A CASE OF GLOBAL AIR QUALITY POLICIES FOR OZONE DEPLETION

INTRODUCTION

It is generally assumed by the people mistakenly that the human beings cannot generate impact on Earth or possibly believed that there have no major impact on the way our planet's ecological system operates. However it was true at one time, but now it is not so.

The problem of air pollution is not local and confined to specific and limited geographical area. The effects of this air pollution can vary by degree across different locations. The associated damage is widespread and hence this air quality problem is termed global air pollution. Controlling global air pollution is a unique policy challenge, because solutions must by developed not only through domestic initiatives but also through international treaties programs.

In this module we investigate the principal issues associated with global air pollution by studying ozone depletion we consider theories about the causes and sources of atmospheric disturbance and the available evidence to support these theories. Using, this as a foundation, we then explore policy responses that have been set in motion by different nations along with proposals for alternatives. Ultimately, our objective is to economically evaluate the effectiveness of these policies, given what we have about the origin of the problem and the associated risks.

(A) OZONE DEPLETION

From 1950s scientist begun measuring the earth's ozone layer in the stratosphere, which is the atmospheric layer lying between 7 and 25 miles above the earth's surface. Ozone layer is ozone present in stratosphere that protects the earth from ultraviolet radiation. The effort was motivated by more than scientific curiosity.

In the early 1980 the scientists became concerned when the thinning of ozone layer was found to be increasing in size and persisting. In 1985, it is an 'Ozone hole' the size of North America was discovered over Antarctica. It was then the world attention was drawn to the problem of ozone depletion and the pollutants responsible for the damage.

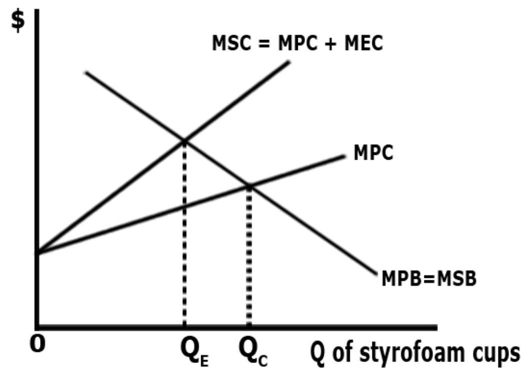
While all implications are not known with certainty, there are some consequences of increased ultraviolet radiation about which there is agreement. Scientists tell us that rising levels of ultraviolet radiation can alter delicate ecosystems, diminish human immune systems, and increase the risk of skin cancer.

(1) Searching for the causes of ozone depletion

Scientists debate about the principal of the ozone hole, which extends approximately a million square miles over the Antarctic. Although no one theory has been able to fully explain the extent of ozone depletion, scientists agree that the presence of chlorofluorocarbons (CFCs) in the atmosphere is the most likely explanation - a theory originally advanced in 1974 by F Sherwood Row land and Mario Molina two university of California researchers. The pair won the Nobel prize in chemistry for this theory in 1995.

Since 1970s the use of CFCs has increased because of its content in domestic durables like refrigeration and the rise of the fast food industry that intensified the use of CFC, because polymer foams were utilized to produce disposable cups and food containers. These long lived compounds are not destroyed in the lower atmosphere and therefore are able to drift up into the stratosphere, where their chlorine components destroy ozone's. In addition because of their long atmospheric lifetimes, CFCs released today affect the ozone layer for decades to come.

From an economic perspective, production of goods like Styrofoam cups is associated with a negative externality, a one that arises when there is an external effect that generates costs to a third party graphically would be modeled as a marginal.



External cost (MEC), which causes the marginal social cost (MSC). Therefore, the MEC is represented as the vertical distance between MSC and MPC at each output level. This relationship is shown in the above figure for Styrofoam cup market. Notice that the competitive equilibrium output (QC) is higher than the efficient equilibrium (QE), indicating that too much of the good is produced in the absence of third party intervention.

Another major group of ozone depletes are halons, which have long atmospheric lifetimes. Before government controls, these substances were becoming increasingly important in the production of fire extinguishant. Their use is not as widespread as CFCs, but halons are known to have a higher potency for ozone depletion than their chlorine containing counterparts.

United states and other countries opted to ban the use of CFCs in most aerosal sprays in 1987. However other uses of these ozone depleters were not controlled, as a result, domestic and international CFC use continued to grow. Hence a stronger policy position was needed to control ozone depleting substances.

(B) CONTROLLING OZONE DEPLETION

As a global air pollution problem, ozone depletion can not be controlled without an intergrated international effort. More formally, think of this environmental problem as an externality with transboundary implications. Domestically, the 1990 clean Air Act Amendments (CAAA) call for the president to enter in to international agreements that encourage joint research on ozone depletion and to establish regulations consistent with those in the United States. Although not without political implications, a number of international agreements and multilateral treaties have been excecuted or are on the negotiating table. A brief summary of the most significant of these follows.

