

**Institutions for Definition and Renegotiation of Property rights in
International Environmental agreements: Ozone Depletion and the
Montreal Protocol.**

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1 Introduction

This paper addresses the question of how to implement international environmental agreements. Many international environmental agreements require side payments to induce participation by all the countries relevant to the problem. This paper looks at an international fund and a tradeable permits system as two institutions for effectively transferring resources and supporting overall cooperation. It considers how each can in theory, and does in practice, deal with certain common contracting problems. It draws on microeconomic theory on contracts, and experience with the Multilateral Fund established in the Montreal Protocol which addresses ozone depletion, as well as experiences with domestic tradeable permit markets.

The first contracting problem is how to establish property rights. Even with agreement on relative responsibilities among countries there is still a need to define the responsibilities in a useful and clear way and to have systems which maintain a fully acceptable and transparent registry of different countries' responsibilities at a point in time. The second issue is how to deal with new information and other pressures to renegotiate property rights.

In the short run I conclude that the international fund is a superior instrument because of the flexibility it offers in definitions of responsibilities and in encouraging compliance. In the long run however, I make a case for the advantages of a tradeable permit market for cost effectiveness but also for greater robustness and protection against renegotiation, and potentially for monitoring and enforcement. I argue that an international fund should be designed as a transitional instrument which facilitates the development of a tradeable permit system.

Since the first United Nations Conference on the Human Environment in Stockholm in 1972 the international community has begun to take serious steps to address international environmental problems in a cooperative way. The resulting agreements regulate the way individual nations produce, trade and consume. The Montreal Protocol on Substances that

Deplete the Ozone Layer has been the most comprehensive and successful agreement to date. It involves rapid phasedown of widely used chemicals, trade sanctions and an innovative institutional form including financial transfers to developing countries to encourage broad participation.¹ How such agreements are implemented and how resources are mobilized and transferred to achieve the overall target is critical. If it is possible to make efficient financial transfers, the total cost of environmental protection is reduced and finding ways to share cost may be easier. If countries have increased control over how they fulfill their obligations, and increased flexibility, they may bring more innovative solutions to the negotiating table and may be less resistant to bearing costs. Thus it may be possible to achieve a higher level of cooperation.

There is very little economic analysis of international regulation of environmental public good provision. Much of the existing economic analysis takes experience and understanding of domestic regulation and directly extends this to the international arena.² While this can provide many useful insights it does not take into account the unique character of international relations. There is a strong literature in political science and law on local commons issues which deals with issues conceptually similar to those in this paper, as well as an extensive literature on international institutions.³ This paper builds on this literature and brings in a new set of analytical tools.

Section 2 develops the theoretical ideas in the paper. I start by defining the international agreement as a contract and outlining the features of a fund and a tradeable permit market. Then the paper considers each of the contracting problems in turn and considers the way that the institutional form affects the nature of these problems and the available solutions.

Section 3 illustrates these ideas in the context of ozone depletion and the Montreal Protocol. It provides some background to the problem and the interests of the parties involved, then defines both the existing fund and a hypothetical tradeable permit market. The following sub-sections consider the contracting problems as they arose in the context of ozone depletion. Each section looks at how the actual fund dealt with a specific problem and whether the failures and successes of the system were inherent to the fund structure. It compares this both to how a

¹ The issues discussed in this paper are not only relevant to regulation of ozone depletion, but also to dealing with global climate change, biodiversity loss, transboundary air pollution, transboundary watershed issues, deforestation, and desertification among other issues.

² See for example, Tietenberg and Victor (1994), Fisher B., et al. (1995)

³ For example Ostrom (1990), Keohane and Ostrom (1995), and Keohane (1984)

tradeable permit system could theoretically deal with the same issues, and to how real permit markets have dealt with these issues in comparable situations. Section 4 concludes.

2 The Theory of Contracts and Institutions for Implementing International Contracts

2.1 PRINCIPALS, AGENTS, AND CONTRACTS

An international environmental agreement is a contract among the participating countries. The principals in the contract are the countries concerned about the environmental outcome but who are unable or unwilling to carry out all the actions themselves to achieve the objectives. The agents are those countries and actors which have the information and ability to implement actions which will contribute to achieving the objectives of the contract. Agents are self interested and not directly concerned with the environmental outcome. Clearly countries cannot be clearly classified in this way and nearly all countries have two roles, both as principal and as agent. It is nevertheless useful to separate these roles to understand the structure of incentives and information within the contract. Some countries elevate their interests as a principal as opposed to an agent in particular situations and some generally regard themselves as agents. Countries which take an active leadership role in forming an agreement are acting as principals. The same country is acting primarily as an agent when it determines its domestic response to the negotiated agreement.

The production of a public good, or management of a common property resource, requires cooperation, so the contract lays out what each country agrees to do and what they are entitled to receive. One country's obligation to comply with the contract is essentially conditional on compliance by other countries. Participation in the contract must be voluntary so it must be optimal for each country to sign the contract if the other countries also sign.⁴ The mechanism to implement financial transfers is a specific part within this contract. Individual transfers are specific contracts which specify particular projects in return for particular amounts of money and / or other resources. These are not written into the basic contract, but are

⁴ i.e. it must be a reassurance equilibrium.

developed later under the rules determined by the transfer mechanism. Thus the basic contract defines the institution or governance system under which individual contracts operate.

An international fund and a tradeable permit market are two broadly defined forms of transfer mechanism. The underlying rights and obligations of the participating countries and the objectives of the contract as a whole are not affected by the form of transfer mechanism. Under both forms of transfer mechanism the implementation of the contract requires an organization to monitor and enforce overall compliance with the contract. The questions this paper deals with is how these two institutions affect incentives, information flows and control rights and how these changes affect the way the contract is able to deal with contracting problems.

