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DETERMINANTS OF ENVIRONMENTAL PROFIT
**An analysis of the firm-level relationship between environmental
performance and economic performance**

Leena Lankoski

**Dissertation for the degree of Doctor of Technology to be presented with due permission for
public examination and debate in Auditorium B at Helsinki University of Technology (Espoo,
Finland) on the 16th of September, at 12 noon.**

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Abstract

The study contains a theoretical and empirical examination of the relationship between the environmental and economic performance of firms. It reframes the crucial question to read, not whether, but when environmental performance improvements are profitable for firms. The study develops the novel concept of environmental profit and investigates its determinants.

To this end, the study first reviews the existing literature to show how and why attempts to detect a systematic relationship between the environmental and economic performance of firms have been unsuccessful. In particular, the study identifies three gaps in the previous knowledge: (1) the relationship may not be constant across environmental performance levels, which means that it needs to be considered a function of environmental performance; (2) the relationship may not be uniform across cases, which means that the determinants of environmental profit need to be identified; and (3) the relationship may not be static across time, which means that changes in the determinants of environmental profit over time need to be discussed.

The study approaches the topic through three research modules. The first research module uses mathematical model building to assert that the relationship should be considered a case-specific, inverted U-shaped function of environmental performance, represented by an environmental profit curve. So-called win-win situations exist as long as a firm is situated in the rising portion of its environmental profit curve.

The second research module examines statistically the overcompliance of 108 Finnish manufacturing plants in the chemical forest industry, chemical industry, metal industry, and food industry with effluent discharge regulations during 1988-1996. This module finds that there is significant variation in overcompliance and, thus, in perceived win-win situations. The most important sources for this variation are to be found at the plant level.

The third research module consists of eleven case studies concerning Finnish manufacturing plants, which are used to develop an understanding of the mechanisms behind the plant-level variation in perceived win-win situations. This analysis reveals six main determinants of environmental profit: technology, regime, visibility, willingness to pay, benchmarks, and discount rate. Combined, these determinants establish whether a particular environmental performance improvement in a particular firm results in a win-win situation or not.

In sum, the study shows that the firm-level relationship between environmental and economic performance takes the form of an inverted U-shaped function of environmental performance, and varies from firm to firm according to the six main determinants of environmental profit.

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Helsinki, September 2000
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1 INTRODUCTION

1.1 Background

It has long been debated whether improved environmental performance hurts or helps the economic performance of firms. Understanding this relationship is important, both from an environmental and economic perspective, when the dual objective of high environmental quality and good economic performance is pursued.

Many studies on the relationship between environmental and economic performance date back to the 1970s. Again in the 1990s, considerable attention started to focus on this issue on scientific, business and policy fora. However, knowledge of the topic is still limited and has not cumulated to allow a unified theory to emerge. Instead, results have remained isolated and sometimes conflicting. At one extreme, there is the traditional view that improved environmental performance increases production costs and thus necessarily harms economic performance. Such an argument is easy to establish based on economic theory.¹ For example, McGuire (1982) maintains that if factors of production are mobile, environmental regulation can entirely drive out the polluting industry from the economy.²

At the other extreme, there is the so-called Porter hypothesis. It contends that firms can obtain private benefits from improved environmental performance in the form of efficiency savings or added market value, even to the extent that their overall economic performance is improved.^{3,4,5} This view where environmental improvements coincide with economic gains for the individual firm is also called the "win-win" approach.

Not only is there a conflict within literature, but there is also a conflict between theory and practice. There is anecdotal evidence supporting both of the polar views, but attempts to empirically verify any systematic impact of environmental performance on economic performance have been unsuccessful. The results of the empirical studies reviewed in chapter 3 range from negative correlation to positive correlation, no correlation, and inverted U-shaped correlation. Jaffe et al. (1995) conclude their review: "Just as we have found little consistent empirical evidence for the

¹ See, for example, Siebert, H. 1985. Spatial aspects of environmental economics. In: Kneese, A V & Sweeney, J L, editors. *Handbook of natural resource and energy economics*, volume I. New York, North-Holland. Pages 125-164.

² McGuire, M. 1982. Regulation, factor rewards and international trade. *Journal of Public Economics*, 17. Pages 335-354.

³ Porter, M. 1991. America's green strategy. *Scientific American*, volume 264, 4. Page 96.

⁴ Porter, M & van der Linde, C. 1995a. Green and competitive: Ending the stalemate. *Harvard Business Review*, September-October. Pages 120-134.