(1) International Agreements to Control Ozone Depletion

(a) Montreal Protocol

In 1987, 24 countries as well as the European community commission signed the Montreal Protocol on substances that Deplete the Ozone Layer. Among the signatories were the major producers of CFCs. This landmark agreement called for 50 percent reduction in CFC consumption and production, a target that was to be achieved gradually...by 2000. To achieve this objective each party to the protocol was responsible for designing and implemeting an effective control programme in accordance with the agreed upon deadlines.

(b) Amendments to the protocol

In 1990, 59 countries executed the London Amendment to the protocol. This amendment, which strenghtended the worldwide commitment to protecting the ozone layer, was in direct response to reports that ozone depletion might be more severe than originally believed. The new agreement outlined a full phaseout plan for CFCs and halons and added controls for other ozone-depleting substance, such as carbon tetrachloride and methoyl chloroform. At subsequent confernces, controls for other substances were added, including additional CFCs, hydrochloroflurocarbons (HCFCs), hydrobromofluorocarbons (HBFCs) methyl bromide, and bromochloro methane (BCM). In addition, various phase out deadlines were advanced and then formalized. The protocol does include special provisions for developing nations, allowing them an additional 10-12 years to phase out ozone depleters.

(c) international Allowance Trading

A market approach was integrated as part of the internationa effort to protect the ozone layer specially, production and consumption allowances were issued to the protocol participants and transfers were permitted under certain guidelines. To ensure that the phase outs were achieved, trading was conditional upon revision of each country's aggregate production limits to levels lower than what would have occurred without the transfers.

(d) Multilateral Fund

Ongoing negotiations are aimed at encourging more nations to ratify the protocol amendments. Some countries have been hesitant because of the high costs of converting production technology to eliminate the use of ozone-depleting substances. This is particularly problematic for developing nations. In response to this concerns, an 'Interim Multilateral fund of $ 160 million was established in 1990 to help developing countries transition toward the requisit CFC repleacement technologies. In 1992, the fund became permanent, and it is replenished every three years. The replemishment amount for 2009-2011 was $ 400 million with a budget for the period of $ 490 million. As of 2011, 45 industrialized nations, including countries with Economies in transition, or CEIT countries, have contributed over $ 2.76 billion to this fund.

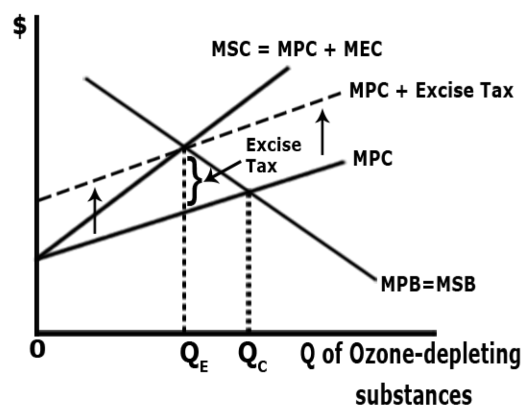
(2) U.S. Policy to Control Ozone Depletion

In U.S.A. congress charged the Environmental Protection Agency (EPA) with the responsibility of identifying ozone-depleting substance. Each substance is assigned a numerical value that signifies its ozone depletion potential (ODP) relative to chlorofluorocarbon - II (CFC - II). Ozone depletion potential (ODP) is a numerical score that signifies a substance's potential for destroying stratosphere ozone relative to CFC - II. The agency also must distinguish between class I and class II substances where class I refers to those having a greater potential for damage. Then for each substance class, phase out schedules were outlined. Related provisions call for federal programs and research aimed at finding safe alternatives to identified ozone depleters. In addition, two policy, instruments are legislated that explicitly use market incentives to eliminate ozone depleting substances.

Excise tax on ozone Depleters

One market based instrument used to control ozone depletion and achieve the phase out deadlines in an escalating excise tax on the production of ozone - depleting substances. Enacted by congress in 1990, the tax rate per pound is a base dollar amount multiplied by the chemicals ODP where the base amount increases with each successive year in the phase out schedule. The tax rate was initially set at $ 1.37 per pound, and by 1995, it had increased to $ 5.35 per pound. Starting in 1996, the tax was to increase by $ 0.45 per pound each year, bringing it to $ 13 per pound in 2012. Although the phase out deadline has passed , the tax is still applicable to imported recycled CFCS.

From the economic perspective, the excise acts as a product-charge on the ozone-depleting substance. Since production of ozone - depleters generates a negative externality the tax can internalize this externality by elevating the producer's marginal private cost (MPC) . If in fact, the excise tax is set equal to the MEC at the efficient output level, QE, an efficient allocation of resources is achieved.



