax savings are from deferral rather than avoidance. The important point is that some incentives to shift income to lower-tax countries are always present. We choose to focus on the straightforward example of firms that have excess foreign tax credits due to higher rates abroad.

3.1 Domestic Program with International Offsets

A domestic emissions permit program for greenhouse gases would cap total emissions generated within the home country and issue permits for those emissions rights. The market price for permits P_H that arises from competition for the right to emit indicates the marginal cost of abating emissions in the home-country

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[6]In a multi-country context, excess credit status is determined according to a basket of taxable profits. Since each subsidiary creates one item in the basket, its profits may not have to be driven to zero to bring average tax rates for the basket in line with the home country's rates; π_F can then be thought of the level of profits which must be transfered to arrive at this point.

economy. A domestic program can let firms take advantage of cheaper abatement opportunities abroad by allowing them to use those activities to offset their domestic requirements. However, to a certain extent, firms may take advantage of the offsets to shift their taxable income. Providing for direct offsets—without recognizing emissions reductions as property transferred between subsidiary and parent—effectively sets the transfer price at zero, creating opportunities for tax shifting.

The multinational corporation seeks to maximize its worldwide after-tax profits with respect to the amount and location of its abatement:

$$\max_{A_H, A_F} \left(\pi_H - C(A_H) - P_H(E_H - A_H - A_F) \right) (1 - \tau_H) + (\pi_F - C(A_F)) (1 - \tau_F + \lambda) \tag{1}$$

where λ represents the shadow value of the tax arbitrage constraint.

If abatement at home is positive, then

$$C'(A_H) = P_H. \tag{2}$$

Abatement by the subsidiary occurs until

$$P_H(1 - \tau_H) - C'(A_F)(1 - \tau_F + \lambda) = 0 \tag{3}$$

Let $\hat{\tau}_F = \tau_F - \lambda$ denote the effective tax rate for the subsidiary, inclusive of the shadow value of the tax arbitrage constraint. Rewriting Equation (3),

$$C'(A_F) = P_H \frac{1 - \tau_H}{1 - \hat{\tau}_F} \tag{4}$$

As long as subsidiary profits outweigh the abatement costs, the foreign tax liability remains higher than the corresponding domestic liability. Therefore, the firm remains in a position of excess credits, $\lambda = 0$ and $\hat{\tau}_F = \tau_F$, meaning that the relevant marginal tax rate for the subsidiary is the foreign one. Marginal abatement costs are then higher in the host country in proportion to the tax differential. In other words, excess abatement effort is being performed abroad.

However, if abatement costs sufficiently reduce the subsidiary's profits ($C(A_F) \geq \pi_F$), the firm is no longer in excess credit position and the tax arbitrage constraint binds. The effective marginal tax rate for the subsidiary is thus the home country rate: $\hat{\tau}_F = \tau_H$ (or $\lambda = \tau_F - \tau_H$). As a result, $C'(A_F) = P_H$, and marginal abatement costs are equalized. However, as the subsidiary's profits are fully shifted home, tax revenues are are also being transferred from the higher-tax to the lower-tax jurisdiction.

Consider an equilibrium in a domestic cap-and-trade emissions program in which a significant portion of the actors are multinationals. To the extent that many are in excess-credit situations, too much abatement effort will be sent abroad relative to efficiency: the lower equilibrium domestic permit price masks a higher overall cost of compliance. Meanwhile, to the extent that profits are shifted home, corporate tax revenues are siphoned from the foreign country to the home country via the offset system. (On the other hand, if tax rates are lower abroad, too little abatement effort will be performed abroad and tax revenues will tend to flow in the other direction).

A key assumption in this process is that the parent company gets credit toward its emissions obligations for the abatement activities of its subsidiary. In other words, the subsidiary incurs the costs but does not get paid for these actions. In this manner, more costs are shifted to the subsidiary and thereby more profits are shifted to the parent. Suppose instead that transfer-pricing rules are instituted, such that the subsidiary must sell the abatement offsets to the parent at the market value, rather than zero. The new profit function is

$$\max_{A_H, A_F} \left(\pi_H - C(A_H) - P_H(E_H - A_H)\right)(1 - \tau_H) + \left(\pi_F - C(A_F) + P_H A_F\right)(1 - \tau_F + \lambda) \quad (5)$$

Marginal costs will be equalized at the home permit price. This transfer-pricing rule removes the opportunity for tax arbitrage, as the marginal profit from abatement before (and after) taxes will be zero in both countries. Alternatively, the parent could be required to pay the costs of foreign abatement to the subsidiary. Either of these rules could be used to eliminate the firm's ability to transfer profits using offsets.

3.2 Separate Permit Systems

Suppose now that both the domestic and the foreign host country have permit systems, but no international trading is allowed. The parent and the subsidiary must each comply with the separate systems.

After-tax profits for the multinational firm are

$$\max_{A_H,A_F} \quad (\pi_H - C(A_H) - P_H(E_H - A_H))\,(1 - \tau_H) + \tag{6}$$

$$(\pi_F - C(A_F) - P_F(E_F - A_F))\,(1 - \tau_F - \lambda)$$

If abatement at home is positive, then

$$C'(A_H) = P_H \tag{7}$$

Abatement by the subsidiary occurs until

$$C'(A_F) = P_F \tag{8}$$

Thus, in each country, marginal abatement costs equal the local permit price, and tax rates are irrelevant.[7] Both the parent and the subsidiary want to maximize pre-tax profits, and no vehicle exists for transferring profits back to the parent before tax. However, if the relevant pollutant is a global one and permit prices differ at home and abroad, potential gains from trade are being left unexploited.

