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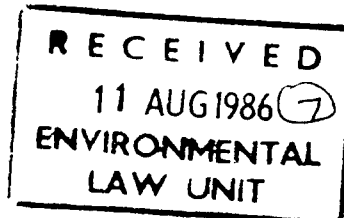
UNITED NATIONS ENVIRONMENT PROGRAMME:
WORKSHOP ON CHLOROFLUOROCARBONS:
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TOPIC 6C

I enclose a copy of the following papers for this topic for which the United Kingdom is coordinating country:

- i. "Economic Instruments for the control of CFCs" by Professor Rolando Valiani, LUISS, Rome.
- ii. "Economy of the reduction measures which have been proposed as well as the newly proposed measure" by Kimio Kurosawa (Japan Freon Gas Association) and Katsuo Imazeki (Japan Aerosol Association).
- iii. "Chlorofluorocarbons in flexible foam manufacture" by British Rubber Manufacturers' Association.
- iv. "An assessment of the economic costs of alternative regulatory strategies" by E M Ambler, Department of Trade and Industry, London.

I should be grateful if you would arrange for copies to be sent to those attending the workshop.

C H BOWDEN
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ECONOMIC INSTRUMENTS FOR THE CONTROL OF CFCs

by

ROLANDO VALIANI

for

Topic 6-C - UNEP Workshop - Washington

1. Conceptual problems in subject methodology and analysis

1.1 In many ways, human history can be looked upon as progress in what we know and understand. Scientific discoveries and their application have always been at the heart of this progress. And any attempt by man to try and limit this enlightenment is fallacious and destined never to succeed. Nonetheless, in recent decades a greater understanding has emerged on the kind of damage, in some cases irreversible, that man may be inflicting on the environment and hence on his own species. Modern technologies have produced unforeseen and dangerous side-effects, a fact relevant not just to the armaments industry but also to ordinary civil-activities. A stark contrast therefore exists between the unceasing attempts to enhance scientific discoveries and the growing awareness of more widespread threats and risks to our ecology. Both forces are innate yet incompatible human instincts. Inevitably, this quite profound contrast sometimes leads man to act in an irrational manner and to accept certain principles without any real reason for doing so. Convictions and beliefs are formed using inadequate and often very misleading information. Policy makers and public opinion change quite inexplicably from one point of view to another.

For example, one finds great enthusiasm for new technology and products which improve the welfare of consumers suddenly changed into a movement which wants these products and technology banned or stringently controlled. This happens when news gets out that there are potential hazards to our health and to our environment from their continued use. Alongside these valuations, which are in a constant state of flux and which clearly result from the irreconcilable interests in, and fears of, new technology,

one finds economic interest groups which are always eager to exploit the sudden changes in public opinion and thus able to influence and profit from the demise of certain economic activities and the success of competitive ones.

The purpose of this introductory note on methodology is to stress the importance of conducting a debate on technology which is grounded on a sense of realism, impartiality and equity. Indeed, the premise is extremely relevant to the problems of CFC control which - from an economist's point of view - appear to be very difficult to handle and which consequently require careful attention to what is ultimately regarded as conclusive and what ought to be the right kind of action to follow through with.

Applied research and in particular the introduction of new technologies (both product and process) into the economic system is determined by calculating costs and rates of return which are in turn established by market forces.

One of the major ideas upon which modern economic theory is based is the efficient allocation of resources resulting from a price system governed by a competitive economic environment. Of equal importance in the subsequent development of economic theory are the criticisms regarding the so-called optimality conditions in a market economy. A wealth of literature in the field of microeconomic theory now exists which clearly identifies the typical "failures" of a market economy; a body of theory has also grown up around the existence and the effects of various types of public intervention measures, such as taxes, subsidies and a whole range of regulations supposedly designed to correct "market failures". But studies carried out on the economics of regulations have revealed that intervention measures of a "non-market" kind may also fail to work and tend only to aggravate the original problem. Many of these interventions arise, for example, because of "externalities" in the economic system whereby certain costs and benefits are not valued

by the market and which, consequently do not form part of the decision-making process. It has also been demonstrated that the system of regulations drawn up by the public authorities has certain characteristics which may be regarded as "externalities"; a range of private costs and benefits are taken into account by the state agencies when they take decisions on the economy (these agencies consequently tend to formulate objectives and rules which are "internal" to their organization and which are not wholly or readily related to any social objective).

The abundance of literature on welfare economics, both applied and theoretical, as well as that on regulation, deregulation and environmental economics, does not really make matters any easier for the economist looking into the problems connected with the control of CFCs. The issue of CFC emissions is an especially difficult one as it is characterized by certain factors which do not allow a secure and efficient methodological approach to be adopted.

- 1.2 One major aspect of the CFC control problem which cannot be handled that easily by the traditional tools of economic analysis, is the uncertainty concerning relevant variables and the interrelationships that exist amongst them. Above all else, there is uncertainty in what may be regarded as the right scientific inputs that the economist must take into account. That is the kind of causal relationship between CFC emissions, ozone depletion, climatic variations (the "greenhouse" effect) and so forth. There is no scientific consensus that CFC's emissions provoke ozone depletion and changes in the climate.