This is shown in above figure. Notice also that because the tax elevates the effective price of CFCs, it motivates a reduction in quantity demanded along the MPB curve. According to Cook (1996), consumption of ozone depleting substances decreased from 318, 000 metric tons in 1989 to 200,000 metric tons in 1990, the year the tax was put into effect.

Allowance Market for Ozone Depleting Chemicals

The EPA established an allowance market to facilitate the phase out of HCFCs. Implementation essentially follows the allowance programs put in place prior to 1996 to control CFCs and certain other ozone depleting, substances. Firms will be allowed to produce or import these substances only if they hold an appropriate number of allowances. Each allowance will authorize a one-time release of one kilogram of an HCFC based on its ODP. The number of available allowances eventually will be brought to zero to meet the phase out deadlines.

(C) ECONOMIC ANALYSIS OF OZONE DEPLETION POLICY

In order to understand the implications of ozone depletion policy, we can use economics to analyze key initiatives, such as the phase out plan and the allowance trading, as well as to examine the influence of these initiatives on the market for CFCs and the market for CFC substitutes. To begin, we review the Regulatory Impact Analysis (RIA) that was done to evaluate the phase out plan.

(a) Regulatory Impact Analysis (RIA) of the phase out

As part of its Regulatory Impact Analysis (RIA) the EPA conducted a benefit - cost study of the phase out plan. Given the long life of ozone depleters, the agency considered the regulatory implications over a long time period, out to 2075. The agency's benefit assessment assigned a value to the damages that would be prevented by controlling these substances. These included health effects associated with increased exposure to ultraviolet radiation and non health effects such as reduced crop yield and rising sea levels. In total the EPA estimated that accumulated damages would be approximately $ 6.5 trillion by 2075.

On the cost-side a value had to be assigned to all anticipated market disruptions that would arise from a phase out plan. Some 84 distinct - use categories for CFCs, were analyzed the two largest being mobile air conditioning and refrigeration. All total, the EPA's estimate of control cost associated with a phase out plan was $ 27 billion through 2075.

(b) Assessing Cost - Effectiveness

Following the 1978 ban of CFCs in all nonessential aerosols, the EPA began investigating the feasibility of further controls. In an EPA-commissioned study conducted by the Rand Corporation, three alternative control approaches were analyzed; a technology - based command and control approach, a fixed emission charge, and a tradable emission permit system. Each approach was modeled to achieve a given level of reductions over a 10 year period so that the accumulated costs of each plan could be compared. The study showed that the estimated costs for each approach were as follows:

* Technology based command and control approach - $ 185.3 million

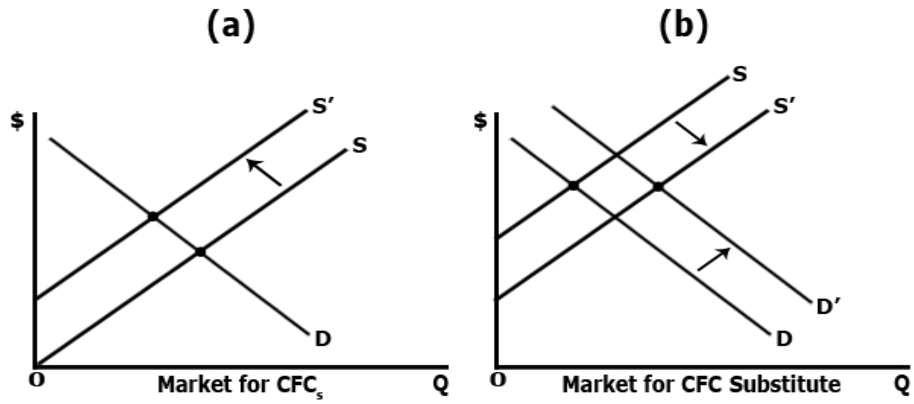
* Fixed emission charges - $ 107.8 million

* Tradable emission permits system - $ 94.7 million

These estimates support the expectation that allowance trading would approach a cost effective solution. At the same time, trading should act as an incentive for the development of substitutes by firms that could do so at least cost. Hence the phase out in the CFC market had implications for other markets in particular, the market for CFC substitutes, which can be analyzed using supply and demand and price movements.

(c) Price Changes

Price of CFCs and other ozone-depleting chemicals signaled the impact of the phase out and the underlying market adjustments. As the phase out plan advanced, availability of CFCs declined. In addition, an excise tax was levied on production, as discussed previously. These events are shown in the following figure by the shift-left ward of the supply of CFCs, which in turn elevated their price. Manufactures of CFC dependent products faced higher production costs as a result and passed on at least some of this cost increase to consumers, thus buyers of commodities such as refrigerators and auto air conditioning units paid higher prices over time.