An international fund is defined by the following characteristics. The principals contribute money to the fund in amounts defined in the contract. An organization is created to receive this revenue and to approve and implement the disbursement of funds to specific projects based on a predetermined set of rules. The predetermined rules usually involve discretion on the part of a group of actors assigned the responsibility to choose projects and deal with ambiguity and small changes in property rights as they arise. The agents apply to this organization to receive funds for specific projects. International Funds generally also involve implementing agencies to disburse funds because of concerns about the use of cash in international organizations.

A tradeable permit market is defined by the following characteristics. Principals are required in the contract to achieve a certain quantity of abatement, relative to defined benchmarks, directly or through the agents. The sum of these quantities is equal to the total amount of abatement agreed upon. An organization is created to monitor/certify the quantity of abatement achieved by each principal. The principals approve and implement projects directly with the agents or through brokers of their choosing. The agents do projects on behalf of the principals and negotiate the sub-contract, including the payment in money or other resources, directly with the principals or their brokers.

2.2 ALLOCATION, DEFINITION AND REGISTRATION OF PROPERTY RIGHTS

At this point we have defined two alternative institutional forms for implementing financial transfers, an international fund and a tradeable permits market. This section compares

these two systems on the basis of how the property rights can and should be defined bringing out both common problems and differences.

A property right is the exclusive right to use a resource in a specified way, for example, using the atmosphere by emitting pollutants. The definition of the “pollutant”⁵ to be controlled is the first step toward defining a property right. The definition of the pollutant needs to take into account three issues. First, it should relate closely to the environmental target; i.e., controlling the pollutant should achieve the environmental goal. This is a purely scientific issue but is frequently uncertain. The actual pollutant definition chosen will have to be one for which there is a high degree of consensus. Without agreement it will be very difficult to support the property rights in a clear way. It is not usually administratively possible or economically efficient to use the scientifically correct definition of the relevant pollutant. The second characteristic of the definition of the pollutant is that it should be easy to monitor emissions. This is particularly important if there are some countries which are likely to defect. Third, the definition of the pollutant should be chosen so that the costs of control are not too high. When the economic costs of pollution control are high it is important to emphasize this feature even if it means incurring higher monitoring costs. When costs are high, the distribution of costs across industries and countries becomes extremely important and minimization of total costs becomes important for the well-being of the countries involved. This will be particularly true in the greenhouse warming case while it has until now been much less critical in controlling ozone depletion.

Once the property rights have been defined, they must be completely allocated among the parties, summing to the agreed total global target. Some countries will have positive rights to use the resource and some may also be allocated obligations to reduce emissions in other countries either defined as responsibilities to contribute cash to a fund or negative rights which implies a responsibility to purchase rights. Allocation is achieved through a negotiation process.

It is essential in any international agreement which establishes property rights that the owner of rights can be clearly identified at all times. In a domestic situation, cars have registration papers, houses have title deeds and shares have share certificates. All of these property rights are recorded in centralized systems and have rules which require notification when ownership of the property changes. These systems of registration provide legal evidence

⁵ “Pollutant” could be emissions into air or water or destruction of biodiversity through loss of habitat.

of ownership in cases where this is challenged. They also allow governments to ensure that property holders are fulfilling the obligations which go with property ownership. For example, car owners are required not to drink and drive and can be identified from their license plate, residential property owners are required to pay property taxes, share holders are restrained from insider trading. When property rights cannot be clearly identified at each point in time it is impossible to maintain property rights. When there are disputes over the obligations an agreement imposes on a particular country, the agreement becomes less effective. In an international environmental treaty, property rights can be determined from the treaty or protocol, though they may be incomplete or ambiguous.

The problems of definition, allocation, and registration of property rights are common to an international fund and a tradeable permit market. A tradeable permit market may ease the process of allocation by increasing flexibility and efficiency. However, the consequences of poor definition and registration could be more serious in a tradeable permit market.

Tradeable permits markets have the potential to increase the efficiency of spending on the environment and thus reduce the financial commitments necessary to achieve a certain level of protection. The competence and impartiality of the organization implementing a fund may be questioned by some donor or recipient countries. In a tradeable permit market, the country transferring the money and that receiving the money have freedom to negotiate the terms under which the transfer takes place. Tradeable permits separate the location of the production of environmental protection from the location of cost bearing even more clearly than under an international fund thus further increasing the zone of possible agreement and making allocation easier. The greater the variance in individual countries' capabilities to address the problem, the more useful a tradeable permits approach becomes. These factors may make it easier in a tradeable permit market to increase the level of protection agreed to, and to increase the extent to which developed countries bear the costs of environmental protection even when protection must be carried out in less developed countries.

However, a tradeable permit market requires very clearly defined observable rights. It requires that distributional issues be fully resolved. For a tradeable permit market, the pollutant must be defined clearly and the place and time in which the permit may be used must be defined clearly. If a tradeable permit is not defined in a way that is compatible with the environmental objective, as trades take place to maximize the economic value of the permit to pollute they

might reduce the environmental effectiveness of the agreement. The owner of the property right must also be clearly defined. This transparency may make it harder for governments to make side deals to encourage reluctant countries to join while still justifying the agreement to domestic interests. These problems arise less in a less formal agreement with greater discretion, such as an international fund, because property rights are not so transparent, and because informal pressure can more easily be brought to bear to keep actions within the general "spirit" of the agreement.