3.3   International Permit Trading with Transfer Pricing

In a regime of unrestricted international permit trading, the parent (as well as the subsidiary) can freely buy permits either at home or abroad. As a result (in the absence of transaction costs), those prices must be equalized. This problem is similar to the previous one, with $P_H = P_F = P$ and no limitations on S. Let T represent the internal transfer price. The new expression for after-tax profits of the multinational firm is

$$\max_{A_H,A_F,S,T} \quad (\pi_H - C(A_H) - P(E_H - A_H - S) - TS)\,(1 - \tau_H)$$

$$+ \quad (\pi_F - C(A_F) - P(E_F - A_F + S) + TS)\,(1 - \tau_F + \lambda) \tag{9}$$

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[7]This analysis assumes that the tax base is pure profits. If, for example, some portion of capital is taxed due to imperfect depreciation rules, and abatement activity requires capital inputs, then tax rates can matter. However, these types of cases are ignored here to focus on the basic effects of the tax differential.

Plugging these values into the previous first-order conditions, we see that

$$C'(A_H) = P = C'(A_F), \tag{10}$$

and

$$(P - T)(1 - \tau_H) - (P - T)(1 - \hat{\tau}_F) = 0. \tag{11}$$

Allowing permit trading across programs means tax arbitrage does not occur with abatement; rather, the arbitrage is accomplished through the buying and transferring of permits. Transfers of permits will thus occur until subsidiary profits are effectively shifted back to the parent and $\lambda = \tau_F - \tau_H$. If $T < P$, the subsidiary will buy permits and sell them at a loss (or plain give them) to the parent. If $T > P$, the parent sells permits to the subsidiary at a gain and $S < 0$.

However, if a transfer-pricing rule were to require that $T = P$, this tax arbitrage option would be closed. Then we would return to the first-best world, where international permit prices and marginal costs are equalized.

3.4 Offsets Between Permit Systems

As evidenced by discussions surrounding the Kyoto Protocol, certain countries or policymakers may be hesitant to allow unlimited permit trading between systems. Part of the reason is a desire that each country perform some amount of its own reductions; another concern regards the extent to which permits acquired from other countries represent actual reductions in emissions.[8] However, in restricting trade in permits, the policymakers might allow a kind of hybrid between the first two systems presented, whereby multinational firms could use overcompliance in one system to offset undercompliance in the other.

Consider a rule that would prohibit a firm from buying foreign permits directly but would allow a multinational to use emissions credits actively generated through abatement in one country to offset emissions liabilities in another. For example, the subsidiary could buy permits in the foreign country for its own emissions, but it could not transfer to the parent more than it actually abated. Such a restriction places a limit on

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[8]This aspect includes "hot air," the excess permits available from the countries of the former Soviet Union, whose emissions have fallen well below 1990 levels because of economic decline rather than abatement effort.

arbitrage; importantly, that limit would be endogenous.[9]

Let $S \in [A_F, -A_H]$ represent permits transferred within the multinational. $S > 0$ implies a transfer from subsidiary to parent; $S < 0$ implies transfer from parent to subsidiary. The multinational firm maximizes after-tax profits with respect to abatement in each location and the amount of permits to transfer, subject to the legal limits:

$$
\begin{aligned}
\max_{A_H, A_F, S} \quad & \left(\pi_H - C(A_H) - P_H(E_H - A_H - S)\right)(1 - \tau_H) - \gamma_H(-S - A_H) \\
+ \quad & \left(\pi_F - C(A_F) - P_F(E_F - A_F + S)\right)(1 - \tau_F + \lambda) - \gamma_F(S - A_F),
\end{aligned} \tag{12}
$$

where γ_H and γ_F represent the shadow values of the boundary constraints on S.

The optimum is characterized by the first-order conditions for abatement in each country, an arbitrage condition for permit transfers, and the constraints on those transfers.

From the first-order conditions for abatement, we get equations for the marginal abatement costs in each country as a function of the effective price of permits:

$$
C'(A_H) = P_H + \frac{\gamma_H}{(1 - \tau_H)}; \tag{13}
$$

$$
C'(A_F) = P_F + \frac{\gamma_F}{(1 - \tau_F + \lambda)}. \tag{14}
$$

Let $\hat{P}_H = P_H + \frac{\gamma_H}{1 - \tau_H}$ and $\hat{P}_F = P_F + \frac{\gamma_F}{1 - \hat{\tau}_F}$ be the effective permit prices for the parent and subsidiary, respectively, inclusive of the implicit value from tax shifting with abatement offsets.

The first-order condition for S, the vehicle for transferring profits from subsidiary to parent, produces an arbitrage condition that will determine the appropriate corner for the solution:

$$
P_H(1 - \tau_H) - P_F(1 - \tau_F + \lambda) = \gamma_F - \gamma_H. \tag{15}
$$

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[9]This type of limitation requires knowledge of the baseline emissions for the subsidiary to determine the actual amount of abatement. One could also envision a policy in which the transfer limits are the extent of local obligations, whereby multinational firms could use foreign permits aquired by its subsidiary to offset its own domestic emissions requirements (or visa versa), but they are otherwise not freely tradable (e.g., the firm cannot sell foreign permits on domestic markets). This case is analyzed in Appendix A.1. The basic results would mirror those here, but the constraints would essentially be reversed, since abatement activity in one country affects the constraint on imports in the same rather than the other country.