Also as CFC prices increased, the demand for CFC substitutes rose, as shown in figure (b). One potential consequence of these events is the evolution of a black market for CFCs. This developed in large part because the phase out dates established by industrialized nations preceded those set of developing nations. The excise tax also may have contributed to this problem.

(d) Incentives and Disincentives to Develop CFC Substitutes

Because costs and prices were allowed to move naturally, the usual incentives encouraged a market adjustment to the observed industry declines and price changes. Theoretically, two opposing reactions were possible.

One possibility is that firms would perceive a profit advantage in developing ozone friendly substitutes. Since prices of these substances were relatively high at the outset. For example, the 1987 price of CFC - 12 which was commonly used in automobile air-conditioning units was about $ 0.50 per pound, where as substitute, HFC - 134a, was $ 3 per pound. However, this relative price difference would diminish over time as technology driven cost declines would shift the supply of HFC-134a to the right, as shown in figure (b), and CFC prices continue to rise. Indeed in 1999, the price of CFC - 12 ranged between $ 25 and $ 30 per pound, while the price of HFC - 134a remained stable, at about $ 3 per pound. Such price stability likely reflects proportionate increases in supply and demand, as shown in figure (b).

A second possibility is that the relatively few firms holding allowances possessed some measure of market power and price control. These firms would have enjoyed above-normal profits and would therefore not have been motivated to find alternatives to ozone-depletion substances. One solution would have been to transfer any excess profit to the government, which in turn could redistribute the wind fall. Such a safeguard was implemented when congress approved the escalating excise tax on ozone-depleting chemicals. A redistribution of income was achieved because fiscal spending was funded in part by the tax revenues collected from CFC producers.

The 1990 Amendments also called for a national recycling program for CFCs used in refrigeration and air conditioners. Consider the economics of this approach. By making recycled substances available in the market as a substitute, firms reduce their demand for virgin compounds needed to produce ozone -depleting products. Moreover, firms can use recycled materials beyond the phase out deadlines, thus avoiding costly retrofitting until new substitute products are available.

Overall the use of the tradable allowance plan along with the excise tax, the recycling program and the safe alternatives policy achieved the phase out objectives in a more Cost-effective manner. Such a control program was less disruptive than an immediate ban on production, which would have affected virtually every segment of society with no time to make proper adjustments.

Proposal to Phase Down Certain CFC Substitutes

In 2009 a proposal was submitted by the Federated states of Micronesia and Mauritius to phase down production and consumption of HFCs as an amendment to the Montreal Protocol. This proposal was subsequently supported by eight other countries. In 2010 and again in 2011, another proposal was made to phase down HFCs, this time by Canada, Mexico, and the United States. A phase down HFCs, rather than a complete phase out, is being suggested because substitutes are not available for HFCs in all applications.

Why countries are looking to phase out a substitute for ozone-depleting substances? Because HFCs, while not damaging to the ozone layer are greenhouse gases that contribute to climate change. This reality is of concern because of the rising use of HFCs as substitutes for ozone depleters and because of developing nations' increasing demand for HFC dependent refrigeration and air conditioning. However any phase down of HFCs must not derail the final scheduled phase out of HCFCs by 2020.

As of 2012, the HFC phase down proposal are still pending. If these or other similar proposals are accepted by the parties to the Montreal Protocol, the supply of HFCs would shift to the left, countering the influence of supply increases linked to technology advances, as noted previously. At the same time, the HFC phase down should motivate the development of HFC alternatives, which in turn should influence the HFC market.

CONCLUSION

In this module we have discussed ozone depletion - an ozone layer is the atmospheric layer above the earth's surface, present in stratosphere that protects the earth from ultraviolet radiation. Owing to getting ozone layer thicker, our ecological system is perturbed and consequently results in global air pollution- a serious environmental problem. The rising levels of ultraviolet radiation can alter delicate ecosystems, diminish human immune system, and increase the risk of skin cancer. According to scientists the most likely explanation is the presence of chlorofluorocarbons (CFCs), caused by air pollution. The air pollution is one of the negative externalities, resulting into efficient equilibrium output is less than the competitive equilibrium output.

We have discussed measures to control ozone Depletion researched by international agreements and also the economic analysis of ozone depletion policy.

It is important to formulate sound policy in response to global air pollution is a major undertaking, but scientific knowledge about atmospheric disturbances and the associate implications is still limited, particularly for global warming. Even when the knowledge base is stronger, such as for ozone depletion policy development is still complicated by the global nature of the problem. A successful resolution depends critically on international commitment, supported in turn by domestic initiatives. On this front the achievements are Montreal Protocol, Kyoto Protocol to limit GHG emissions along with the Durban platform, which extends the protocol.