An accurate and efficient registration system is essential for any formal tradeable permit system far more than under other systems so that the distribution of rights is always unambiguous and readily observable. In a tradeable permit market property rights can change rapidly. To enforce compliance, the ownership of rights must be transparent, otherwise unscrupulous traders may use the non-transparency to avoid obligations. In an international system, the registry would have to be run by a highly trusted and competent international agency.⁶

2.3 CHANGING PROPERTY RIGHTS - RENEGOTIATION AND HOLD-UP

The previous section discussed issues relating to how to define property rights in a contract. In the international sphere in particular, property rights are never permanent and contracts change over time. This section discusses how those changes or possibilities of change affect the regulation, and how an international fund and a tradeable permit market deal with this.

Renegotiation occurs any time the terms of the original contract are changed, that is, when property rights are altered. Renegotiation can occur by consensus, or as a result of an incomplete original contract which did not specify what to do in a situation which later arises. In an international agreement which is ultimately unenforceable, renegotiation can also be forced by powerful countries.⁷

Renegotiation can be a good thing when it is a response to changing conditions or better information which allow the agreement to be improved upon. However, the anticipation of

⁶ It may be the type of function which could be given to an international financial institution with experience and credibility and the backing of some international law.

⁷ Forced renegotiation may be more of a problem in environmental agreements than in many other areas because the interests in favor of environmental protection are not as well developed and strong as the forces in support of other international agreements such as financial, trade, or telecommunications agreements. Probably the fundamental solution to this problem lies more in the development of the forces for protection rather than in the form of agreements used. However the form of agreement may be used to strengthen the forces for protection by encouraging the involvement and strengthening of environmental NGOs (Non-governmental Organizations), or by linking the protection of the property rights under the agreements to other property rights with stronger protectors.

renegotiation of property rights hinders effective investment which is dependent on the current agreement because of fear that the investment or returns from that investment will be lost. The challenge in all agreements is to maximize the process of "good" evaluation and feedback, while minimizing the uncertainty about the conditions under which investments are made, which renegotiation can create.

Flexibility versus Investment Inefficiency

A complete contract includes provisions for what should be done in all possible contingencies. If a contract is complete, it is never necessary to renegotiate the contract. In a complex and highly uncertain situation, with significant transaction costs, and especially where a large number of countries must agree on the contract, it is impossible to agree on solutions to every conceivable problem.

An incomplete contract essentially implies lack of definition of property rights at least in some circumstances. The environmental area is one in which most property rights, i.e., either the right to a clean environment or the permit to pollute, are not defined. For efficient and secure investment we would need to firmly establish all the property rights relevant to the control of a particular pollutant. In a previously unregulated area it is difficult to identify all the property rights which must be established, and to negotiate the appropriate definition and allocation of these rights. When scientific knowledge is rapidly evolving it is necessary to allow some flexibility in the definition of rights so we are not trapped into scientifically inappropriate regulation. In addition, until distributional issues are completely resolved, it will be impossible to agree on any significant level of regulation unless it is known that the current allocation of rights is still open to future negotiation.

The disadvantage of this flexibility is that with uncertain property rights countries will not have incentives to make efficient investment decisions. Suppose an international agreement is made which allocates property rights which require countries to achieve certain levels of abatement. Suppose country X chooses the most efficient way to achieve this abatement which involves investment in technology and institutions which are specific to abatement. If the agreement is renegotiated in a few years, country X will face lower marginal costs of abatement and will be unable to threaten or claim that it will not or cannot achieve certain levels of abatement because of the specific investments. New cost shares will be negotiated and other countries will receive some of the benefits of country X's efficient investment decision, because

country X will probably bear a higher new cost share than otherwise.⁸ If country X had anticipated this renegotiation it would have invested less and would not have made such specific investments. It would have chosen a less efficient response but one which would not affect its later bargaining position so that it could capture the benefits of its own investment.⁹ The underinvestment or biased investment which results leads to higher costs for the countries as a group and is thus inefficient.¹⁰

Possible Solutions

Addressing renegotiation requires balancing the need to change agreements in response to new information with the need to provide secure property rights. There are four basic approaches. The first is to make the contract more complete so that the frequency of renegotiation is diminished. This solution is not affected by the form of implementation.

The second approach is to clearly specify conditions under which bargaining will occur, thus limiting the outcome of the renegotiation. This is a mechanism design problem where the parties are trying to design an optimal process for revision of the targets taking into account the costs and benefits of all parties. Hart and Moore (1988) discuss an approach of this type where contracting parties are unable to write a complete verifiable contract but are able to reduce the inefficiency this causes by specifying a particular communication mechanism. Their mechanism essentially gives the bargaining power in the renegotiation process to those who are required to make specific investments. The basic problem of renegotiation arises because those who make investment decisions are not the only ones involved in making decisions about factors which affect the future return from those investments. If those who make the investments have all the bargaining power they essentially make all the decisions and there is no "hold up" problem.

In an international agreement, bargaining may be affected by the voting rule used. In an international fund, small changes to property rights are made through the discretion of those who manage the fund. Voting structures in the fund, the institutional location of the fund and information flows affect the way property rights will be renegotiated. However voting rules cannot change underlying power relationships and any agreement can itself be renegotiated. This illustrates one problem with applying the Hart and Moore approach to many situations. It is

⁸ With a lower total costs and the same sharing rule, country X will only receive a share of the reduction in total costs due to its own investment.

⁹ This problem is analogous to the problem discussed by Groot (1984) which involves bargaining between a union and a firm where the firm makes specific investments and later renegotiates wages.

¹⁰ The effect of investments in specific capital on bargaining power is referred to as the problem of "hold up". (Milgrom and Roberts 1992)

rarely possible to give all the bargaining power to one party. The allocation of bargaining power can itself be renegotiated in most situations.

