

**EV5V-CT94-0382:**

# **AN ECONOMIC APPROACH TO THE PROBLEM OF TOXIC PRODUCTS AND WASTE**

## **SUMMARY FINAL REPORT**

**MARCH 1996**

**Keywords:** toxic waste; law and economics

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## **I. OBJECTIVES**

The objective of the project was the development of optimal policies for the control of toxic waste. A large number of economic instruments have been studied in an extensive literature search to address this problem; the aim of this project was to assess what combination of instruments provided the best direct incentives to change production technology and the characteristics of toxic substances. A dynamic theoretical framework has been developed, set in an optimal control format. This has allowed (i) the 'social optimum' to be defined clearly; and (ii) the shortcomings of current approaches to regulation to be identified. The same framework was used to investigate the interactions of the different policies available to see which combination approximated the social optimum. The model allowed simulations to be performed to give quantitative indications of the effects of regulation. In parallel, the legal and institutional background to regulation was investigated in a series of case studies comparing the regulatory experience of the United States and Europe. The theoretical and institutional parts of the project were combined to form joint recommendations on policy approaches to the problem of toxic waste.

## **II. METHODOLOGY**

One axis of the work (the Cambridge team) focused on the development of economic models to analyse the market failures involved in the problem of toxic products and waste; four were identified:

- (i) externalities (firms consider only their own, private marginal costs when making decisions, and not the total, or social, (marginal) costs of their actions);
- (ii) the interaction of existing institutions (in particular, the perverse incentives created by the combination of product-specific bans and the patent system);
- (iii) imperfect competition (how firms will choose to design products that persist in the environment in order to influence the behaviour of a small number of rival firms); and
- (iv) limited liability and the 'judgement proof problem'<sup>1</sup> (the ability of firms to generate large, long-term environmental damage without having to face the full cost of their actions).

The four market failures were investigated in four separate theoretical models. Optimal control theory has been used to express the problem in dynamic terms, so that the accumulation of hazardous products in the environment can be studied. In addition, the results of these models have been simulated to give qualitative indications of the effect of different policy instruments.

The case for regulation of international trade in hazardous waste was examined. First, aggregate data for both Europe and the U.S. were analysed and flows of hazardous waste between countries identified. A model of the drivers of international trade in waste was then developed, using trade data for thirty states from the California Department of Health Services Database (1990)<sup>2</sup>. The theoretical case for waste trade was then examined, and the efficiency and risk-sharing consequences analysed. A particular issue in this discussion was the difficulty, but importance, of incorporating the (shadow) price of environmental resources into trade decisions, in the face of uncertainty and potential irreversible damage to the environment. Finally, an overview of current regulation of international trade was provided.

The other axis of the research (the Limburg team) focused on an analysis of the comparative effectiveness of alternative regulatory frameworks. The analysis was both descriptive (or positive), and policy orientated (or normative). The positive analysis focused on the overview of current regulation of hazardous substances. The policy orientated approach consisted of the critical analysis of existing regimes, and the development of better alternatives. The work employed three approaches. The first adopted a general overview of the law and economics of an optimal regulatory regime for hazardous substances, highlighting the issues involved in comparative evaluation. This overview considered the alternatives: liability rules, financial instruments (such as taxes and levies), and command and control regulation (through e.g. administrative regulations, permits etc.). A particular focus of the work was the performance of legal rules in the U.S. in dealing with toxic substances. The benefits and failings of both *ex ante* regulation and *ex post* liability were analysed.

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<sup>1</sup> See Shavell, S., "The Judgement Proof Problem", *International Review of Law and Economics*, Vol. 6, 1986, pp. 45-58.

<sup>2</sup> Unfortunately, the relevant data is not presently available at the European level.

The second approach summarised European Community hazardous waste legislation. This part of the project gave a comprehensive description of the history and foundations of Community legislation in this area, and described the current state of European law and the extent to which harmonisation had occurred. The third approach consisted of case studies, examining the situation in various Member States (The Netherlands, Belgium and the U.K.). The analysis focused on the comparative costliness of the institutions in these countries, and examined the differences in the various regimes in order to indicate the extent to which harmonisation may be achieved. The problems concerning the lack of implementation by various Member States were assessed. In addition (and complementary to the Cambridge team's work on waste trade), the legal regime in Europe concerning the movement of waste (and particularly regulation 259/93/EC) was reviewed.

### III. MAIN RESULTS

The main results may be summarised as follows:

1. Product-specific bans are a poor method of regulating products which are designed to persist in environmental media. There are two reasons for this conclusion. First, such a ban often achieves no more than a substitution to an equally undesirable product. Secondly, when a less-polluting, but more expensive substitute is available, a product-specific ban is an inefficient way (in terms of both management of the natural resource, and the switching costs incurred) to regulate use of the polluting product.
2. Any regulation must take into account the (un-)competitive nature of the manufacturing industry: Firms, where possible, will use regulation as a further strategic weapon to disadvantage their rivals. Examples of this sort of behaviour abound: the reaction of agricultural chemical manufacturers to pesticide-specific bans in Europe; Du Pont advocating a chlorofluorocarbon (CFC) ban in the U.S. in order to increase the profitability of a new product that it had developed; firms lobbying for more stringent regulation in order to deter entry into their industry. The result can be increased sales of products with socially undesirable characteristics.
3. Both of the above factors suggest that an effective means of regulation might involve taxation of the characteristics of hazardous products which give rise to environmental damage: For example, agricultural chemicals should be subject to a tax based on their ability to accumulate in groundwater; CFCs should be taxed on the ozone depleting potential (ODP); solvents on their solubility in animal and human fats (organic partition coefficient).
4. Ex post liability systems alone are not sufficient to provide the correct incentives to firms that generate large, long-term environmental damages; ex ante instruments (for example, performance bonds, or compulsory insurance) must also be considered: *Ex post* liability allows firms to avoid damages that occur in the distant future, by providing sufficient time for the firm to make a profit and then exit the industry before they can be held responsible for damages caused. The uncertainties inherent in this situation mean that the only practical method of regulation is to charge firms for potential future damages while they are still in operation; the resulting system bears many similarities to the current approach to the regulation of banks.
5. A compensation fund (the U.S. approach) is not a panacea for all hazardous waste ills: There are no strong a priori reasons for favouring a social compensation fund over e.g. private insurance markets; and the problem of time credibility - the temptation to charge retrospectively for past damage - inevitably causes significant inefficiencies in firms' behaviour (despite achieving the objective of payment for clean-up costs).
6. Four principles govern the amended European waste framework directive: They are: (i) the establishment by individual States of adequate networks of disposal installations; (ii) the use of Best Available Technology Not Entailing Excessive Costs (BATNEEC); (iii) self-sufficiency (Member States should be self-sufficient in the disposal of waste; and (iv) proximity (waste should be disposed of in one of the nearest appropriate installations).
7. The systems for regulating hazardous waste in The Netherlands, Belgium and the U.K. are very different: At the most fundamental level, the definition of 'hazardous substance' varies significantly between the three countries. Dutch and European environmental law are similar (for example, both advocate the use of liability systems to regulate hazardous products); in contrast, U.K. policy is more ex ante in its focus.
8. Trade of hazardous waste is driven by two factors: The first is the more general trend of increased off-site treatment of waste; the second is distance. Differences in regulatory treatment play at best a secondary role (somewhat surprisingly).
9. Straightforward application of pure trade theory to the case of hazardous

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waste transport is too naive: Theoretical arguments against trade restrictions are undermined by the nature of hazardous waste and the reality of national sovereignty.

10. Regulation of waste trade may result in trade pattern reversal: The impact of regulation on the generating sector, and not just the waste trade sector, must also be taken into account.

### **IV. SCIENTIFIC INTEREST AND POLICY RELEVANCE**

#### **Policy Relevance**

The main contribution of the project lies in its policy implications, as indicated in the previous section (although the research is not without scientific interest; see below). The theoretical economic analysis suggested that optimal regulation must take into account the competitive framework that it creates. It also suggested that, while liability rules can be useful in the regulation of short-term environmental damage, they are not able to provide the correct incentives when damage is long-term. The analysis should be of some relevance to the Community in its consideration of the various draft Directives that advocate liability systems. The work on hazardous waste trade suggests that regulation of this sector may be necessary; but in assessing the case for regulation, the effect on not just the waste trade sector and the environment, but also the generating sector, must be taken into account. The institutional analysis highlighted the major differences in regulatory regimes which currently exist between Member States; and showed that the amended European waste framework directive would require significant policy changes for e.g. the U.K.. The results from the trade model suggest, however, that hazardous waste trade cannot be explained entirely (or even in large part) by the differences in regulatory treatment across countries.

The comparative legal analysis provided a framework for evaluating alternative policy instruments. It outlined the criteria by which any regulatory approach should be evaluated; and it suggested how legal rules should be formulated to give optimal incentives for the prevention of damage caused by waste. Especially important in this context was the administrative costs of each system - as the experience of Superfund in the U.S. has shown, a theoretically ideal regime can fail in practice if it is too expensive to implement<sup>3</sup>. The research allowed an assessment of the costliness of different policies.

#### **Scientific Interest**

The scientific interest of the project lies in the techniques employed. The projects' economic research was the first time, as far as the authors are aware, that a fully dynamic model has been used to analyse firms' incentives in designing and generating hazardous and persistence substances. It also provided the first formal model of the behaviour of firms who generate large, long-term damages when they are faced with an ex post system of strict liability<sup>4</sup>. Although comparative institutional analysis of alternative regulatory regimes has been performed for the

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<sup>3</sup> The administrative costs of Superfund have been estimated at 44% of the total cost of cleanup; see Menell, P. S., "The Limitations of Legal Institutions for Addressing Environmental Risks", *Journal of Economic Perspectives*, Vol. 5(3), Summer 1991, pp. 93-113.

<sup>4</sup> Ringleb, A. H. and S. N. Wiggins ("Adverse Selection and Long-Term Hazards: The Choice between Contract and Mandatory Liability Rules", *Journal of Legal Studies*, Vol. 21(1), January 1992, pp. 189-215) present a model of the incentive effects of a liability system. They treat, however, the probability of bankruptcy as a parameter, which defeats the purpose of their analysis - to show that firms will choose to go bankrupt under certain circumstances - somewhat. The research model used here does not treat bankruptcy as a parameter.