

EV5V-CT94-0376

**THE IMPACT OF PARAMETERS PROVIDED BY
ENVIRONMENTAL POLICY ON THE
INNOVATIVE BEHAVIOUR OF COMPANIES IN
SELECTED EUROPEAN COUNTRIES**

SUMMARY FINAL REPORT

DECEMBER 1995

Key words :innovation; environmental innovation; environmental policy; regulation; industry

RESEARCH TEAM

Coordinator :

Dr. Georg Licht

Jens Hemmelskamp

Centre for European Economic Research, Mannheim (ZEW)

Kaiserring 14-16

D-68161 Mannheim

Tel. ++49/621/1235-177 or 203,

Fax: ++49/621/1235-226,

E-mail: licht@zew.de ;

E-mail: hemmelskamp@zew.de

Partners :

Dr. Jan Willem Velthuisen

Egbert Oldenboom

Foundation for Economic Research of the

University of Amsterdam (SEO)

Roeterstraat 11

NL-1018 WB Amsterdam

Tel. ++31/20-6242412

Fax: ++31/20-6258993

E-mail: egberto@seo.fee.uva.nl

I. OBJECTIVES

Technical progress is located in an area of conflict between the emergence of new environmental problems and the solution to or reduction of existing environmental problems. Therefore some people regard technological developments as a threat to nature and the environment. Others, by contrast, see them as a possible salvation. If the latter are right, then technological progress must result in companies being able to generate innovations which make it possible to:

- come up with new possibilities for the substitution of natural resources
- reduce specific impacts on the environment
- improve resource productivity or
- improve the reversibility of environmental damage.

Innovations, as a rule, are based on continuous and successive improvements in existing products or production processes. In this context, the results of an innovation process based on acquired experiential know-how affect the selection and the implementation of future processes and products. A fundamental change in the direction of innovation endeavours is associated with the (occasional) loss of acquired know-how. At the same time, it is precisely such radical innovation opportunities which enable breakthroughs in new technological fields.

Government can be a significant factor in the direction innovation takes by forming the exogenous institutional environment for companies, such as taxes, R&D or environmental policies. Environmental policy measures are increasingly important for innovation processes. Yet the influence of environmental protection measures on innovative behaviour of enterprises, has received little attention in scientific and political discourse.

The majority of the available studies are theoretical on the dynamic effects of individual environmental policy instruments. The few empirical studies demonstrate that environmental policy measures represent only one of many innovation-relevant factors. A more in depth study of the correlation of innovations with environmental regulations must address this fact.

In 1993 the Corporate Innovation Survey was initiated by the EU-Commission in all EU-member countries. These coordinated innovation surveys for the first time enabled a comparative analysis of the innovation behaviour of companies. The innovation surveys enabled the comparison of the effect of environmental measures in the context of the general analysis of a company's innovation behaviour.

The focus of this research was to investigate the effect of environmental regulations on the generation of environmental innovations. The following questions were examined :

- Does the application of environmental regulations provide effects to innovation activities in companies?
- Which regulatory instruments provide a fairly strong environmental innovation stimulus?
- Which factors determine the adaptive behaviour of companies in response to the application of environmental regulations?
- Is there any difference in environmentally-oriented innovative behaviour between individual EU-Member States?

The answers to these questions provided important clues for an innovation-enhancing formulation of environmental policy.

II. METHODOLOGY

The research was conducted simultaneously in two EU-Member-States, Germany and the Netherlands. This mode of procedure aimed at obtaining country-specific findings about the impact of environmental regulations on innovations. The selected methodological approach of the research was based on an analysis of the latest literature on the given survey topic, a statistical analysis of the data collected for the German and Dutch 1993 Innovation Survey, and supplementary interviews with individual companies.

From the total of 2,954 companies participating in the German survey of 1993, a sample of 2,481 companies was taken for the German case study. The sample mainly covered the following industries depending on the German economic structure: "refineries, chemicals, rubber, plastics" and "mechanical engineering, household appliances, arms and ammunition". In the German sample companies with fewer than 50 workers make the largest contribution part (33%). The Dutch survey of 1992, which was answered by 4,085 companies. In the Dutch case study 2075 companies were taken into account. The industry food and beverages is strongly represented in the Dutch sample, reflecting the relative specialisation of the Dutch economy. Another industry of which the same holds true is woodprocessing, paper and printing matters. Larger companies make up a smaller part of the Dutch

sample than of the German one.

A low rate of participation may lead to biases in the analyses, something that may influence the findings of the study if using the sample, conclusions are also to be drawn on larger populations. As the research was meant to yield general findings on the impact of environmental regulations, no-response analyses were made in both countries. Amongst other things it was found that in certain industries in the sample, companies undertaking R&D were over-represented. This bias in the responses was identified and corrected by statistical methods, so that extrapolated data are less affected by response bias.