A third way to change the renegotiation process is to reduce the transaction costs of certain types of renegotiation by specifying the process for them in advance, thus making general renegotiation less likely. The use of a fund allows some renegotiation of cost shares and re-weighting of different forms of protection without changing the protocol as a whole. In a tradeable permit market, possibilities for renegotiation of rights have to be built into the definition of the permit. The permit could have a limited life, or could be defined as a share of an overall target which can be adjusted within the agreement. These provide certainty for a given time horizon or certainty that individual investment decisions will not change the share of total costs borne.

Alternatively the rights can be structured to raise the transaction costs of changing them to minimize all forms of renegotiation. Because the definition of property rights is by necessity very clear in a tradeable permit market, reallocation or alteration of rights is also very clear. This may make it more difficult to change property rights politically because the holders of these rights will fight for their protection unless there are benefits to them from the change. International funds may be more vulnerable to renegotiation because they involve cash payments from developed countries which are subject to short term domestic budgeting pressure. On the positive side, the rights in a tradeable permit market will be more fervently protected against forced renegotiation. Removal of property rights is a very obvious thing in an international economic system where property rights at least in principle are sacrosanct. If tradeable permits become accepted on the same basis as other more conventional rights, such as rights of creditors in international financial markets, the forces which are rallied to protect conventional rights may also be used to support the tradeable permits. However, this also means that the use of a tradeable permit market can create some barriers to "good" renegotiation. This suggests that tradeable permits should not be established until they are worthy of the protection other conventional rights receive.

If complete binding contracts could be written, the balance between flexibility and certainty could be achieved by fully compensating those whose property rights need to be changed. Aghion, Dewatripont and Rey (1990) outline one way in which this outcome could be achieved. In their model, the parties agree on an enforceable "status quo" point which protects

the rights of one party and guarantees them a certain level of return on investment. This party can always insist on this outcome. The other party is given all the bargaining power in renegotiation. If there are joint gains to renegotiating, the renegotiation will occur and the first party will get the same level of utility as in the original agreement. Therefore the first party will invest optimally on the basis of secure returns. Because the other party has all the bargaining power it also has incentives to invest optimally.

International politics does not allow significant changes to the current allocation of bargaining power. A fifth way to deal with renegotiation problems is to make the powerful players who already have the bargaining power make all the investments. In a tradeable permits market an option for minimizing "hold up" is to design and allocate the permits in such a way that the intrinsically most powerful nations have an interest in protecting the returns from specific investments made as a result of the market. This turns the models by Hart and Moore, and Aghion, Dewatripont and Rey upside down by allocating investments to those with bargaining power rather than designing a mechanism which gives bargaining power to those who need to make investments. If the property rights are given to those who do not have bargaining power but the initial rights are strongly protected they could act as a status quo point for developing countries and the tradeable permit market may imitate the Aghion, Dewatripont and Rey model and lead to optimal investment.

For example, a powerful country makes investments in specific abatement technology within a non-powerful country and receives returns in the form of permits from the non-powerful host country as abatement is produced. This contract is made under domestic law in the powerful country. When the international agreement is renegotiated, the powerful country will protect the permit allocation of its host country against claims by third countries to ensure its ongoing return from its specific investment. When the contract between the powerful and host countries is renegotiated, domestic law protects the status quo rights of the host country and the powerful country is forced to maintain the host's utility. The powerful country can claim all additional gains from renegotiation. This preserves the status quo utility for the host developing country thus guaranteeing them a certain return on any investments they made, and gives all the returns to specific investment to the powerful country.

3 Ozone Depletion and the Montreal Protocol

3.1 THE MONTREAL PROTOCOL

Ozone is a trace gas which absorbs UV-B rays in the stratosphere and prevents them reaching the earth's surface.¹¹ Ozone also affects temperature and circulation patterns in the stratosphere which have major implications for the climate around the world. The ozone layer is a pure public good in terms of its use for protection because no one can be excluded from protection and climatic effects and the consumption of protection and climate is non-competitive. In 1974 the first evidence was found that human activity could lead to large changes in the amount of ozone in the stratosphere. This discovery led to a process of international discussion and later negotiations which culminated in the Montreal Protocol in 1987. Ozone depleting substances (ODS) are uniformly mixed.¹² That is, it makes no difference for the ozone layer where the chemical is emitted.¹³ The ozone layer can be considered a common property resource because the atmosphere is used to dispose of ozone depleting chemicals and has limited carrying capacity.

The Montreal Protocol, and the Vienna Convention which preceded it, were originally negotiated among developed countries which are the major producers of ODS. These countries are in temperate zones which are likely to be more affected by ozone depletion, and have richer populations with fairer skins who are more concerned about UV-B radiation and environmental amenities. As the science developed further and suggested that the problem was even more serious than originally thought, the developed countries realized that their reductions in ODS use would count for nothing if the developing countries expanded their own currently small production as they grew. The developing countries strongly opposed being limited by a Protocol which they had not been involved with developing, and which addressed a problem for which they were not responsible. Many of the developing countries also felt they had more serious problems to worry about. In particular it was impossible to coerce large countries such as China and India to control their production simply through the use of trade sanctions and diplomatic pressure. Some transfer of resources including technology was necessary to encourage their participation.

¹¹ In excessive quantities UV-B rays can cause skin cancer and biological damage.

¹² The "ozone depleting substances" (ODS) include CFCs, Halons, Methyl Chloroform, Carbon Tetrachloride and HCFCs.

¹³ In fact the most serious damage so far has occurred over Antarctica which is probably the point on the globe farthest from the major CFC producers.