⁵ Porter, M & van der Linde, C. 1995b. Toward a new conception of the environment - competitiveness relationship. *Journal of Economic Perspectives*, volume 9, 4. Pages 97-118.

conventional hypothesis regarding environmental regulation and competitiveness, there is also little or no evidence supporting the revisionist hypothesis that environmental regulation stimulates innovation and improved international competitiveness."⁶

As a result, it is often suggested that the level of environmental performance does not affect the economic performance of firms one way or the other. But, in spite of researchers being unable to confirm the existence of a systematic link between environmental and economic performance, many people in business and politics are convinced that the link is there. As long as the perception of such a link keeps affecting decision-making, the question cannot be ignored. Further research is therefore warranted.

Moreover, absence of proof is not proof of absence. The lack of evidence concerning a link between environmental performance and economic performance can at least partly be explained by conceptual and methodological shortcomings discussed in chapter 3, below. Indeed, it is the underlying conjecture of the present study that there are a number of factors impinging on this relationship. The economic impacts of environmental performance improvements are neither universally negative nor positive: some, but not all situations are win-win situations. This also makes understandable the fact that conflicting views on the relationship coexist and are supported by anecdotal evidence. When the factors influencing the relationship are identified and accounted for, part of the seeming discrepancy may be resolved and the conflicting evidence accommodated.

1.2 Objectives and scope

The objective of the present study is to improve the understanding of the firm-level relationship between environmental performance and economic performance. The main research question is *what determines environmental profit*, where environmental profit refers to the isolated net economic impact of environmental performance on a firm.⁷ To answer the main research question, the study addresses the following specific questions:

- How and why have attempts to detect a systematic relationship between firms' environmental and economic performance failed? (chapter 3)
- How should previous theoretical treatment of the relationship be extended to account for the possibility that the relationship may not be constant across

⁶ Jaffe, A, Peterson, S, Portney, P & Stavins, R. 1995. Environmental regulation and the competitiveness of U.S. manufacturing: What does the evidence tell us? *Journal of Economic Literature*, volume 33. Pages 132-163.

⁷ Environmental profit is defined more closely in section 2.3.

environmental performance levels and that it may not be uniform across cases and time periods? (chapter 4)

- Does empirical evidence support the non-uniformity of the relationship? Where are the main sources of non-uniformity? (chapter 5)
- What are the factors producing non-uniformity in the relationship? What circumstances favour and what circumstances hinder the creation of perceived win-win situations? (chapter 6)

There are two important restrictions in the scope of the study. First, the social costs of environmental damage and social benefits of environmental protection are not covered. The focus is solely on firms' private costs and benefits. The social costs and benefits are, of course, important, but they do not matter for the economic performance of firms. This is true by definition. Any social costs that do affect firms' economic performance immediately become private costs for the firms. The presence of social costs and benefits is recognised in the present study in that they determine the socially optimal level of pollution and influence government policy.

Several methods, such as contingent valuation, hedonic pricing, travel cost method, and others have been developed to assign monetary values to environmental goods and services. However, as long as such values are not reflected in market transactions, some environmental social costs remain outside the private decision-making calculations of firms. An analysis of the relationship between environmental and economic performance should therefore not confuse private costs and benefits with social costs and benefits. Table 1 shows two perspectives to examining the relationship that satisfy this condition.

Even though the present study revolves around the firm's private optimum for environmental performance, this is not to suggest that impacts on individual firms' economic performance should dictate environmental protection efforts in society. The purpose of the study is to improve the understanding of what determines the privately optimal level of environmental performance for profit-maximising firms, so that the private optimum could eventually be pushed nearer the socially optimal level of environmental performance. The study thus takes the perspective of category A of Table 1 to the issue, in order to reduce the ground for conflict between A and B.

There have been calls for new paradigms to address corporate environmentalism through a more integrated treatment of social and private environmental costs and benefits. Hart (1995) notes that the concept of the environment in management theory emphasises political, economic, social and technological aspects but often ignores the natural environment.⁸ Some of the proposed new paradigms prescribe a fundamental shift in firm values and goals away from profit maximisation towards broader

⁸ Hart, S. 1995. A natural-resource-based view of the firm. *Academy of Management Review*, volume 20, 4. Pages 986-1014.

stakeholder responsibility and environmental sustainability. Examples include Garrod and Chadwick (1996) who advocate a transformation from a shareholder value paradigm to one reflecting an environmental focus.⁹