Since there are other causes, both natural and artificial, which disturb the conditions of the upper atmosphere, the uncertainty regarding the effects of CFC emissions in any given period of time is enhanced as little is really known in respect of the cumulative impact and the interdependence of all the associated variables. In addition,

there is no certainty as to the intensity and time-lags of the effects which result from disturbances to the ozone layer on man's health, on sea-life, the animal world and the ecosystem in general. A similar kind of uncertainty can be found in respect of the consequences, in terms of time and material impact, of the greenhouse phenomenon.

This is a particularly acute problem for the economist in that the consequences are different in different parts of the world. The impact varies according to the particular geographical area of the world that is under consideration and to a wide range of other factors such as agriculture, economic development, and so forth. A general equilibrium analysis of the final economic effects of climatic variations due to the impact of CFC and the changes in production and consumption, as well as other developments such as migration, changes in patterns of energy use and so forth, would entail research on an enormous scale and would probably end up only providing tentative and incomplete conclusions. In practically all fields of research, the answer to the problem of inadequate or imperfect knowledge of variables and the relationship between them is quite simply that of gathering further information on the phenomenon being examined.

In our particular case this means allowing CFC emissions to continue at a significant rate since in this way new evidence can be documented and used eventually in a more precise, secure and rational fashion, especially when it involves drawing up CFC control measures.

On the other hand, the fact that there is just one single ozone layer and that there is probably a depletion threshold beyond which continued damage could become no reversible, means that there may be increased risks of continued CFC emission into the atmosphere over time. How much longer, then, do we have for carrying out a large-scale experiment of CFC emissions into the atmosphere and stratosphere, assuming that we can do so safely and without provoking significant damage to our environment?.

It is all too easy to fall into a vicious circle when looking at this kind of problem.

The whole matter is further complicated because of the existence of time - lags. These lags exist not just between the emission of CFCs and the subsequent impact on the ozone layer, but also between the identification of the impact and the drawing up of appropriate control measures. Policy-formation takes up considerable time both for technical and institutional reasons so one can never say with any precision what kind of time-constraints are involved.

A second methodological problem in defining the criteria for the correct economic management of CFCs concerns the method by which one can assess the social costs and benefits of intervention or non-intervention. The economist who is accustomed to cost-benefit analysis would tend to look at the issue in terms of a certain rate of discount.

The real difficulty is that the greater potential damage which could result from unlimited emission of CFCs will fall on future generations.

The current scientific uncertainty concerning the relationship between CFC emissions, ozone depletion and the climate, leads inevitably to the presumption that the issue of CFC damage will only really become a significant problem at some point in the future rather than today.

However, imposing limits to the production and use of CFCs also involves socio-economic costs which the present population would have to bear.

Comparing such costs with the benefits which will be received by future generations in terms of reduced risk of damage to the ecosystem is only really possible using value-judgements which are, by definition, arbitrary. One should bear in mind that by incurring these costs, the present population could well reduce its rate of capital accumulation and in so doing reduce what it has to pass on to future generations. Another quite significant aspect which should not be overlooked is that future generations will inherit from the present a wealth of knowledge and technology which

will enable them to tackle problems which economic activity creates for the environment more efficiently and at a lower cost than is currently possible.

Another important characteristic of the CFC problem is that it is a worldwide phenomenon. When we talk of protecting the ozone layer we are in effect talking about the protection of an indivisible worldwide public good. CFC emissions and the possibility of introducing regulatory measures in one country or group of countries leads to effects in all countries. This means that every country (or group of countries) contemplating what to do in this problem area must assess at the same time what other countries are planning to do. Clearly, there is a strong case here for top-level international collaboration. But the scope for such cooperation is easily diminished and destined to fail if insufficient attention is paid to the different circumstances prevailing in each country and especially to the different individual economic problems which they face. For example, the definition, on a collective basis and for policy purposes, of "essential" and "non-essential" uses and needs relative to CFCs is not necessarily the same in all countries since much depends on factors which have different weights attached to them in different countries. The structure and level of consumption and the reaction of consumers to changes in the structure of production as well as the costs of reconversion (of both directly and indirectly related output) are never likely to be the same in any two countries.

The very weight which nations give to the problem of ecological risk will also vary as will their assessment of the appropriate safeguards to adopt. Certain kinds of regulations considered fundamentally important by some nations will not find favor with others. Moreover, when regulations have a significant impact on productive activity,

employment and prices the distributional effects could provoke contrasting interest struggles as well as domestic political and social unrest.

I have endeavoured so far to point out the methodological difficulties in appraising the issue and I have done so not just for reasons of intellectual honesty. As the debate on the CFC problem is characterised by a clash of different points of view and different policy proposals, it appears to me that the primary objective of the researcher is that of making it clear that there are no grounds for anybody to uphold as superior any one proposal for CFC control over another.