Finally, we have the equations for the constraints on transfers:

$$\gamma_H \geq 0, \quad -S \leq A_H, \quad \gamma_H(-S - A_H) = 0; \tag{16}$$

$$\gamma_F \geq 0, \quad S \leq A_F, \quad \gamma_F(S - A_F) = 0. \tag{17}$$

We then have different scenarios for the optimum, depending on whether the firm is in an excess-credit situation and on whether after-tax permit prices are higher in the home or host country.

Suppose that the tax arbitrage constraint does not bind ($\lambda = 0$) and the firm remains in a position of excess credits. By Equation (15), an interior solution ($\gamma_H = \gamma_F = 0$) can only occur if after-tax permit prices are exactly equal. However, this can only hold simultaneously with the first-order conditions for abatement (13) and (14) if before-tax permit prices are also equal. Thus, if any price or tax differential exists, one of the transfer constraints must bind. We therefore consider those situations.

Home Permits More Expensive (After Tax): Suppose first that the after-tax price of permits is higher at home: $P_H(1 - \tau_H) > P_F(1 - \tau_F)$. This situation can occur when foreign permit prices are lower or higher than domestic ones, just not high enough to dominate the tax differential. Then for Equation (15) to hold, $\gamma_F > 0$ while $\gamma_H = 0$, implying that all of the subsidiary's abatement credits are transferred home: $S = A_F$. In this case, the effective permit price for the parent is the actual home price: $\hat{P}_H = P_H$. However, for the subsidiary, the marginal value of a permit reflects the value of shifting profits and changing the endogenous limit: $\hat{P}_F = P_H \frac{1 - \tau_H}{1 - \tau_F}$. From the initial relative price assumptions, we see that the effective price—and thereby the marginal abatement costs—of the subsidiary are higher than the foreign permit price: $C'(A_F) > P_F$. Since $\tau_H < \tau_F$, we know they are also higher than those of the parent: $C'(A_F) > C'(A_H) = P_H$.

In other words, if the after-tax permit price is lower in the foreign country, the subsidiary will over-abate and transfer those emissions rights home. This situation mimics that of the single permit system in the home country with offsets from emissions reduction projects in a foreign country with a higher tax rate. Marginal abatement costs abroad will actually be higher than both the foreign and the home permit prices, reflecting the shadow value of transferring profits to the lower-tax jurisdiction. Meanwhile, marginal abatement costs

at home will remain equal to the opportunity costs of emissions in the domestic market.

Foreign Permits More Expensive (After Tax):   Suppose now that the price of emissions permits in the foreign country is not only higher than the domestic price, but also high enough to offset the tax differential: $P_H(1 - \tau_H) < P_F(1 - \tau_F)$. Then $\gamma_H > 0$ and $S = -A_H$; all of the parent's abatement credits get sent to the subsidiary and the parent uses E_H permits to cover its domestic emissions. Now the effective permit price for the subsidiary is the foreign permit price: $\hat{P}_F = P_F$. However, the value of a permit transferred from home reflects the tax cost: $\hat{P}_H = P_F \frac{1 - \tau_F}{1 - \tau_H} > P_H$. The subsidiary then abates until marginal costs equal the before-tax foreign permit price, which is greater than the domestic price (necessarily so since the after-tax foreign price is higher). The parent, meanwhile, also pushes marginal abatement costs above the domestic permit price, though not as high as the foreign price and not as high as the subsidiary's marginal abatement costs: $P_H < C'(A_H) < C'(A_F) = P_F$.

Thus, if the after-tax permit price is lower at home, the parent will increase abatement and transfer permits to the subsidiary. While the parent's marginal abatement costs will rise above the home permit price, they will not attain the foreign permit price, reflecting the additional tax cost of incurring costs in the low-tax rather than the high-tax jurisdiction. Meanwhile, marginal abatement costs for the subsidiary will remain equal to the opportunity costs of emissions in the foreign market.

No Excess Credits: Now suppose the tax arbitrage constraint binds and $\hat{\tau}_F = \tau_H$. Since effective tax rates are the same, the before-tax permit prices are what is relevant. Unless $P_H = P_F$, a corner solution will still arise with respect to S.

If domestic permit prices are higher ($P_H > P_F$), then $\gamma_F > 0$ and $S = A_F$. In this case, all of the subsidiary's abatement credits are transferred home. The effective permit price for the subsidiary becomes the home price. Marginal abatement costs in each country are equalized at the higher home price of permits: $C'(A_H) = C'(A_F) = P_H$.

Meanwhile, if foreign prices are higher ($P_H < P_F$), then $\gamma_H > 0$ and $S = -A_H$. The effective permit price for the parent becomes the foreign price: $\hat{P}_H = P_F$. Marginal abatement costs in each country are equalized at the higher foreign price of permits: $C'(A_H) = C'(A_F) = P_F$.

In other words, in the country with the lower permit price, marginal abatement costs will rise to equal

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Table 1: Offsets Limited to Abatement

	Excess Credits		No Excess Credits	
	$P_H(1-\tau_H) > P_F(1-\tau_F)$	$P_H(1-\tau_H) < P_F(1-\tau_F)$	$P_H > P_F$	$P_H < P_F$
S	A_F	$-A_H$	A_F	$-A_H$
$C'(A_H)$	P_H	$P_F(1-\tau_F)/(1-\tau_H)$	P_H	P_F
$C'(A_F)$	$P_H(1-\tau_H)/(1-\tau_F)$	P_F	P_H	P_F

the higher permit price in the other country. Thus, whenever opportunities for transferring profits home are exhausted, marginal abatement costs will then be equalized within the firm at the higher of the national permit prices. On the other hand, if the limits on offsets bind before the tax arbitrage constraint does, marginal abatement costs will not be equalized.

