

A RETROSPECTIVE EVALUATION OF CONTROL MEASURES FOR CHLORINATED SUBSTANCES

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Introduction

The purpose of this report is to describe the results of a broad retrospective evaluation of socio-economic impacts related to chlorinated substance control measures implemented in Canada and several other nations. This evaluation was done to test the validity of the belief, held by many in the environmental policy community, that the costs of environmental management initiatives, estimated prior to implementation (ex ante), are higher than what is actually incurred and estimated in studies after the initiative has been in place and taken effect (ex post). The Phase I component of this study was reported on previously¹, providing an overview of control measures and existing socio-economic studies for a variety of countries, which was used to select 5 case studies for comprehensive assessment and evaluation. The Phase II component, reported here, describes the Final Report² main results of these case studies, including comparisons of the ex ante and ex post analyses, as well as estimated effects on socio-economic variables such as employment, prices, product substitutions, process modifications, etc., as available.

Materials and Methods

The methodology employed was two-fold:

- a) a literature review;
- b) surveys of knowledgeable contacts.

Results and Discussion

There have been some broad assessments of available ex-ante and ex-post studies to determine if there is a trend with respect to whether actual costs of environmental management initiatives tend to be below or above those costs estimated prior to the promulgation of the initiative. In this current study, the four main reviews of this nature were obtained and assessed.

The general consensus among economists and policy analysts is that there is an observable tendency to overestimate actual compliance costs when conducting an ex-ante assessment of the initiative. The major rationale provided in each of the studies that have stated this opinion is that ex-ante cost studies do not have the necessary information which would enable them to adequately determine the technical innovative capacity of industry to develop solutions to meet the objectives of the environmental management initiative at least cost. Several other reasons are also provided to explain the tendency to overestimate actual compliance costs (e.g. unanticipated changes in the nature of the regulation, strategy on behalf of industry, flexibility inherent in the regulation, etc.). It should be noted that there are opinions that ex-ante costs actually underestimate the true compliance costs of environmental management initiatives. However, only 1 of the above 4 broad studies which have assessed this issue reaches this conclusion.

RISK EVALUATION - POSTERS

Table 1: Results From Ex-Ante/Ex-Post Cost Comparison Reviews

Study	Results of Ex-Ante Assessment	Reasons for Over/Under-Estimation
Resources for the Future	<ul style="list-style-type: none"> • 25 regulations assessed • 12 overestimated costs • 2 underestimated costs • rest were accurate or no determination was made 	(i) unanticipated technical innovations; (ii) quantity errors; (iii) changes in the regulation after the cost estimate is prepared, (iv) use of maximum cost estimates; and (v) asymmetric error correction.
Goodstein & Hodges	<ul style="list-style-type: none"> • 12 regulations assessed • 12 overestimated costs 	(i) technical innovation on behalf of industry; and (ii) flexibility mechanisms that are inherently built into the regulatory process as well as the regulation itself.
Council of Economic Advisors ¹	<ul style="list-style-type: none"> • refuted 9 of the 12 regulations that were assessed in the Goodstein & Hodges paper as being overestimated. 	actual costs are understated because ex-ante costs: (i) include only direct compliance costs and do not consider indirect costs borne elsewhere in the economy; (ii) falsely incorporate a substantial fraction of total costs into the baseline; and (iii) assume frictionless implementation.
Risk & Policy Analysts Ltd.	<ul style="list-style-type: none"> • paper based on how to conduct an ex-post study. The paper did however state that there is a tendency to overestimate actual compliance costs. 	(i) technology forcing (i.e. development of more cost-effective approaches in response to regulations); (ii) strategic bidding (i.e. exaggeration of potential costs or benefits in order to influence a decision); or (iii) unpredicted responses (i.e. approaches to meet a regulation were different than those assumed in the ex-ante study).

¹ the Council of Economic Advisors paper provides reasons why ex-ante cost estimates underestimate actual compliance costs. The other three papers provided reasons why ex-ante cost estimates overestimate actual compliance costs. Note: the report prepared by the Ontario Ministry of the Environment entitled, *Water Pollution Monitoring Costs in Ontario - Comparison of Estimated and Actual Cost* also provides a synopsis of ex-ante and ex-post costs. However, only those studies which assessed the breadth of ex-ante/ex-post reports available were reviewed, not all reports focused on specific policy initiatives.

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A total of 5 case studies were prepared in support of this report.

RISK EVALUATION - POSTERS

1. 1988 CFC Regulation in the U.S. implementing the Montreal Protocol and the 1977 U.S. Regulation limiting the use of CFCs in aerosols;
2. 1992 Canadian Regulation mandating the virtual elimination of dioxin and furan releases from the pulp and paper industry (and other related regulations);
3. 1972 U.S. cancellation of registered uses of DDT and the U.S. suspension/cancellation of chlordane/heptachlor registered uses;
4. 1996 Danish tax on chlorinated solvents; and
5. 1993 Netherlands covenant with the chemicals industry (case study focused on the chlorinated substance reductions agreed to in the covenant).

The results of the 5 case studies generally support the consensus that ex-ante costs tend to (but not in all instances) overestimate the actual compliance costs of environmental management initiatives. Again, the main rationale for this is the difficulty incorporating the technical innovative capacity of industry into the ex-ante cost analyses. Several of the case studies demonstrated that total cost estimates, or sub-segments of the costs, were overestimated when compared to similar ex-post cost estimate categories. However in two instances, ex-ante costs were underestimated in terms of actual compliance costs. There were also instances where total costs, or sub-segments of the costs, were accurate when compared to similar ex-post cost estimates.