The choice between alternative policies in this area rests largely on value-judgements and on political evaluations as well as economic possibilities which may differ from country to country and between different sections of society. National political choices and international cooperation agreements must find some sort of equilibrium between the different values, interests and needs that exist.

2. The different effects of the alternative instruments for the control of CFCs.

- 2.1. The economic theory of environmental policy tends in general to favor the use of economic (pricing) incentives for the control of pollution, rather than direct controls on polluting activities. The basic argument in support of this approach is that economic incentives, in the form of various types of taxes, subsidies and marketable emission permits, set in motion those market forces which promote the necessary and most efficient adjustments so that the desired reductions in polluting activities can be achieved, which in our case would be emissions of CFCs. Allowing the market to reallocate resources on the basis of a

new price structure (which includes the pricing incentives) means that the cost of the desired reduction in CFC emissions are much less for the economy as a whole than would be the case were direct administrative controls adopted.

Moreover, the very flexibility of the economic incentives scheme allows the authorities to act over the entire spectrum of polluting activities whereas the imposition of a mandatory standard of maximum pollution would not affect the lower levels of pollution.

The arguments which suggest that economic incentives are superior in efficiently allocating resources than direct controls are usually based on models (implicit or explicit) of perfect competition where firms are profit-maximizers and consumers well-informed and act rationally. But as markets in the real world are by and large imperfect, and the decision-making of firms (public and private) and consumers so vastly complex and often far from the position of profit-maximizing as the competitive model suggests, it is reasonable to doubt whether the pricing incentive is an efficient form of resource allocation. Other doubts emerge when we consider also that the opinions on optimality in markets are based on a given pattern of distribution and that the pricing incentives themselves have an impact on distribution. On the other hand, direct controls are subject to the obvious criticisms that they are arbitrary and therefore have a very high probability of creating distortions in efficient allocation and distribution. In particular, as there is currently no scientific explanation justifying a total ban on all emissions of CFCs, those governments that would like to achieve certain environmental standards are forced to choose that kind of strategy which will allow them to achieve a partial cut-back in emissions. If the authorities rely on pricing mechanisms to reach the desired level of emissions, then the task of distributing the overall reduction in volume amongst the different uses of CFCs is seen to be by market forces (which will make the distinction between "essential" and

non-essential" uses); the authorities can at the same time influence final decisions taken in the market through, for example, different tax rates on different products.

At the other extreme, the authorities can decide on a political basis which uses are allowed and which prohibited (with possible exemption) but in doing so they obviously face inevitable criticisms because of arbitrariness and increased costs of inefficient resource allocation and distribution.

In addition to the fundamental choice between economic incentives and administrative controls, the authorities have at their disposal a wide range of other instruments and ways of implementing them to regulate CFC emissions in a coherent way. This is through market decentralization or, in other words, through increases in CFC prices. In fact, the economic reasoning of emission controls using economic incentives is that the increases in CFC prices encourage, on the one hand, industry to find and apply new CFC-saving technologies - such as substitute or alternative chemicals, new equipment to recover and recycle CFCs and to limit the rate of emissions - and on the other hand, encourage consumers to look for substitutes for CFC-made products or limit their use of products which are CFC-based.

A traditional instrument used in increasing CFC prices is the introduction of an excise tax on the acquisition of CFC products. However, the authorities can quite often be reluctant to use this instrument as it only really works in reaching the desired levels of CFC use if a correct estimate has been made of demand curves. Otherwise, the process of successive adjustments of tax rates could lead to a considerable waste of time and generate substantial uncertainty costs in the market. Furthermore, in a constantly changing market, the attempts by consumers to maintain a real level of net income (especially in countries where inflation is

particularly high) could make the process of tax changes difficult and very costly for purposes related to reductions in CFC use.

As such, the authorities may well be justified in following a different strategy to raise CFC prices: by fixing limits to the quantity of CFCs that can be made available or simply restricting CFC supplies. The authorities can leave it up to the market to allocate the reduced amount of CFCs available amongst the competing uses. The most direct way is through an increase in prices by producers to the extent that will clear the market rationing demand.

An alternative mechanism, which has received a great deal of attention in economic literature, is the issue of permits for the purchase of CFCs.

Effectively, what this entails is the fixing of a certain quota by the authorities. They sell the marketable permits at a price which is then added to the final cost of the CFC product. Thus, the increase in the effective price of CFCs serves to reallocate the reduced amount of CFCs (quota). Compared with the imposition of an excise tax, the permit system allows the authorities to reach with certainty the CFC reduction target that it sets itself. The only snag concerns the uncertainty in respects of the level of permit prices. Ultimately, however, these prices do get established by the market. This is the most significant difference, from the point of view of environmental policy, between the use of excise taxes and the system of permit quotas; clearly, there are other administrative and operational differences but these are of minor importance in the present paper.

The flexibility of the system based on intervention using economic incentives allows for the combination of specific and varied taxes and subsidies tailored to particular uses and techniques which the authorities may wish to stimulate. A well known example is the deposit/refund system.