The situation where $\gamma_H > 0$ implies that the firm is buying permits at home and transferring them to the subsidiary. This direction of offsetting does nothing to repatriate profits; in fact, it does the opposite. It should thus be noted that this constraint can only bind along with the tax arbitrage constraint if subsidiary profits net of abatement costs are already negative from the start.

Table 1 summarizes the results from this section.

Limiting emission offsets to actual abatement renders the program, from the multinational firm's perspective, identical to a separate permit system with offsets, where the system with the higher after-tax price is the one that dominates. If permit prices are higher at home, adjusting for tax differences, the multinational firm will conduct extra abatement in the foreign country, pushing marginal abatement costs there beyond both the home prices and foreign permit prices in order to transfer profits home. If, adjusting for tax differences, permit prices are greater abroad, the parent will increase its abatement beyond home country requirements in order to reduce the abatement costs of the subsidiary, although not to the full extent of the actual price difference, reflecting the tax cost of shifting profits to the subsidiary.

Importantly, in neither case with excess credits are marginal abatement costs equalized. In relative terms, marginal abatement costs are always higher for the subsidiary facing a higher tax rate: $C'(A_F)/C'(A_H) = (1-\tau_H)/(1-\tau_F)$. In absolute terms, marginal abatement costs remain the equal to the permit price in the jurisdiction with higher after-tax prices. Limiting transfers to actual abatement activity serves to raise marginal abatement costs in the lower (after tax) emission price country. Normally, permits will flow from the lower-price country to the higher-price one. However, in one case, when the foreign country has a higher

permit price before but not after the tax deduction, transfers will occur in the opposite direction from what one would expect from observing just the permit price differential.

If no excess credits remain, then marginal abatement costs are equalized to the higher price for permits that the multinational faces. Unable to buy permits directly at the lower price, the multinational firm increases its abatement everywhere until the marginal costs equal the highest price it must pay for its remaining emissions. Thus, the higher price determines the value of an offset. On the other hand, if offsets are instead limited to actual emissions, as shown in the Appendix, the lower price determines their value. Since the multinational can buy permits in the low-price country to cover its remaining emissions elsewhere, it will abate everywhere just until marginal costs equal the lower price, the multinational's effective cost of an additional permit.

In an equilibrium with many multinational firms, many of which remain in excess-credit situations, allowing these limited offsets would cause the after-tax price differential to shrink. Still, this tendency toward equalization does not necessarily imply actual (before-tax) permit prices will tend to converge. In fact, if prices are initially close, they would tend to diverge according to the tax differential.

Of course, if foreign permits are treated not as pure offsets but as internal trades, transfer pricing becomes an issue. Thus far, we have assumed a transfer price of zero. Allowing the firm discretion in setting permit prices can enable the parent to repatriate fully its subsidiary's profits by setting below-cost prices for transfers from the subsidiary and high prices for transfers to the subsidiary. Then the $\lambda > 0$ case would be the relevant one. On the other hand, transfer prices may also have bounds put on them, in which case it is still possible to have the transfer limits bind before the tax-arbitrage constraint. The effects of transfer pricing will be discussed in more detail in the next section.

3.5 Transfer-Pricing Rules with Limited Offsets

In a system of separate permit policies and limited offsets, transfer-pricing rules can mitigate, though not always eliminate, tax-arbitrage distortions to abatement activities. For the purposes of this limited-offset plan, positive transfer prices tend to reduce the shadow value of the transfer constraint. Different types of transfer-pricing rules can be envisioned, such as using the price of permits in the home country or in the importing country as the appropriate valuation. However, different rules can have different interactions with

the constraint on offsets. This section lays out the incentives for offsets constrained to actual abatement; the Appendix discusses the effects under a regime limiting permit transfers to emissions obligations.

Consider after-tax profits when offsets are limited to actual abatement and a positive transfer price T is imposed:

$$\max_{A_H, A_F, S} \quad (\pi_H - C(A_H) - P_H(E_H - A_H - S) - TS)(1 - \tau_H) - \gamma_H(-S - A_H)$$
$$+ \quad (\pi_F - C(A_F) - P_F(E_F - A_F + S) + TS)(1 - \tau_F + \lambda) - \gamma_F(S - A_H) \quad (18)$$

where γ_H and γ_F represent the shadow values of the boundary constraints on S.

The first-order conditions for abatement lead to the same marginal abatement cost equations as in (13) and (14), although the shadow values may differ at the new optimum. The first-order condition for S gives us the arbitrage conditions for transferring profits from subsidiary to parent:

$$(P_H - T)(1 - \tau_H) - (P_F - T)(1 - \tau_F + \lambda) = \gamma_F - \gamma_H \quad (19)$$

From the limits on transfers we have the same conditions as in (16) and (17). Suppose first that the tax arbitrage constraint does not bind ($\lambda = 0$).

Foreign Price Rule: Suppose first that $T = P_F$.

If the foreign price is higher than the home price, then $\gamma_H > 0$ and $S = -A_H$: the multinational wants to transfer permits from the parent to the subsidiary. The subsidiary continues to abate until marginal abatement costs equal the host country price: $C'(A_F) = P_F$. Meanwhile, the parent raises abatement such that its marginal costs also equal the host country price: $C'(A_H) = P_F$. Since the subsidiary is "charged" the actual marginal cost of the transferred permits, there is no opportunity for tax-induced profit shifting in that direction.