III. MAIN RESULTS

Based on the interdependent correlations of the various economic, legal or technological factors relevant to innovative behaviour, significant parameters of environment-oriented innovative behaviour were identified using the data in the Dutch and German Innovation Survey; this data was presented in a descriptive comparative study of the two countries. According to the results, the environmentally innovative and non-environmentally innovative companies in The Netherlands and Germany are distinguishable as follows:

- the bigger, the more environmentally innovative
- the primary product industry is more environmentally innovative
- regulations impede environmentally innovative companies in particular
- environmentally innovative companies are not more innovative than the average.

The analysis of the innovation objectives collected in the innovation surveys showed that the companies evaluated the contribution of individual innovation objectives to environmental protection differently in The Netherlands and Germany. Environmentally friendly products and process innovations, as well as the reduction of energy consumption are pursued in both countries among other reasons, due to environmental considerations. In contrast, the reduction of material consumption is considered a measure for the reduction of environmental impact only by companies in The Netherlands, whereas in Germany this is considered only as a cost reduction measure.

Based on these results, econometric analyses of the influence of environmental regulations were conducted. In both countries the study concentrated on two instruments: in The Netherlands on covenants and environmental legislation and in Germany on requirements and levies. In addition to the information derived from the two national innovations surveys, the respective regulative intensity was determined by surveying the national chambers of commerce. The regulative intensity indicators thus obtained were then taken into consideration in the multi-variant analyses, as well as in defining the characteristics of environmentally innovative companies derived from the descriptive analysis.

In these analyses it became evident that in Germany environmentally friendly process innovations have a relatively high priority primarily in the environmentally intensive branches of the basic materials industry and environmentally friendly product innovations are emphasised in the consumer goods branches. In The Netherlands in contrast, the reduction of environmental impact is a higher priority for innovation objectives in the capital goods industry. It is also evident that environmental protection innovations objectives correlate with company scale in Germany, whereas in The Netherlands this only applies to the objective of the reduction of energy consumption. The reduction of environmental impact due to production and products as well as the reduction of energy consumption are positively correlated in both countries with the impact of legislation on the enterprises. Only for The Netherlands this applies to the reduction of material consumption as well.

For environmental protection legislation in particular, it was evident in „non-comparative“ analyses in both countries that the selected instruments can have a positive influence on the significance of the objectives of reducing environmental impact due to production and products and cutting down the amount of energy used. The importance to companies of the innovation objective of "reducing of raw material used" is not affected in either country by the selected environmental policy instruments.

The German data enabled "comparative" analyses of the effect of levies and requirements on environmental innovations. Due to statistical problems the results were not sound and can only be interpreted to a limited extent. For that reason policy options will not be derived on the basis of these comparative analyses. The evaluation of the data for The Netherlands was absolutely impossible due to statistical problems. The analyses of the German data suggested different innovation effects of levies and requirements in Germany. The analyses indicated that in the context of today's institutional environment in Germany, the implementation of environment levies, in contrast with requirements, could positively influence the significance of environmentally benign product and

process innovations. On the one hand, the reduction of energy consumption could be accorded greater significance if environmental policy objectives are implemented by further requirements, while on the other hand, levies in this sector could be associated with more innovation-impeding effects.

The results of supplementary company interviews showed that the innovative effects described above must be interpreted in the context of the effect of the predominantly environmental instruments utilised in the past in both countries, i.e. emissions levies or emissions regulations. This also helps to explain the surprising result that the reduction of material consumption seen as an environmental objective in The Netherlands is not a target of the studied instruments. The implementation of the resource conservation objectives entailed in the recent Dutch environmental protection programmes do not yet have practical significance. Rather one could assume that the companies in The Netherlands have already accepted the requirements formulated in the government's environmental protection programme and have incorporated them in their long-term investment planning before they are formally required to do so. The interviews conducted with company representatives also revealed that companies in The Netherlands are increasingly attempting to incorporate environmental protection objectives as an integral part of innovation strategies. As a response to environmental protection policy, German companies focus, in contrast, primarily on end-of-pipe-solutions; these solutions have very little innovative potential and represent more a reactive rather than proactive strategy.

IV. SCIENTIFIC INTEREST AND POLICY RELEVANCE

Further research

Empirical data required for the study of the correlation of environmental regulations and innovations is still lacking. Time and again it is evident that comparative country studies on the effect on innovations of different environmental policies are missing. Based on the data available in the innovation surveys, the present research was a contribution to filling the gap in research on the effect of environmental policy instruments on innovation behaviour. Further comparative country studies based on the data available in the CIS could expand the results of the present study.