(that is, a subsidy is granted for CFC recovery and a tax is imposed on CFC disposal) which has been proposed as a means of recapturing CFC used in refrigeration equipment and which could be usefully applied in other instances where CFC emission controls are being contemplated.

- 2.2 It has been amply proven that the strategies to control CFC emissions based on economic incentives (taxes and subsidies, sales quota, marketable permits) impose fewer costs on the economy as far as reduced allocation efficiency is concerned than direct administrative controls, when they have to achieve the same environmental standards. This is primarily because incentives induce in the system the choices of the least costly combinations of techniques for reducing the uses of CFCs, since their prices have increased.

The distribution over time of the effects of the different regulatory actions is another important criterion to compare the merits of alternative control strategies of CFCs emissions. In fact, while the regulations concern the economic activities that produce a flow of CFCs into the environment, the risks of damage to the ozone equilibrium depend on concentration of CFCs in the stratosphere. According to some information sources, for a given level of cumulative emissions, the ultimate effect on the ozone layer is not significantly affected by the timing of emissions over a period as long as one decade. Therefore in conditions where cumulative emission effects are equal, pricing incentive strategies may be selected and varied for the purpose of achieving the temporal profile of the emission reductions that imposes fewer costs on the economy (or change the temporal profile when the conditions in reference change). They also stimulate the search for new technologies in product-areas where no emission reducing techniques are available.

Under this aspect controls based on economic incentives are more flexible and better suited to graduate the costs of transition to the regulated levels of activity. This represents a major vantage over direct controls.

It has been remarked that while one may uphold the superiority of strategies founded on pricing incentives because they impose fewer allocation costs (as compared to direct controls) on the economy as whole, on the other hand such strategies impose additional re-distribution costs to producers and users of CFCs. Firms and their customers using CFCs have to pay for taxes, permits and higher prices under the incentive regulatory schemes. These redistributive payments, in favor of the Treasury and/or the rest of the economy, that the incentive strategies impose on CFCs users, may become quite large when the goals of environmental policies cause severe restrictions to CFCs emissions. The burdens on users of CFCs products and/or the risks of plant closures may become too heavy. Compensation techniques may be elaborated (subsidies, tax reimbursements, free permits allocations) in order to avoid such burdens and risks, even though the compensation procedures are evidently difficult from a political as well as a technical point of view and also because they must not interfere with the incentives structure. In any case, should reliable scientific information require severe restrictions of emissions, the policy of banning the use of CFCs in some applications appears necessarily to impose the heavier costs on economy. Given the level of emission reduction required, pricing incentive policies would call for the elimination of any CFCs application only if the market should prove the inexistence of any less costly alternative.

Finally, one should not forget about the strategies of voluntary control of CFCs emissions by firms. Undervaluing the importance of such strategies would be an unjustifiable bias if systematically adhered to a-priori.

Strategies of voluntary actions legitimately belong to the arsenal of controls on CFCs emissions and a negative judgement on them may be justified, empirically speaking, only when the results of voluntary control actions prove unsatisfactory. And it seems only right to try such strategies that require the cooperation of entities that are directly affected by regulations of their activities.

3. Policy perspectives

3.1. On reviewing the experiences of environmental policies during the past decade (after diffusion of the new of the ozone depletion hypothesis published by Molina-Rowland in 1974), there are substantially two different strategies for the purpose of controlling CFCs emissions.

The first one, adopted by the United States authorities, resulted in the decision of the Environmental Protection Agency (EPA) to ban the use of CFCs in "non essential aerosols"; the ban was announced in 1977 and made effective as of 1979.

As a result aerosols account for only about 4% of US CFC-11 use; also, the US only account for about 5% of world aerosol use (in the rest of the non communist world aerosols account for about 29% of CFC-11 use). Similar figures are estimated for aerosol uses of CFC-12 (in the US aerosols account only for 4% CFC-12 total use). Canada, Norway, Sweden and Finland have adopted a similar approach.

In the EEC, instead, a different strategy has been deemed preferable: a reduction (since 1980) of total CFC use in aerosols products by over 30% as compared to the 1976 peak levels; and an upper limit on production of CFC-11 and 12 at current capacity levels. As a result in many EEC countries the aerosols use of CFC decrease to about 2/3. On the other hand, total CFC-11 use by the US accounts for about 33% of all non communist world (US and others) and total CF-12 US use for about 37%.

At present, the proposals being exchanged within the frame of CFC emissions control strategies to be adopted in future in view of an international agreement substantially tread along such two different experiences made in the US and in the EEC.

According to the U.S. EPA the international agreement should include the principle that "a ban on non essential aerosols is the rational first step in protecting the ozone layer".

Such an opinion is based on some assertions that can be questioned.