If the home price is higher, then the left-hand side of (19) is positive, implying $\gamma_F > 0$ and $S = A_F$: the multinational wants to transfer permits from the subsidiary to the parent. The parent continues to abate until marginal abatement costs equal the home price: $C'(A_H) = P_H$. Meanwhile, the subsidiary raises abatement such that marginal costs are not only greater than the host-country price, but also greater than the

	$T = P_F$		$T = P_H$	
	$P_H > P_F$	$P_H < P_F$	$P_H > P_F$	$P_H < P_F$
S	A_F	$-A_H$	A_F	$-A_H$
$C'(A_H)$	P_H	P_F	P_H	$P_H + (P_H - P_F)\frac{1-\tau_F}{1-\tau_H}$
$C'(A_F)$	$P_F + (P_H - P_F)\frac{1-\tau_H}{1-\tau_F}$	P_F	P_H	P_F

parent's price: $C'(A_F) = P_F + (P_H - P_F)\frac{1-\tau_H}{1-\tau_F} > P_H > P_F$. This premium reflects the tax gain from repatriating profits.

Home Price Rule: Now suppose that $T = P_H$.

If home prices are higher, then from (19), $\gamma_F > 0$, implying $S = A_F$: permits are transferred to the parent. The parent continues to abate until marginal abatement costs equal the home price: $C'(A_H) = P_H$. The subsidiary also equates marginal abatement costs to the parent's price: $C'(A_F) = P_H$.

If foreign prices are higher, then $\gamma_H > 0$ and $S = -A_H$: the multinational transfers permits from the parent to the subsidiary. The subsidiary abates until marginal abatement costs equal the host country price: $C'(A_F) = P_F$. Meanwhile, the parent raises abatement in response to the higher prices abroad, but not to the full extent: $C'(A_H) = P_H + (P_H - P_F)\frac{1-\tau_F}{1-\tau_H} < P_F$. The differential reflects the tax cost of shifting rents into the higher tax jurisdiction.

Both of these particular rules make the tax rate differential irrelevant for determining the direction of the transfers; only the permit price differential matters. Furthermore, if the transfer price rule is the price of the importing country—the higher prevailing price for emissions permits—then tax differentials do not matter for abatement either. Marginal abatement costs will be equalized at that (higher) national permit price.

If, on the other hand, the rule is the price of the exporting country, then marginal abatement costs are not equalized. If the permits are transferred from subsidiary to parent, the transfer price is lower than the home opportunity cost. The subsidiary then overabates, raising marginal costs above the home country price to allow for more profit shifting. If the permits are transferred from parent to subsidiary, marginal costs for the parent will not rise to the level of the foreign price, reflecting the tax cost of effectively incurring a capital loss in the lower-tax home country.

If no excess credits exist, then with either rule only the price differential matters. As in the previous case

(with $T = 0$), marginal abatement costs are equalized at the higher price.

Thus, when the limit to offsets is actual abatement effort, an importing country transfer price rule assures the multinational equalizes marginal abatement costs across countries to the higher national permit price. However, the same transfer-pricing rule would have a different effect in another offset limitations regime. The Appendix shows that if offsets are limited to actual obligations, the lower permit price is the relevant one, and an export price rule would be needed to assure marginal abatement cost equalization for the multinational firm.

4   Conclusion

Corporate income tax rates vary significantly across countries (see Table 3). U.S. rates exceed those in many of the developed countries and in almost all the developing countries. Only those in a few western European countries are higher, but those countries are also major trading partners: Europe alone accounted for 45.1% of the $25.6 billion in 1994 foreign taxes.[10] Tax considerations may be important for offsets generated in developing countries (such as the system foreseen in the Kyoto Protocol's Clean Development Mechanism): all else equal, the desire to keep profits in lower-tax countries would make multinational firms more reluctant to incur more abatement costs in those countries (unless compensated with higher transfer prices). Without explicit and appropriate transfer-pricing rules, as well as a clear price for emissions, many of the efficiency gains from flexible abatement location mechanisms may be lost to inefficient tax shifting.

Furthermore, some of the sectors most likely to be impacted by potential international environmental policies like the Kyoto Protocol are the very ones with the most foreign tax obligations. U.S. manufacturers reported 71.1% of foreign taxes and 70.0% of the total foreign tax credit in 1994 (implying an excess-credit status). Furthermore, of these manufacturers, the leading industry group in terms of foreign-source taxable income were U.S. manufacturers of petroleum and coal products, reporting 19.6% of the total foreign taxes and an average foreign tax rate of nearly 41% (well above the 35% rate of the United States). Other leaders were corporations within the industry groupings of pharmaceuticals and drugs, and of motor vehicles.[11] Thus, many of the industries poised to engage in greenhouse gas emissions reductions activities are likely

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[10]IRS (1998).

[11]IRS (1998).

to be quite sensitive to tax provisions and rate differentials.

The policy question at hand is how to design a national emissions reduction policy with rules allowing for the performance of abatement activities abroad. The treatment of emissions offsets within tax policy will need to be sensitive to the design of the emissions policy, and perhaps vice versa. As is well known, limits on trading across countries restrict the international efficiency gains from reducing greenhouse gas emissions, given any internationally negotiated emissions caps. But those trading limits can also make abatement activities susceptible to incentives to shift taxable income.