Some countries are more important as principals in the Montreal Protocol than others. For example, the US, Canada and the Nordic nations among others pushed for stronger measures in the Vienna convention and were the first and almost only¹⁴ to ratify it before the negotiations on the Montreal Protocol began.¹⁵ Any country which is needed to take action to address the global issue is an agent. In the negotiation of the Montreal Protocol, the US and the EC were pivotal agents because in 1986 they produced around 74% of all ozone depleting substances.¹⁶ In the negotiation of the London Amendments, India and China were pivotal agents because they are extremely large growing economies and hence potential users of ODS.¹⁷

The issues of participation of, and assistance for the developing countries were addressed in the London Conference in 1990. In London, many developing countries agreed to controls with a ten year grace period in exchange for funding to cover the “incremental costs” of implementing the controls. The controls and financial responsibilities of developed country signatories are given in Appendix 2. The controls and the provisions for “article 5” countries, which are developing countries which currently use less than 0.3 kg ODS per capita, are given in Appendix 3.¹⁸

Definition of International Fund and Tradeable Permit Market

In 1990 at the London Conference the negotiators agreed what controls the article 5 countries will accept and to what financial and technological resources they are entitled. The obligations of each developed country were determined both in terms of their domestic abatement responsibilities (Article 2) and their responsibility to contribute to article 5 phasedown with shares set according to the United Nations scale of assessments. Given these overall targets and cost shares, the negotiators had a choice on what form of institution to use to transfer resources from the developed countries to the article 5 countries. With the benefit of hindsight, I consider how the actual financial mechanism designed in the London Conference dealt with

¹⁴ The Soviet Union also ratified the Convention.

¹⁵ pp. 64, 68 Benedick (1991).

¹⁶ p 26 Benedick (1991).

¹⁷ In addition they could make a credible threat to increase their use of ODS. They have sufficiently large internal markets that the restrictions on trade in products containing ODS did not make it uneconomic to support domestic production of ODS. In contrast, many other LDCs would not find it economically efficient to continue to use ODS domestically when any goods they trade have to be produced with substitutes.

¹⁸ There were also controls on Halons 1211, 1301, 2402, other halogenated CFCs, Carbon Tetrachloride, Methyl Chloroform and other Halons. In addition to the Multilateral fund, there was also a commitment by developed countries that technology will be expeditiously transferred under fair and most favorable conditions. (Article 10A, London Amendments to the Montreal Protocol.) Trade of controlled substances and goods containing controlled substances with non-signatories were banned by the Protocol. (Article 4 para. 1 Montreal Protocol) The control of trade in products produced using ODS but not containing ODS was more difficult due to GATT rules.

contracting problems and consider whether the failures were inherent to a fund structure or were failures of only the specific Multilateral Fund as it was designed and operated. I contrast this with how a tradeable permit market may have operated and how such markets have operated in a domestic setting.

The Multilateral Fund

The Multilateral Fund created by the London Amendments has a total pool of money (where the total was fixed at each time but could be replenished) which is contributed annually by developed countries on the basis of the UN scale of assessments. Studies between 1988 and 1990 suggested that the total incremental cost of phaseout in developing countries would be between \$1.5 billion and \$5 billion over a 10 to 18 year period¹⁹. This can be seen as a negative “property right” for the developed countries. For example this implies a contribution by the EC of between \$520 million and \$1.7 billion, and between \$375 million and \$1.25 billion for the US.²⁰ In addition to their rights to use and produce ODS, developing countries are entitled to receive funding for all “incremental costs” of complying with the controls. This is an additional “property right”. In this way, the amount of ODS each country is allowed to use is controlled but the burden sharing is defined not only by the control responsibilities but also by the financial rights and responsibilities.²¹

The executive committee (ExCom) of the fund consists of 14 members representing different regions.²² Decisions are made by consensus or a double majority vote.²³ The secretariat which assists ExCom is located in Montreal to separate it from the agencies (UNEP, UNDP, UNIDO and World Bank) which implement projects. UNEP’s Industry and Environmental Program Activity Center acts as a clearing house for information on substitute technologies and regulatory approaches to controlling ODS. Recipient countries present country programs to ExCom with information about uses, production etc. of ODS and proposed policies for controlling these. Proposals are evaluated for cost effectiveness, accuracy of accounting, savings

¹⁹ See DeSombre and Kauffman 1995 (UNEP/OzL.Pro.WG.II(2)/7,p.6)

²⁰ The US and EC also have rights to consume and produce ODS as specified in Article 2.

²¹ The financial responsibilities of developed countries are well defined at a point in time but flexible over time. The financial rights of developing countries are ambiguous because of the words “incremental cost” which in reality have proven to be very difficult to define. The financial rights are not explicitly limited but depend on needs and incremental costs. The lack of definition of rights to financial aid reflect the underlying problem that the burden of cost sharing is not fully resolved among the parties. See DeSombre and Kauffman 1995. For example India has called for an extension of the types of costs to be considered “incremental”. (UNEP/OzL.Pro/ExCom/12/36)

²² For a good discussion of the structure and operation of the Fund see DeSombre and Kauffman 1995.

²³ There must be a 2/3 overall majority constituting a majority of both developed and developing countries. The importance of these rules in the negotiation reflects the considerable discretion the fund has in approving projects.

or benefits and time frame. Payments are based on incremental cost guidelines which have proven difficult to implement.²⁴ Projects once approved are implemented by the implementing agencies, UNEP, UNDP, the World Bank and UNIDO.