In fact EPA's proposal:

- relies too much on the hypothesis, which is not scientifically proven, that if the present rate of CFC emissions continues in the future, it may exceed the limit beyond which significant reductions in ozone could occur;
- stresses the need for an immediate restriction of such CFC uses also in consideration of forecasts of high world increase of the other uses in the future, even though such forecasts are largely subject to uncertainties both as regards the global rate of uses and the growth rate in the different product areas;
- entrust the regulatory authority, instead of the market, with the task of defining the non essential uses, neglecting the costs of such a political choice;
- extends to other countries the administrative definition of "non essential uses" which was elaborated in the US, without investigating whether in those other countries such a definition may or may not be applied not only with regard to users' different preferences and life-styles, but also and above all with regard to the different economic impact of the various CFC uses on the productive and occupational system;
- considers positively the economic effects produced by the ban of aerosol CFC uses in the US, and accepts favourable judgements as to

the ease and convenience of reconversing productions and replacing products; such judgements have been instead objected to even recently by American firms as well as by knowledgeable consulting firms operating in the field; moreover it has not been considered that such reconversions and replacements may be more expensive and difficult to achieve in other Countries. The EEC's proposal to base the international agreement on the strategy of capacity restriction and voluntary reductions has taken into account assumptions that are different from, or even in contrast with, EPA's.

The EEC believes that maintaining the present production standards does not involve any grave risk for the ozone layer and for the climate and therefore deems that a cap on production capacities would be a decisive step toward environmental safeguard, because it limits all CFC emissions for all use areas, while the EPA proposal allows all non-aerosol use to grow indefinitely.

It is true that current EEC production levels are about 70% of capacity, while in the US and in Japan they may be closer to full capacity. However this problem can be overcome by means of an agreement aimed at imposing on each geographical area a cap which respects the ratio between present EEC capacity and production.

Moreover the proposal should be strengthened by agreements in order to prevent production limits in advanced countries from being circumvented by imports from third world countries (acquiring technologies from advanced countries).

The latter certainly have a right to produce and use CFCs for their "vital needs"; but this concept too, which is being discussed, must be clarified, because it has a positive significance for the global policy of emissions control if referred to internal uses, but not when it refers to the country's capacity to get foreign currency by exporting CFCs products into countries where production limits exist.

Indeed, it appears that the involvement of developing and socialist countries in international agreements will play a very important role for the effectiveness of the CFC's control policies.

The global character of the CFC's emissions problem does not alter the significance of the two alternative approaches to the CFC's control, the one experienced in the U.S., and the other one in the EEC.

The intention of the EEC's proposal, as compared to the American one, is that of entrusting the CFC's emissions-control to the market forces and to the voluntary cooperation of firms. The fact that the production is subject to a cap, and awareness that CFCs emissions are kept under stricts "surveillance" by the authorities, necessarily induce firms to direct their strategies for the future towards CFCs-saving products and techniques, and final users will also follow in this direction. The economic incentives for the control of CFC emissions are definitively less costly, in terms of efficiency of the economy, as compared to bans and mandatory controls.

3.2. If we pass on now to examine the alternative strategies of controlling CFCs emissions adopted in recent years by the EEC and by Japan, i.e. the call for a limited production at current capacity levels (production capacity cap) and for a given percent reduction (30% in the EEC) in the use of CFCs in aerosols from the year of maximum use, it appears that these control measures while they are efficient from an environmental point of view, they imply more limited costs for producers and users.

The total production of CFC 11 and 12 in the EEC represents a 65% of total production capacity. The volume of sales of CFC 11 and 12 in aerosols was 33% lower than the 1976 reference (industry reduced consumption of CFCs in aerosol of at least the 30%, called for by the EEC Council Decision).

This reduction was obtained by the manufacturers mainly by partially substituting CFCs with hydrocarbon propellants.

As is known, for non aerosol applications codes of practice have been adopted by the EEC Commission and the respective governments in order to reduce CFC losses (and emissions) in the sectors of refrigeration, foam plastics, and solvents.

These provisions have also stimulated research on CFC recovery, mainly in the manufacture of open cell foam plastics.

Bearing in mind that scientists have not reached a consensus that CFCs are depleting stratospheric ozone and producing detrimental effects, or even when such a phenomenon, if ever, could take place in the future, one sees that the strategy adopted by the EEC Council is much more vigorous and effective than it may appear at first glance. Indeed, the strategy adopted by the EEC, by putting a

ceiling on CFC production, provides an efficient safeguard on ozone, gives a signal to industry to look for alternative products and technologies, and allows time for such a conversion to take place. Once the ceiling is reached, user industries will be compelled to make the switch from fluorocarbon technology to other technologies according to the economic importance of CFC uses, starting from those industries which cannot afford higher costs for these products. We have already mentioned the costs of the productive conversion from the use of CFCs to other propellants for the aerosol industry, in order to reduce their use in aerosols in comparison with the 1976 peak level in the EEC. The reduction brought about by the move to mixed propellants (CFC/HC) has required heavy capital expenditures (for reformulating, redesigning, changing investment projects, for consumer research) and other related expenditures (we have already pointed out the higher costs of safety measures for the workers and warehousing).