We considered a limit imposed on the multinational firm itself. Limiting offsets to actual abatement activity would make the treatment of joint implementation projects (in countries with their own permit or other regulatory system) consistent with those under the Clean Development Mechanism (in countries without a national emissions permit program). With this type of offset limitation, the multinational firm will choose its abatement everywhere not just according to the highest price for emissions permits among the countries of its operations, but also according to relative tax rates. If offsets are free, the firm prefers to incur more abatement costs in higher-tax countries in exchange for valuable permits in lower-tax countries. If the subsidiary in a higher-tax country faces higher emissions prices, the parent will not take full advantage of abatement opportunities, as sending permits would also be sending profits to face higher taxes. To mitigate, though not eliminate, these incentives, a transfer price using the importing country's price as the rule could be imposed.

On the other hand, a supplementarity provision might restrict the share of an individual national source's net emissions that can be covered by foreign offsets. This type of restriction would suggest using the permit price in the country of export as the transfer price rule.

Only in a system of unlimited international trading would abatement be efficiently allocated across countries. However, even in this regime, tax shifting can still be achieved through unrestricted intrafirm transfer pricing. For efficiency in both environmental and tax policies, the best design is an international permit trading system with transparent, enforceable transfer-pricing rules.

In the absence of an environmental policy that creates a clear international price for emissions, transfer pricing will be much easier to manipulate. The general standard is that appropriate transfer prices equal

those prices that unrelated parties would have used in a transaction.[12] Without an international market price for emissions, such a price will be hard to determine and harder to enforce. However, even in the best of circumstances, valuation may be a challenge. At what point is the transaction deemed to take place—when abatement effort occurs, when the reductions are realized, or when the permits or offsets are actually redeemed or sold? Market prices can vary over time, and firms might choose to time the reporting of their transactions accordingly, with tax avoidance in mind. Does the home price or the foreign price prevail if differences exist? Can cost basis be used to measure value? This latter option would be especially problematic if emissions permits are allocated gratis to firms, creating a precedent for a zero price. This issue is of relevance to the proposed EU trading program. That program envisages gratis grandfathering allocation to national subsidiaries and trade among covered enterprises throughout the EU, including subsidiaries.

One option, with or without overall trading limitations, would be to disallow direct offsets and require international trade to be conducted through a national or international clearinghouse. Sales to the clearing-house would bear the clearinghouse price and be taxed accordingly. If other policy goals mandate the use of restrictions to international trade in emissions permits, those limits could be achieved by a national auction of import quotas for permits. Purchases from the clearinghouse would bear the clearinghouse price and the cost of the import quota, which would equalize the differential with the domestic permit price, and these costs would be deducted accordingly. Abatement decisions and permit purchases would then follow the prices in the particular country of operation, but prices would tend to converge through the pressures of the clearinghouse.

A "right to pollute" is an unorthodox asset, but recognizing the value of emissions is important to using flexibility in environmental compliance to its best advantage. The designers of emissions trading systems must work together with tax policy designers to provide good incentives for using the new asset. International trade in abatement offers great opportunities to lower the costs of reducing global pollutants. It also raises the importance of not just regulating, but also defining, allocating, and taxing emissions permits in a manner consistent with the treatment of other valuable assets.

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[12]This standard used throughout the countries in the Organisation for Economic Cooperation and Development.

Table 3: Comparison of Effective Corporate Tax Rates of Annex B Countries

Country	Effective rate (%)	Federal rate (%)
Japan	48	34.5
Canada	44.6	29.1
Germany (distributed / retained earnings)	43.6 / 52.31	30 / 45
Italy	41.25	37
Belgium	40.17	
United States	**40**	**35**
France	40	33.33
Greece	40	
Luxembourg	37.45	30
Portugal	37.4	34
Australia	36	
Czech Republic	35	
Netherlands	35	
Spain	35	
Austria	34	
Poland	34	
New Zealand	33	
Turkey	40.3 / 33	
Denmark	32	
United Kingdom	31	
Iceland	30	
Finland	28	
Ireland	28	
Norway	28	21.25
Sweden	28	
Switzerland	25.1	
Hungary	18	
Average	35	

Effective tax rates include statutory national rates plus other relevant taxes, including state, provincial or municipal income taxes (incorporating deductibility) and witholding taxes. Source: KPMG (2000).

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A Variations on Limited Offset Rules

A.1 Offsets Limited to Domestic Obligations

Another type of trade limitation might allow firms to use foreign permits acquired by subsidiaries to offset the parent's domestic emissions requirements (and visa-versa), but they are otherwise not freely tradable (e.g., it cannot sell foreign permits on domestic markets). Such rules would place a certain limit on arbitrage; importantly, that limit would also be endogenous, but the constraint takes the opposite sign of the previous example.

The set of possible permit transfers between the subsidiary and the parent are $S \in [E_H - A_H, A_F - E_F]$. After-tax profits are

$$
\begin{aligned}
\max_{A_H, A_F, S} \quad & \left(\pi_H - C(A_H) - (P_H - \gamma_H)(E_H - A_H - S) - TS \right)(1 - \tau_H) \\
+ \quad & \left(\pi_F - C(A_F) - (P_F - \gamma_F)(E_F - A_F + S) + TS \right)(1 - \tau_F + \lambda)
\end{aligned}
\tag{20}
$$

where γ_H and γ_F represent the (tax adjusted) shadow values of the boundary constraints on S.