Nevertheless, it has become evident that a number of questions require further research and data. For a comprehensive study of the question at hand, the innovation surveys placed too little emphasis on environmentally relevant information. A better distinction should be made - like in the German survey - between environmental product and process innovations. Product innovations can be distilled from questionnaires because they are recognised as such by firms. It seems to be quite fruitless to ask about an 'environmental innovation' or 'environmental investment', because only end-of-pipe innovations and investments are readily recognised as such. As a consequence, data sources (including the Dutch Innovation Survey) cannot give an accurate picture of the magnitude of process innovations with beneficial effects on the environment. A better question seems to be to ask about investments with environmentally beneficial side-effects.

It proved to be difficult to find a suitable indicator for regulative intensity in the environmental sector. The selected indicator could reflect well the effect on the branch-level, but much data contained in the innovation surveys was lost on the micro-level due to the high aggregation of indicators in thirteen branches resulting from the special surveys of chambers of commerce in Germany and the Netherlands. It was also evident that the indicators could only reflect past experience with instruments. This encompasses, therefore, primarily the effect of regulations since finding the appropriate data to test for differential effects of environmental regulations could be difficult given the dearth of experience with regulations other than command and control. Future studies should look into further possibilities of studying differential effects of instruments on innovation. For example, a disaggregate special study of companies could be made which would be complementary and addressed to companies that participated in the innovation surveys in Germany and The Netherlands. By proceeding in this fashion the amount of available information on companies would increase considerably. The target group of such a survey should be made up of the companies' environmental coordinators. Further findings relevant to the subject of this research could be provided by linking the national innovation surveys to national patent statistics. This would make it possible to carry out a well-targeted analysis of the environmentally-relevant patent applications made by the companies contained in the innovation surveys. A link of innovation surveys and patent statistics is being made for Germany. Further research is necessary on the issue of interactions between public authorities and firms. Although the size and branch of a certain firm explains some part of the attitude towards innovations, environment and public authorities, management culture may also play an important part.

In the context of a potential new European Innovation Survey, it would therefore be desirable to put more emphasis on environmental concerns.

In addition to highly aggregate analyses on the level of innovation surveys, the case studies did seem to be useful. Comparative branch case studies could be conducted in countries which utilise different environmental regulatory instruments. For example, a study of the chemical industry in Germany, The Netherlands and Switzerland could, on the one hand, analyse the effect of different instruments and, on the other hand, study the effect of instruments in the context of different general economic and social frames of reference. Additional information concerning these question could be obtained in studies of specific technologies. This would enable the study of innovation effects of regulations without the distortion of branch and size-class effects. It would also be interesting to study the general effect of environmental regulations on innovations, a subject which was not dealt with in this research.

Policy relevance

It is characteristic of innovations that they evolve along the lines of the already existing direction of development. Once a direction has been taken in development, it is difficult to motivate a company to suddenly change course to a new direction in technological development. In The Netherlands and in Germany significant impulses were initiated towards development and implementation of environmentally friendly products and processes based on environmental policy. Therefore government plays an important role in technological development in the environmental protection sector.

For several years the Dutch long-term environment programme has defined long-term environmental protection objectives for companies which should be implemented in the next few years through the utilisation of environment policy instruments. This provides companies with indications of the general perspective on environmental protection and they can adjust their environmental strategies accordingly. In Germany no such long-term programme exists. The German Bundestag's Committee on the "Protection of Human Life and the Environment" is intended to fill this gap in the near future. There are clear signs that the described environmental protection policies will be reflected in The Netherlands by continued emphasis on holistic environmental protection and in Germany by the predominance of emissions-oriented measures.

In view of the demands for innovations, innovation-oriented environment policy should keep in mind that once a certain direction has been taken in development of environmentally benign technologies and products, it is very difficult to change course. The alleviation of acute hazards must always be based on environmental policy instruments that work quickly. For the challenge of sustainable development, long-term perspectives should nevertheless be so defined that companies can incorporate them early on in their innovation planning. Therefore these measures could support fundamental ecological structural change in a long-range context. The goal should be to integrate environmental protection considerations into the "normal" innovation process in order to integrate environmental protection in the research and development phase.

This research has shown that in the context of current experience neither levies nor regulations prove to be clearly superior instruments. This is remarkable, but not particularly surprising since other empirical studies indicate that the individual advantages ascribed to market-based instruments must often be relativized. This refers to both the given institutional environment based on the actual regulative framework, as well as to the concrete form of those instruments. For example, dynamic standards could be set and have stronger innovation incentives than levies, which often become increasingly watered down in the political process and are often too low. The traditional regulation and emission-oriented environmental policy has consolidated the development of environmental technologies significantly in the direction of end-of-pipe-solutions. Here the dynamization of regulatory legislation in future, as well as market-based measures suited to the given problem would be desirable to achieve a technology shift towards more integrated solutions. Evidently the ideal environmental policy is based on a policy-mix in which the comparative advantages of individual instruments can be utilised and their individual disadvantages can be mitigated in the careful structuring and coordination of the various instruments.