The development of new aerosols products has likewise been severely thwarted; on the other hand, research into new technologies, and processes in order to economize on CFCs losses has been stimulated.

Considering these many effects of the restrictions imposed by the EEC Council's Decision, it is evident that these measures have significantly changed the economic conditions for the aerosol manufacturers in EEC countries and will continue to influence the development of costs also for other user industries in the future. The costs of regulations imposed by the EEC Council on industry and on the related productive factors represent the counter part of the positive actions to contain the CFCs emissions.

The strategy chosen by the EEC has also shown to be on target as far as the environmental goals of UNEP are concerned, for the reason already noted above. To sum up: the limit set on the production capacity of CFCs poses a limit on the growth of consumption in Europe, on a middle and long term basis, thus revealing itself to be a strategic decision which requires both producers and consumers to make appropriate structural choices regarding both economic factors and the quality of life.

It must be emphasized that the production capacity cap covers the whole range of CFCs uses and not just a few of them as in the case of the selective bans, which raise problems as to the arbitrary and relative definition of "non-essential" uses. In the case that there should be an attempt to avoid the long term limit on the increase of CFCs uses by importing those products

from countries where no upper limit has been imposed, it would be necessary to control such imports. The argument is also connected with what type of agreement regarding the limit of production of CFCs is to be offered to the underdeveloped and developing countries who wish to make investments in this sector. The strategy of imposing a production cap can be reconciled with the needs of these countries through a correct evaluation of their "vital" needs in the sense outlined above.

In this perspective a capacity cap accepted by all the countries of the United Nations, will eliminate the fear that the regulations may be circumvented by imports.

I would like to remind that within the guidelines of economic efficiency, a production capacity limit presents the advantage over the selective bans of creating incentives for the allocation of limited resources in the most valuable uses and for the development of CFCs saving processes and products in the whole area of CFCs use.

Selective bans on the other hand tend to reverse the pressure of the supply on to unregulated product areas, bringing down prices and failing to create incentives for the search of CFCs saving innovations.

I would like to underline that the basic difference between the regulation approach adopted by the USA based on the selective ban on CFCs use in aerosols, and the EEC approach based on a production capacity cap and on the reduction of those uses (without resorting to a ban), lies in the limits of the function assigned to the market in the allocation of resources. The approach of the EEC allow greater freedom to the market to modify through price mechanisms the allocation of resources and income distribution, also regarding the timing pattern of the adjustments in order to minimize transition costs. The approach of the EEC is more consistant within the logic of the market.

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ANNEX

Discussion on pro's and con's of aerosol ban

1.0. The main strength of the argument in favor of the ban on the use of CFCs particularly in aerosol products, lies in the affirmation that the restrictive measures introduced in the USA and in other countries have not had significantly adverse economic effects.

The insistence with which the many studies supporting the ban on non-essential CFCs use emphasize the fact that restrictions have not created economic problems, reveals implicitly that the supporters of the ban do not wish to claim that the ban is an absolute necessity for environmental protection. Indeed if it were scientifically proven that the actual rate of CFC emissions does provoke grave and irreversible damage to the ozone layer, it would be unnecessary to resort to an economic analysis demonstrating the lack of economic damage in order to justify a ban on the use of CFCs.

But since this hypothesis has not been scientifically proven and is still subject to criticism and debate, it is easy to understand why so many studies and proposals devote a great deal of attention to the economic and social costs of selective bans and of other restrictive strategies concerning CFCs uses. The supporters of the proposal to extend the ban on non-essential CFC uses to all countries feel the need to show that these bans and other administrative restrictions have no negative

side effects from the economic and social point of view. It follows that if, on the contrary, it were to be demonstrated that in one country or in a group of countries the introduction of selective bans or analogous administrative measures might create serious economic side effects, the full responsibility for the justification of those measures would have to be assumed by the scientific discussion regarding the effect of CFCs emissions on the ozone layer, which is still open to controversy.

A wealth of material has already been written about the effect of selective bans, especially on CFCs in aerosol, which examines the experiences of the USA and other countries who have introduced these bans and which make forecasts regarding the eventual adoption of similar control measures by the EEC countries and by Japan. To sum up: there are two conflicting interpretations.

The first shows that the experiences of the USA and of other countries who have banned the use of CFCs in aerosols, have had the effect of forcing the manufacturers to switch to non CFCs propellants (mainly hydrocarbons) or to change technologies from aerosol to non aerosol dispensers.

CFCs substitutes, hydrocarbons and carbon dioxide, are lower cost materials than CFC's and thus their use has lowered the production costs of aerosols to the benefit of both producers and consumers.

On the other hand, it is maintained that the increase of costs, both direct and indirect, for productive conversion, including the costs necessary to handle the problem of the flammability of hydrocarbons, are tolerable on a medium term for the productive system as a whole.