Hypothetical Tradeable Permits System²⁵

The total amount of CFCs produced and used under the London Amendments in each year between 1997 - 1999 is the sum of the amounts developed countries are entitled to use (15% of 1986 levels) which is approximately 120 thousand metric tons²⁶, and the amount developing countries are entitled to. Article 5 countries are entitled to use up to 0.3 kg per capita to meet basic needs. If this was taken literally as a target, if as an example countries with a total of 2 billion people became Article 5 countries, then developing countries would have the right to use 600 thousand metric tons which would nullify the reductions by the developed countries. In reality, in 1986, China and India combined only produced 2% of all CFCs or 16 thousand metric tons. Even with high growth rates it is unlikely they would fully use their entitlement. Suppose for purposes of illustration, that basic needs would entitle each article 5 country to 0.025 kg per capita in 1996 and that their needs grow at 5% per annum from then on²⁷. The assumptions and an assumption of two billion people in article 5 countries are used to create the allocation of permits to article 5 countries (D) in Appendix 4. These assumptions are not based on evidence but are chosen to give numbers in the right order of magnitude.

In Appendix 4, columns A and B show the current production targets given to the two groups of countries under the London Amendments under our assumptions about CFC usage by article 5 countries in the absence of controls. Columns C and D show the allocation of rights for a tradeable permit system which would be equivalent to the current regulatory system in terms of both total CFC control and cost sharing. The targets and permit allocations are shown for the groups as a whole.

²⁴ DeSombre and Kauffman (1995) p 25

²⁵ There are two forms of trading permissible within the London agreement. First, a country which is a small producer of CFCs may "transfer to or receive from any other Party, production in excess of the limits" provided that their total combined production does not exceed the limits (Montreal Protocol Article 2 Para. 5). This is the same as trading within the hypothetical market but trading is limited to those operating under the developed country limits. Second, "Bilateral, and in particular cases, regional cooperation by a country ...may...be considered as a contribution to the Multilateral Fund up to a total of twenty per cent of the total contribution by that party..."(Annex IV Appendix IV para. 8., London Amendments) This gives donors more flexibility in how they contribute to the phaseout of CFCs in developing countries. However the countries' total required contributions are set in terms of dollars not amounts of CFCs controlled which makes it very different from our hypothetical system.

²⁶ Benedick p 26

²⁷ This may be a low estimate of the growth rate. In the late 1980s, Indian demand for CFCs in refrigeration, air conditioning and aerosols was expected to grow at 20% per annum. DeSombre and Kauffman (1995). However it allows for much higher growth between 1986 and 1996.

Article 5 countries as a group are allocated permits to use the amount of CFCs given in Column D. These would be equivalent to their production levels if they had not signed the Protocol based on our assumptions. For example in our illustration, India would be issued permits approximately equal to 0.025 kg times their 1996 population with a growth rate of 5% since 1996 (or maybe more if India's use of ODS is growing faster than other article 5 countries). Developed countries are required to buy permits from them to reduce article 5 production and consumption to the amount given in Column B, i.e. to the target levels, or otherwise reduce developed country production even further. This combined with developed country domestic obligations under article 2 implies the allocation of permits to developed countries given in Column C. Every country, developed and article 5, has to hold a number of permits equal to (or greater than) their actual ODS production.

If the negative permits (B-D) were allocated among developed countries according to the UN scale of assessments this allocation of rights would be roughly equivalent to the present burden sharing. For example the United States' share of permits in 1998 would be 15% of 1986 production in the US, minus their share in the UN scale of assessments times 5 thousand metric tons which is the difference between the overall article 5 target and permit allocation.

Article 5 countries would be able to sell their CFC reductions to any developed country which had not yet satisfied their requirement. Developed countries would also be able to choose which article 5 countries they wanted to assist with the phaseout. For example in 1998, developed countries as a group would have 115 rights but are allowed to use up to 120 if they buy 5 rights from article 5 countries.²⁸ In the year 2000, developed countries are required to buy 11 rights from article 5 countries because they are issued negative rights.

If a new article 5 country ratified the agreement after the initial allocation of permits, they would be issued permits in accordance with their expected production and developed countries would have to accept more negative permits to induce the new country to reduce production to the target level. This would be equivalent to an increase in funding for the Multilateral Fund when India and China joined. The issuing of new permits would not increase global emissions, although there would be more permits, because the countries outside the agreement are also producing ODS. If a new developed country joined they would be issued permits based on

²⁸ I maintain absolute limits on ODS production and consumption by developed countries to maintain comparability with the current system. These limits are imposed because of monitoring and equity concerns by NGOs and developing countries, and because of the need to stimulate research and development.

article 2, and negative permits based on the UN scale of assessments. All other developed countries would have slightly fewer negative permits because the cost of article 5 phasedown would be spread over more countries.

In a tradeable permit system a developed country would negotiate directly with an article 5 country and write a contract for a certain amount of abatement or conversion in exchange for transfers of money, technology or other resources. A central organization would be required to certify that the abatement was a real contribution and monitor that the contract was carried out as specified. The certification could be carried before or after the trade takes place. It might be advisable to create public organizations to initially coordinate information and match potential buyers to sellers but these would need to compete with other suppliers of the same services.

Now we have defined the alternative institutions we can look at how they may differ in how they deal with the contracting problems which have arisen in the Montreal Protocol.

3.2 DEFINITION OF PROPERTY RIGHTS

The targets for ODS production and consumption in the Montreal Protocol created property rights for each of the signatory countries to use or produce a certain quantity of ODS but no more²⁹. In the case of the depletion of the ozone layer, the environmentally relevant pollutants were all ozone depleting substances. The different substances have different life times and are involved in different chemical processes. Ideally the control should have been on “ozone depletion units”³⁰ which would specify both the amount of ozone damage and the time at which the damage occurs. For example, CFCs are more damaging than HCFCs so each ton of CFCs used would count for more “ozone depleting units” than HCFCs. In addition HCFCs breakdown faster³¹ so each ton contributes to “ozone depletion units” at fewer points in time.