One of the objectives of the case studies was to review environmental management initiatives outside of the U.S., as well as non-regulatory initiatives. Therefore, formal ex-post cost/socio-economic assessments were not available for all of the selected case studies. Interviews were then conducted in order to develop perspectives on actual cost/socio-economic impacts of the initiative.

Table 2: Results of the Ex-Ante/Ex-Post Case Studies

Case Study	Accuracy of Ex-Ante Studies and Degree of Differences
Ozone Depleting Substances (U.S. Regulations) (i) Montreal Protocol (1988) (ii) Aerosols (1977)	<ul style="list-style-type: none"> • Montreal Protocol (Overestimation) - several different ex-ante scenarios with costs being overestimated anywhere from a factor just over 1 to 8 times actual costs. Some ex-ante scenarios indicated estimated costs lower than actual costs. • Aerosols (Underestimation) - total costs were underestimated by a factor between 1.5 and 7 times actual costs.
Pesticides (U.S. Regulations) (i) DDT (1972) (ii) Chlordane/Heptachlor (1978)	<ul style="list-style-type: none"> • DDT (Overestimation) - ex-ante studies overestimated actual costs between a factor of 1.9 and 7.0. One ex-ante study estimated no costs. • Chlordane/Heptachlor (Overestimation) - Based on qualitative information - minimal impacts on corn farmers after cancellation. Record crops in years following cancellation suggest minimal cost consequences. EPA also confirm minor effects on production, revenues, profits, etc. due to suspension/cancellation.
Pulp Paper (Canadian Regulation - 1992)	<ul style="list-style-type: none"> • Accurate - aggregated plant by plant ex-ante cost estimates similar to actual environmental expenditures attributed to the regulation when aggregated across all plants. Accuracy of ex-ante costs vary on a plant-by-plant basis.
Chlorinated Solvents Tax (Denmark Economic Instrument - 1996)	<ul style="list-style-type: none"> • Overestimation - based on qualitative information - no impact on dry cleaners (major sector that would be effected) after tax was imposed. Much more rapid decline in solvents consumption than predicted indicates overestimation of costs or underestimation of technical innovative capacity of industry.
Chemicals Industry Covenant (Netherlands Voluntary Agreement - 1993)	<ul style="list-style-type: none"> • No Data - while the chemicals sector originally stated that the measures required to achieve the targets would be very costly, they have obtained unanticipated benefits because of the covenant and are now completely in favour of the covenant (covenant now critical component of their Responsible Care program).

Note: the determination of whether the ex-ante costs were overestimated, underestimated or accurate is based upon reviews of the literature that has been published on the subject, as well as technical interviews with individuals familiar with the particular policy and its economic effects.

The socio-economic consequences of the environmental management initiatives subjected to case studies were generally minimal for the economy as a whole, although for some sectors, significant economic dislocation occurred. The Chlorinated Solvents Tax in Denmark has been reported to have had no effect (i.e. on solvent prices, price to dry clean clothes, profits, employment, etc.) on the major affected source (i.e. dry-cleaners). Increased recycling and chemical substitutes (e.g. pentane, vegetable esters, glycol ethers, etc.) reduced any negative economic impacts on the range of sectors affected. With respect to the DDT and chlordane/heptachlor cancellation, record corn crops have been recorded since the cancellation. In addition, the corn pests that were sprayed with DDT and chlordane/heptachlor at the time they were canceled were becoming resistant to those pesticides and as a result, other pesticides were being developed and used in their place (e.g. methyl parathion, toxaphene, etc.). The Netherlands covenant has also had minimal economic effects on production, revenues or profits, as several investments in new chemical plants in the Netherlands have been announced since the covenant was signed.

Alternatively, the CFC regulation on aerosols had some significant socio-economic results with plant closures and associated employment losses in the aerosol and chemical sectors. However, estimates of the labour intensity of producing non-aerosol substitutes (e.g. hydrocarbons, mechanical pumps) indicated that these employment losses would be completely offset by increases elsewhere in the economy. In addition, no consumer price increases were observed and additional product availability was attributed to the regulation. The main economic consequence was unemployed capital, which was dedicated to producing CFC related products. In terms of the 1988 U.S. regulation implementing the Montreal Protocol, the usage of CFCs declined much more rapidly than expected in the U.S. after 1988, with the adoption of many alternatives (with associated production and employment gains) offsetting losses in the "CFC sector". Among these alternatives were HCFCs, HFCs, hydrocarbons, chemical-free substitute processes, etc.

In terms of the Canadian regulation on dioxins/furans, the pulp and paper industry maintained its capacity level and mills took the opportunity to upgrade and augment operations. In many cases, mills also installed systems that allowed them to operate in modes that exceeded minimal environmental requirements. Overall, net employment in the pulp and paper sector was estimated to increase due to the 1992 regulations. However, there are mill cases where negative socio-economic consequences resulted (e.g. mill bankruptcy) in context of a combination of unique business factors and environmental regulations influencing the mills at the same time. While some sectors of the economy suffered noticeable economic dislocation (e.g. chlorine facilities), other sectors of the economy (e.g. sodium chlorate production facilities to produce chlorine dioxide, a chlorine substitute) enjoyed substantial economic benefits. The technical innovative capacity of industry also enables the socio-economic results of environmental management initiatives to be mitigated, although not eliminated. For instance, the development of alternatives to the polluting process results in socio-economic gains that tend to offset the dislocation observed in those sectors most impacted by the environmental management initiative.

References

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