It is also to be noted that there has been a substantial switch on the part of consumers from aerosol products to non-aerosol products, a contraction in CFCs manufacturing and related industries (aerosol valves, caps, and cans) and also a reduction in related activities (for instance in Sweden the number of independent aerosol fillers decreased). The studies which favor a ban on the use of CFCs in aerosols assume that the effect of the ban on employment has been negligible.

Some studies maintain that the decline in the market for aerosols can also be attributed to other factors unrelated to the new control measures, such as changes in consumer preference, the effect of the economic cycle, the influence on consumers of the debate regarding the environmental effects of CFCs-based products and regarding the safety hazards of aerosols, and the reduction in the advertising of aerosols.

Lastly, studies favoring the ban on CFCs in aerosols claim that the regulation does not negatively affect consumer

satisfaction. The hypothesis is that aerosols which use alternative propellants are qualitatively comparable to their CFCs-based precedents, at least as far as consumer opinion is concerned, and that they are not significantly more hazardous than the CFCs based-products. It should also be noted that the prices of these, new products are not higher and at times they are even lower. The disappearance of some product types because they have become non-viable due to the ban has not substantially reduced the range of products available to consumers who are able to find on the market new and often improved substitutes for the products no longer available.

Thus the first interpretation of the effects of the ban on CFCs use in aerosols claims that the substitution of CFCs with other propellants has maintained both the quality of the products accepted by consumers (without significantly increasing the hazards involved in use), and a comparable range of products available. Thus even the observed fall in volume of the sale of aerosols in countries which have introduced the ban cannot be substantially attributed to the regulations, and may indicate that the consumer can find on the market non-aerosol products which, as far as he is concerned, are good substitutes for the aerosols.

So according to this interpretation, the ban on CFCs use in aerosols has had a minimum effect on consumer satisfaction. Furthermore, this interpretation on the effects of the ban assumes that the productive factors (capital and work), involved in the various stages of production of CFCs for aerosols and in related activities, are mobile enough to avoid a crisis in economic activity and in employment. Namely the cost of productive conversion including the costs of covering the technical risks involved in the production of hydrocarbons, must be acceptable to the firms in their calculations concerning the convenience of investing their capital in the aerosol and related product industry.

2.0. If the interpretation which I have summarized above, drawing from various sources, were to be accepted as correct for the countries who have applied a strict ban on CFCs use in aerosols, this would certainly reinforce the argument in favor of an overall adoption of such regulations as "the rational first step in protecting the ozone layer." Indeed such a strategy of controlling CFCs would have the advantage of heavily reducing the emissions, given the importance of CFCs use in aerosols both before the adopting of the ban and in countries which have not placed any restrictions on it, while imposing negligible economic costs for the consumer, the producer, and the workers of activities affected by such regulations. There would

be no plausible reason for not adopting control measures on CFCs emissions. It remains to be seen whether or not the economic costs imposed by the ban on the use of CFCs in aerosols would also be negligible in other countries where today so far no ban has been adopted.

However, the interpretation given above is largely contested by other studies both with reference to the experiences in recent years of other countries who have placed restrictions on CFCs use and with reference to the forecasts concerning the extension of the ban to other countries, primarily the EEC and OCSE countries. The main reason for the dispute is the degree to which CFCs can be substituted by other propellants from the consumer's point of view, and the degree to which aerosol products may be substituted by non-aerosol products according to consumer opinion.

It has been observed that in the USA after 1974 (when the ozone depletion theory was first published), pressure immediately began on the part of public opinion and certain political forces to curtail the use of CFCs propellants which eventually led to the 1978 legislation which banned their use. Aerosol fillers rapidly started reformulating personal product aerosols to use hydrocarbon propellants; all the same there was a dramatic decrease in the volume of sales of these products. Overall in the period from 1974 -84 there was a 40% reduction of fillings in personal product

aerosols , while fillings of other types of products increased by 19% in the same period. According to the opinion of various manufacturers' associations, "This reduction clearly indicates consumer rejection of personal care aerosols when formulated with hydrocarbon propellants." In contrast, the manufacturers' association observed that in the same time period, 1974 -84, aerosol fillings (personal products) in the UK increased by 24.8% throughout the EEC countries with a small decrease of 5.5% in the period from 1974 -80 followed by a strong recovery of 32.1% after 1980. Thus in 1984 personal products account for 56.7% of total EEC aerosol fillings, but only for 35.7% of total USA fillings. The manufacturers' associations of the European countries in which the ban has not been introduced affirm along with these statistical observations that " the industry has not changed over to a complete use of hydrocarbons for personal care products because of dissatisfaction with their quality determined by consumer tests." Aside from these statistical observations regarding the market trends for aerosols in the USA and in the EEC countries, certain economic phenomena must be taken into consideration which raise doubts about whether or not the CFCs based products are really equivalent to those based on other propellants as far as the consumer is concerned.

If they were truly equivalent as far as regards consumer preference, it would be difficult to explain why the US aerosol industry before the ban preferred CFCs to HC propellants, as the latter are cheaper, and why the EEC and Japanese industries continue to prefer the CFCs propellants even though these industries work under regulations which restrict the production and the use of CFCs and face the possibility of even more severe restrictions in the future and the possible adoption of a ban similar to that introduced in the USA in 1978.