The first-order conditions for abatement are

$$
C'(A_H) = P_H - \gamma_H \tag{21}
$$
$$
C'(A_F) = P_F - \gamma_F \tag{22}
$$

Let $\hat{P}_H = P_H - \gamma_H$ and $\hat{P}_F = P_F - \gamma_F$ be the effective permit prices for the parent and subsidiary, inclusive of the shadow value of the offset constraint.

These arbitrage conditions can be seen in the first-order condition for S, the vehicle for transferring profits from subsidiary to parent:

$$
(P_H - T - \gamma_H)(1 - \tau_H) = (P_F - T - \gamma_F)(1 - \hat{\tau}_F) \tag{23}
$$

Consider first a pure offset system, with zero transfer prices: $T = 0$. Suppose that the tax arbitrage constraint does not bind. If any differential exists in the after-tax permit price, one of the transfer constraints

must bind.

If $P_H(1 - \tau_H) > P_F(1 - \tau_F)$ then it must be that $\gamma_H > 0$ and $\gamma_F = 0$. Since the home constraint is binding, $S = E_H - A_H$. Meanwhile, the relevant permit price at home is then $\hat{P}_H = P_F \frac{1-\tau_F}{1-\tau_H}$. The subsidiary chooses abatement such that $C'(A_F) = P_F$, while the parent equalizes marginal abatement costs to the effective price of permits, including the shadow value of the transfer constraint: $C'(A_H) = \hat{P}_H < P_F$.

In other words, if the after-tax permit price is lower in the foreign country, all the permits will be bought there. However, the firm will not equalize all of its marginal abatement costs to the foreign permit price; less abatement will be performed at home to reflect the value of transferring profits to the lower-tax jurisdiction. Marginal abatement costs at home will then be lower than both the foreign and the home permit prices (since $P_H > \hat{P}_H$).

If, on the other hand, $P_H(1 - \tau_H) < P_F(1 - \tau_F)$, then it must be that $\gamma_F > 0$ and $\gamma_H = 0$. Since the foreign constraint is now binding, $S = A_F - E_F$. The effective cost of permits to the subsidiary is then $\hat{P}_F = P_H \frac{1-\tau_H}{1-\tau_F}$. The parent chooses abatement to equalize $C'(A_H) = P_H$. Meanwhile, the subsidiary abates until marginal costs equal the effective price of permits, including the shadow cost of the transfer constraint: $P_F > C'(A_F) > P_H$.

In other words, if the after-tax permit price is lower at home, permits will be purchased there and transferred to the subsidiary. The parent will equalize its marginal abatement costs to the home permit price. However, marginal abatement costs for the subsidiary, while lower than the foreign permit price, will not fall completely to the home price, reflecting the additional tax cost of incurring costs in the low- rather than the high-tax jurisdiction.

Now suppose the tax arbitrage constraint binds, and $\hat{\tau}_F = \tau_H$. Unless $P_H = P_F$, a corner solution will still arise with respect to S: all permits will be purchased in the country with the lower permit price, and marginal abatement costs will equalize at that price.

If $P_H > P_F$, then $\gamma_H > 0$ and $\gamma_F = 0$. This implies that $S = E_H - A_H$ and the effective permit price at home is $\hat{P}_H = P_F$. Thus, $C'(A_H) = C'(A_F) = P_F$. In other words, if the permit price is lower in the foreign country, all the permits will be bought there and the firm will equalize all of its marginal abatement costs to the foreign permit price.

If, on the other hand, $P_H < P_F$, then $\gamma_F > 0$ and $\gamma_H = 0$. In this case, $\hat{P}_F = P_H$, and $C'(A_H) =$

Table 4: Transfers Limited to Net Emissions Obligations

	Excess Credits		No Excess Credits	
	$P_H(1-\tau_H) > P_F(1-\tau_F)$	$P_H(1-\tau_H) < P_F(1-\tau_F)$	$P_H > P_F$	$P_H < P_F$
S	$E_H - A_H$	$A_F - E_F$	$E_H - A_H$	$A_F - E_F$
$C'(A_H)$	$P_F(1-\tau_F)/(1-\tau_H)$	P_H	P_F	P_H
$C'(A_F)$	P_F	$P_H(1-\tau_H)/(1-\tau_F)$	P_F	P_H

$C'(A_F) = P_H$. In other words, if the permit price is lower in the home country, all the permits will be bought there and the firm will equalize all of its marginal abatement costs to the home permit price. Since this direction of offsetting does nothing to repatriate profits (in fact, it does the opposite), this constraint can only bind along with the tax arbitrage constraint if subsidiary profits net of abatement costs are already negative.

The table summarizes these results. If the limit on offsets binds before the tax arbitrage constraint, marginal abatement costs will not be equalized. Permits are bought where the after-tax price is lower. In that country, marginal abatement costs equal the local permit price, while in the other country, they are higher or lower, according to the relative tax rates. Once opportunities for transferring profits home are exhausted, marginal abatement costs will be equalized within the firm at the lower of the national permit prices. This result contrasts to the regime where offsets are limited to actual abatement, where marginal abatement costs follow the higher permit price.

A.2 Transfer Pricing with Limit of Emission Obligations

For the purposes of this limited-offset plan, positive transfer prices tend to reduce the shadow value of the transfer constraint (as with the other limitation rule for offsets). We now consider the same types of pricing rules as before, where the prevailing price in either the home or foreign country is chosen as the required permit price.