However, scientific understanding was not sufficiently advanced to identify all of these substances or to give clear indications of their relative contributions to depletion per unit. Thus different stages in the negotiations defined the pollutant differently and eventually CFCs, HCFCs, Methyl Chloride, Carbon Tetrachloride and Halons were controlled under separate time

²⁹ The Protocol was worded in terms of responsibilities to reduce use relative to a benchmark but this implicitly defines the quantity countries are entitled to use.

³⁰ An alternative concept is ozone depleting potential which deals with the same issues in a different way.

³¹ Benedick p 136

paths although they all contribute to the same problem.³² Some substances such as carbon tetrachloride were initially ignored both because they were largely used by poorer countries and because their production was so diffuse it would be difficult to monitor and control.³³ However, it was widely recognized that there was little point in controlling CFCs if some effort was not made to control these other substances because controlling CFCs alone was not sufficient to limit damage in the stratosphere.³⁴ Since the initial controls in Montreal in 1987 there have been adjustments in the targets in 1990 and 1992. (See Appendix 5 for changes in CFC targets.) Thus there have been changes in the property rights not only in terms of total targets but also in terms of which chemicals are controlled.

A tradeable rights market requires explicitly defined permits. There was some concern over the wording in the London Amendments relating to HCFCs because it did not provide very strong encouragement for manufacturers to use the least damaging of the HCFCs.³⁵ In terms of article 5 countries this problem could have been partly ameliorated through pressure on the Multilateral Fund to only approve projects which used the least damaging HCFCs. This option would not be available in a tradeable permit market. If the total targets need to be changed, permits have to be taken away from their owners. If this is written into the definition of the permit it is possible to do. For example in the New Zealand fisheries Quota Management System, when scientists found that the levels of allocated quota were higher than sustainable, the permits were changed, to a percentage of total allowable catch rather than a certain number of tons of fish, so that they could be easily adjusted from year to year.³⁶

In the London Amendments some responsibilities were determined in dollar terms. Money flows are very easy to monitor but only effective environmentally if the money is used well. Specifying responsibilities in terms of money provides cost certainty to the developed countries but does not provide environmental certainty. This tradeoff is very similar to the tradeoff between price and quantity instruments discussed by Weitzman (1974).

The obligations each country agreed to under the Montreal Protocol and its amendments are established in the text. The financial rights of developing countries were very loosely defined

³²Benedick p 173-75

³³Benedick p 121-122

³⁴Benedick (1991) p 130-131

³⁵ Benedick p. 175

³⁶ Pearse (1991) p 11

through the definition of incremental costs which they are entitled to be compensated for. Their actual receipt of funds depends on the process within the fund and future contributions to the fund. Distributional issues have not been fully resolved and the fund was a way to relegate these issues to a more flexible forum.³⁷ A tradeable permit market would have required resolution of distributional issues at each point in time. This resolution would have created precedents which would make future redistribution of rights difficult. It may therefore have been impossible to reach agreement on any level of control.

In a tradeable permit market, as permits are traded there would be a need for an efficient registry so that permit use is monitored and so that the market can operate efficiently. For example, in the United States in the 1980s there was a relatively effective tradeable permits market in lead in leaded gasoline. One of the flaws in that market was the lack of an effective registry of permits which could ensure that all permits were valid before they were sold, and could be used to monitor compliance³⁸. Clerical lags meant that many invalid permits were traded, decreasing the environmental benefit and reducing confidence in the system as a whole. In the implementation of the Montreal Protocol, allowances for export of recycled CFCs and other increases in complexity of the rules and obligations under the Protocol are making it increasingly difficult to understand and monitor countries' obligations. These problems would be exacerbated in a tradeable permit system without an efficient registry.

3.3 CHANGING PROPERTY RIGHTS - RENEGOTIATION AND HOLD-UP

A major feature of the entire process of negotiation has been, the scientific uncertainty and the evolving understanding of the nature and scale of the depletion problem, and lack of agreement over, or precedents to deal with, distributional issues. This has led to an unusual negotiation process where the Protocol includes clear guidelines for updating the agreement as new information arrives. Much of the new atmospheric science has been "bad news" in the sense that it finds that the problem is more serious than previously thought and that more chemicals are responsible for the depletion. It has also led to lack of clarity in the distribution of costs between developed and developing countries.

³⁷ For example, India claims that future demand for CFCs should be taken into account in determining the cost of phaseout. DeSombre and Kauffman (1995) (UNEP/OzL.Pro/ExCom/12/36)

³⁸ GAO 1986 These problems also may have led to inefficiency in the market. See Kerr 1995

It is impossible to write an efficient complete contract, particularly in a previously unregulated area. In the ozone depletion case it was not sufficient to establish property rights to use CFCs in order to efficiently phase out CFCs, it was also necessary to establish property rights to CFC substitutes such as HCFCs. A complete contract would have required provisions for every possible outcome of the scientific process in terms of both the need for stringency on already controlled substances and in terms of which substances should be controlled. It would also have needed to define responses to the specific transition needs and demands of every less developed country.

The renegotiation of the agreement has taken the form of increasing the stringency of the targets on chemicals which are already controlled (see Appendix 3) and adding controls to previously unregulated chemicals. Carbon tetrachloride and methyl chloroform were both regulated in the London Amendments (1990) but not the Montreal Protocol (1987). HCFCs were not formally regulated until Copenhagen (1992). The assistance to developing countries was added to the agreement in 1990 and the incremental cost criterion and level of funding for the fund have been developed since. Renegotiation can be a good thing when it is a response to changing conditions or better information which allow the agreement to be improved upon. For example after March 15 1988 when the Ozone Trends Panel Report³⁹ found that the threat to the ozone layer was greater than previously thought, it was beneficial to amend the Protocol and make the targets more stringent.