It has also been pointed out that the US owned companies marketing all-hydrocarbon propellant personal products formulations in the US have found it necessary to use CFCs/hydrocarbon blends in order to compete in the EEC countries. To sum up, it is evident that, in the current state of technology, in major aerosol product sectors the quality of the CFCs-based products is superior to substitute products based on other propellants as far as the opinions of both the consumer and the producer are concerned.

The second reason for dissent concerning the ban on CFCs use in aerosols regards the conclusion that such a ban would result in negligible costs for producers in countries where the ban has been applied and that, if extended to the other countries, specifically the EEC countries

and Japan, would impose negligible costs for producers there as well. The manufacturers' associations assert on the contrary that the costs of changing over from CFCs to hydrocarbons or other propellants are extremely high - involving capital costs (including safety equipment), additional maintenance costs, R and D costs of new formulations, additional quality control costs, additional safety maintenance costs, warehouse costs which also depend on safety regulations, and increased insurance costs created by the use and warehousing of flammable material.

In order to meet safety regulations in some cases it may be necessary to change the locations of plants when the sites are judged unsuitable for the installation of facilities for hydrocarbons. The cost of suitable plants and resiting may become prohibitive for small firms. Aside from these additional costs which are generally taken into consideration by the various studies of the subject, one must also take into account the special costs of reconversion in the cases of joint production (and joint costs) which may create serious difficulties for certain firms and plants. A correct estimate of the costs involved must also include the costs borne by the sectors which furnish raw and auxiliary materials which would be negatively affected by control measures or by a selective ban on CFCs uses.

Further estimates must also consider the net impact on the balance of payments. Finally, the administrative and enforcement costs of the ban, which would be borne by the public administration (and by the tax-payer), by the firms involved and by the consumer, must also be considered.

3.0. I also wish to emphasize the fact that the costs of the conversion from the use of CFCs for aerosols to other propellants borne by the productive factors may widely differ from country to country. The economic and social costs would be quite high in countries where there is a high unemployment rate and low mobility of productive factors and where the plants affected either directly or indirectly by the ban are located in economically depressed geographical areas. This situation more or less reflects the current economic and regional situation in Italy in the areas where the CFCs producing plants, the filling process of aerosols and related industries (including the mining industry) are based. In an Italian study on the effects of a possible CFCs ban, it was shown that because of the integration in the productive cycles of CFCs, certain economic conditions would be created which would force one of the three Italian CFCs manufacturing plants, located in a depressed area in the South of Italy, to close down, resulting in grave economical and social consequences and adversely affecting indirectly related activities. Furthermore, the study showed that

important departments of the other two plants would have to be closed, bringing about a sharp fall in production which involves large quantities of basic products for the chemical industry (with a negative influence on the balance of payments in the chemical sector which in Italy is already in heavy deficit).

As far as concerns the impact of the ban on CFCs use in aerosols in the sector of aerosol manufacturers, research in Italy shows that almost one half of the small firms (53 all total) and one fifth of the medium firms (20 all total) do not have the technical nor financial means to convert from the use of CFCs to other propellants. The difficulty of the change over lies not only in the vast problem of technically restructuring the plants but also in the problem of having to change location in order to conform to safety regulations regarding flammable propellants. The re-siting of plants involves high costs which are unacceptable to most firms as well as bureaucratic problems because the geographical location of the plants must be approved by local authorities, an administrative procedure which can be quite slow, complicated, and unpredictable.

Finally, we must note that the Italian mining industries which furnish raw materials for the production of CFCs are located in depressed areas of the South of Italy where mining

is the main form of employment and source of income. Thus the estimate of the cost of conversion forced by a selective ban on CFCs use, even if it should be shown beyond a shadow of a doubt (although I don't believe that the studies done so far are satisfactorily conclusive) that these costs have been economically and socially feasible in the countries which have adopted the ban, this would not mean that these same results would be automatically produced in other countries if the ban were to be extended. In other countries, and I have given Italy as an example, the adoption of a ban on CFCs uses in aerosols would bring about higher costs in relation to the conditions of the labor market and in relation to the structures of the productive sectors directly or indirectly involved, in relation to the trade with other countries, and in relation to the regional locations of existing plants. Furthermore, a comparative study of the collective scales of values, regarding social costs, of the different countries must be made.

In no way is it correct to affirm that the costs of productive conversion forced by a ban are insignificant. It must be added that the regulations on CFCs use will have redistributive effects on the consumers (according to income bracket), on the productive sectors,

on the firms involved, and on the regions
and the countries, which are very difficult to estimate
but which indicate the vastness of the economical and
social impact of these regulations. When these factors
are not taken into account it is easy to misjudge
the feasibility of certain drastic forms of regulation
because one has a tendency to forget or underestimate
certain aspects of the economic and social consequences of
such measures.