Suppose $T = P_F$. If that price is lower than the home price, then the multinational wants to transfer permits from the subsidiary to the parent. The lower foreign price becomes the relevant one for both the parent and the subsidiary. The parent reduces its abatement until $C'(A_H) = P_F$, since it is cheaper to allow the remaining emissions to be offset by foreign permits. Meanwhile, the subsidiary has no incentive to overabate: $C'(A_F) = P_F$.

	$T = P_F$		$T = P_H$	
	$P_H > P_F$	$P_H < P_F$	$P_H > P_F$	$P_H < P_F$
S	$E_H - A_H$	$A_F - E_F$	$E_H - A_H$	$A_F - E_F$
$C'(A_H)$	P_F	P_H	$P_F + (P_H - P_F)\frac{\tau_F - \tau_H}{1 - \tau_H}$	P_H
$C'(A_F)$	P_F	$P_H - (P_F - P_H)\frac{\tau_F - \tau_H}{1 - \tau_F}$	P_F	P_H

If home prices are lower than the transfer price, then the parent wants to sell permits to the subsidiary. The parent does not abate more than the home country price would dictate: $C'(A_H) = P_H$. However, it sells permits to the subsidiary equal to its emissions requirement. To raise that requirement and allow the transfer of more costs to the subsidiary (and thereby profits to the parent), the subsidiary reduces its abatement below the home as well as the host country price: $C'(A_F) = P_H - (P_F - P_H)\frac{\tau_F - \tau_H}{1 - \tau_F}$.

Now suppose that $T = P_H$. If that represents the lower price, then the multinational transfers permits from the parent to the subsidiary. The parent abates according to the home country price, and the subsidiary lowers its abatement to equalize marginal costs: $C'(A_F) = P_H = C'(A_H)$. Since the transfer price reflects the actual marginal cost of abatement, no opportunity for tax shifting exists.

If home prices are higher than the transfer price, then permits are transferred to the parent. In this case, the subsidiary abates until marginal abatement costs equal the host country price: $C'(A_F) = P_F$. The parent, however, does not reduce its abatement to equalize marginal costs with the foreign price, since it must pay a higher price for the transfer (which transfers profits to the higher-tax jurisdiction): $C'(A_H) = P_F + (P_H - P_F)\frac{\tau_F - \tau_H}{1 - \tau_H}$.

As with the previous example, both of these rules make the tax rate differential irrelevant for determining the direction of the transfers. However, the same transfer-pricing rules have different effects for different regimes of limiting offsets. If firms cannot import more permits than they can use, a transfer price rule of the purchase price cost ensures marginal abatement costs will be equalized at the lower national permit price. If, on the other hand, the rule is local (importing country) permit costs, then marginal abatement costs are not equalized. If the permits are transferred from subsidiary to parent, marginal abatement costs by the parent do not fall to the lower foreign permit price, reflecting the tax cost of incurring capital gains in the subsidiary. If the permits are transferred from parent to subsidiary, the subsidiary will keep marginal abatement costs even lower than the home country price. This undercompliance enables the parent to incur more gains at

home and costs abroad, thereby shifting taxable profits home.

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(xliii)This paper was presented at the International Workshop on "Voluntary Approaches, Competition and Competitiveness" organised by the Fondazione Eni Enrico Mattei within the research activities of the CAVA Network, Milan, May 25-26,2000.

(xliv) This paper was presented at the International Workshop on "Green National Accounting in Europe: Comparison of Methods and Experiences" organised by the Fondazione Eni Enrico Mattei within the Concerted Action of Environmental Valuation in Europe (EVE), Milan, March 4-7, 2000

(xlv) This paper was presented at the International Workshop on "New Ports and Urban and Regional Development. The Dynamics of Sustainability" organised by the Fondazione Eni Enrico Mattei, Venice, May 5-6, 2000.

(xlvi) This paper was presented at the Sixth Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei and the CORE, Université Catholique de Louvain, Louvain-la-Neuve, Belgium, January 26-27, 2001

(xlvii) This paper was presented at the RICAMARE Workshop "Socioeconomic Assessments of Climate Change in the Mediterranean: Impact, Adaptation and Mitigation Co-benefits", organised by the Fondazione Eni Enrico Mattei, Milan, February 9-10, 2001

(xlviii) This paper was presented at the International Workshop "Trade and the Environment in the Perspective of the EU Enlargement ", organised by the Fondazione Eni Enrico Mattei, Milan, May 17-18, 2001

(xlix) This paper was presented at the International Conference "Knowledge as an Economic Good", organised by Fondazione Eni Enrico Mattei and The Beijer International Institute of Environmental Economics, Palermo, April 20-21, 2001

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(li) This paper was presented at the Fourth Toulouse Conference on Environment and Resource Economics on "Property Rights, Institutions and Management of Environmental and Natural Resources", organised by Fondazione Eni Enrico Mattei, IDEI and INRA and sponsored by MATE, Toulouse, May 3-4, 2001

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(liii) This paper was circulated at the International Conference on "Climate Policy – Do We Need a New Approach?", jointly organised by Fondazione Eni Enrico Mattei, Stanford University and Venice International University, Isola di San Servolo, Venice, September 6-8, 2001

(liv) This paper was presented at the Seventh Meeting of the Coalition Theory Network organised by the Fondazione Eni Enrico Mattei and the CORE, Université Catholique de Louvain, Venice, Italy, January 11-12, 2002

(lv) This paper was presented at the First Workshop of the Concerted Action on Tradable Emission Permits (CATEP) organised by the Fondazione Eni Enrico Mattei, Venice, Italy, December 3-4, 2001