The anticipation of renegotiation can however, lead to distorted investment incentives. As an illustration of this consider the situation of Brazil.⁴⁰ Under the London Amendments, Brazil (an article 5 country) has obligations to reduce CFC use in the long term and the right to funding from the Multilateral Fund to cover the costs of doing this. The funding was given to Brazil to encourage its participation in an otherwise costly international agreement. Suppose Brazil invested in the most efficient way to phase out its CFCs over time which involves changing its industry standards and investing in CFC substitute technology. Its variable costs of phaseout are still higher than the costs of using CFCs before the phaseout and it expects the Multilateral Fund to cover these costs. After Brazil had made its investment there would be strong economic pressures to ensure that it does not return to CFC use. The donors to the fund

³⁹ Watson, Robert T., F. Sherwood Rowland and John Gille (1988) See also Kerr, Richard A. (1988)

⁴⁰ This is a hypothetical example only.

could now forcibly renegotiate the agreement and refuse to fund further projects in Brazil because there are other higher priority countries where funding is necessary to ensure the phasedown. If Brazil anticipates this renegotiation it will not make the efficient investments, in order to ensure that it can always credibly threaten to keep using CFCs. This increases the costs the fund has to cover and probably reduces the speed of abatement in Brazil.

Possible Solutions to Adverse Effects of Renegotiation

The first solution to the problem of renegotiation is to write a complete contract. We will assume that this was not an available option. This would have required scientific information which was not available and significant negotiation over burden sharing not only for the actual situation but for all possible outcomes. This would have made agreement impossible in the short term at least.

The second solution is to control the conditions under which the protocol is renegotiated by changing the bargaining conditions. Various voting structures are used in the Montreal Protocol in an attempt to do this. A change to the Montreal Protocol target for a given chemical is an “adjustment” which requires approval of two thirds of countries representing 50% of consumption but is binding on all countries without ratification of the changes.⁴¹ Changes in the chemicals covered by the protocol require an “amendment” which requires a two-thirds majority of the parties and two-thirds ratification but is only binding on those who ratify. In the context of the multilateral fund bargaining power is shared between developed and developing countries. The final voting rules involve a two-thirds majority as well as a simple majority among North and South individually which gives both sides a veto. These rules were hotly contested during the negotiation of the London Amendments. In practice decisions in the Protocol and the fund are made by consensus, so actual bargaining power is difficult to define. Decisions are unlikely to go significantly against the interests of the major powers.

The third approach is to reduce the transaction costs of some forms of renegotiation to avoid renegotiation of the entire agreement. The Montreal Protocol was designed, not to minimize the frequency of renegotiation but to control the scope of that renegotiation. The agreement included clear procedures for adjusting targets on controlled chemicals as new

⁴¹ Article 2 para. 9 of the Montreal Protocol allows for adjustment of targets and ozone depleting potentials. These adjustments are binding on all parties.

scientific information emerged, thus avoiding complete renegotiation of the Protocol. The structure of the Multilateral Fund deliberately involves discretion so that negotiations on exactly how funds are allocated can continue without stopping the flows completely.

A fourth approach is to raise barriers to any renegotiation of parts of the agreement which lead to the possibility of hold up. Among the developed countries the agreement that reduction were percentages of 1986 production is of this nature. Before the Protocol was agreed, the EC and US both bargained hard to establish rules which didn't disadvantage them given their industry structure and the domestic regulation they already had in place. The developing countries have tried to establish the precedent that their share of the costs of phasedown is zero.

Despite these different techniques, developing countries in particular still seem to feel vulnerable to the power of developed countries and this limits their investment and cooperation. An additional solution to the under-investment problem is available in a tradeable permit market which may further reduce the impact of this distortion. This approach is based on the model of Aghion Dewatripont and Rey discussed earlier (See section 2.3). Suppose that the United States has an annual obligation to reduce global CFC production and use by 30 metric tons (-30 permits) and that Brazil has the right to produce 30 tons of CFCs annually (+30 permits). One way the United States can satisfy its obligation is by paying Brazil to invest in efficient changes in its industry structure to replace its CFCs. If, after the investments have been made there is international pressure to reduce the rights Brazil holds relative to other developing countries because it is clear that it will never revert to using CFCs the United States would use its intrinsic power to block this renegotiation because it would have to buy its rights from another country and would lose the return on its investment. If Brazil was the only country to reach the point where it needs no assistance with the phaseout then there would be no chance that the obligation of the United States (and no other country) would be reduced as a payoff for the Brazilian rights being reduced. If all countries manage to reduce the costs of abatement, or scientific evidence suggests that the phasedown should be more rapid, the US will not block overall renegotiation on the basis of its investment because it does not affect them or Brazilian rights disproportionately.

Clearly the arrangement between the United States and Brazil is vulnerable to the United States renegotiating its contract with Brazil after it has paid Brazil to make the investment by insisting that it get the rights with no additional payment. This could be avoided either by having US direct investment in the industries which benefit from the funding for CFC conversion (in

which case it would be renegotiating with itself) or by writing a contract which is enforceable under US law. If the US tries to force a renegotiation by breaching the contract Brazil would have the legally enforceable option of selling the rights to another party⁴². This is easier for a bilateral contract than for a multilateral agreement. If the United States and Brazil chose to devolve their obligations and rights respectively to the private sector this would simply be a contract between two private parties. Thus Brazil would have a stable return on any investment it makes (which is not specific to US involvement) through a guaranteed “status quo” point. If the US is involved through direct investment, they will have contract specific investments which Brazil could theoretically “hold up”. However, it is not unreasonable to expect that the US holds more bargaining power in this bilateral relationship and can expect to receive most of the gains from any renegotiation.

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⁴² This is the “status quo” point.

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