The present study, however, is based on the assumption that the objective of firms is to maximise expected profit. Environmental performance counts for firms only inasmuch as it influences economic performance. This is not meant to be a value judgement. The assumption is intended to be as conservative as possible and to reflect the fact that so far any widespread pro-environmental value change has apparently not taken place in firms.¹⁰ Räsänen et al. (1994) express doubt that the greening of industry has involved any fundamental change in managerial logic of action.¹¹ Garrod and Chadwick (1996) found that firms have adopted environmental management tools only to the extent to enable the firms to pursue more effectively their profit-centred approach.¹² Lovio (1995) suggests that environmental regulations and market demand, not value changes, explain the observed improvements in environmental management.¹³ Halme (1996) found that traditional economic values such as profitability were still more important than environmental considerations in two firms where an environmental paradigm shift had occurred.¹⁴ In a 1997 study on management values in large Finnish firms, 75 per cent of managers named profitability as one of five central values in their firm; 15 per cent of managers named environmental concerns.¹⁵ Khanna and Damon (1999) demonstrated that the decision of firms to participate in a voluntary environmental programme was motivated by rational economic self-interest.¹⁶

The profit maximisation assumption is also useful because it works as a devil's advocate by maximising the potential for conflict between societal and firm interests that the present study seeks to explore. If there are firms who care for the environment

⁹ Garrod, B & Chadwick, P. 1996. Environmental management and business strategy: Towards a new strategic paradigm. *Futures*, volume 28, 1. Pages 37-50.

¹⁰ Indeed, in the case study module of the present study it repeatedly came across that environmental improvements had been made for business reasons, not for environmental reasons.

¹¹ Räsänen, K, Meriläinen, S & Lovio, R. 1994. Pioneering descriptions of corporate greening: notes and doubts on the emerging discussion. *Business Strategy and the Environment*, 3. Pages 9-16.

¹² Garrod, B & Chadwick, P. 1996. Environmental management and business strategy: Towards a new strategic paradigm. *Futures*, volume 28, 1. Pages 37-50.

¹³ Lovio, R. 1995. *Yritykset ja ympäristö: ongelmien ratkaisusta uusiin ongelmiin*. In: Massa, I & Rahkonen, O (editors). Riskiyhteiskunnan talous. Helsinki, Gaudeamus. Pages 143-159.

¹⁴ Halme, M. 1996. Shifting environmental management paradigms in two Finnish paper facilities: A broader view of institutional theory. *Business Strategy and the Environment*, 5. Pages 94-105.

¹⁵ EVA. 1997. *Yritysjohdajien menestyksen eväät. Raportti yritysjohtajien asenteista 1997*. Helsinki, Elinkeinoelämän valtuuskunta. 71 pages.

¹⁶ Khanna, M & Damon, L A. 1999. EPA's voluntary 33/50 program: impact on toxic releases and economic performance of firms. *Journal of Environmental Economics and Management*, 37. Pages 1-25.

for ethical reasons, then so much the better for the environment. But if it can be shown that there are circumstances where even solely profit-centred firms are encouraged to improve their environmental performance, tangible and immediate ways to promote sustainable development can perhaps be found by creating and reinforcing such conditions. Similarly, if it can be shown that certain circumstances hinder improvements in environmental performance, it is possible to consider whether business strategies or national and international policy-making could actively change such circumstances.

Table 1 Two perspectives to examining the relationship between environmental and economic performance. The present study falls under category A, but with the goal of reducing the conflict between A and B

		Benefits	
		Private	Social
Costs	Private	A. The perspective of firms maximising their profit	
	Social		B. The perspective of society maximising welfare

The second major restriction in the scope of the present study is that the study only examines those private costs and benefits that relate to environmental performance, as marked by the shaded area in Figure 1. In other words, private costs and benefits that are unconnected to the environmental performance of a firm are excluded from the study, although they are important determinants of the overall economic performance of a firm. The scope is limited to the isolated economic performance impacts of environmental performance, that is, using the terms in Figure 1, to environmental profit instead of profit. In effect, thus, the study analyses the direction of the link between environmental performance and economic performance: whether marginal environmental profit is positive or negative. Analysing the magnitude of the link would require comparing environmental profit to overall profit.

In addition, the scope of the study is restricted in a few other respects. The theoretical treatment in chapter 4 and the case-study approach in chapter 6 are applicable to all environmental impacts of firms throughout the life-cycle of the products, that is, from raw material extraction to final disposal. However, due to data availability, statistical treatment in chapter 5 is limited to direct production emissions into water. Finally, the empirical scope of the study covers manufacturing firms in four industrial sectors in Finland.

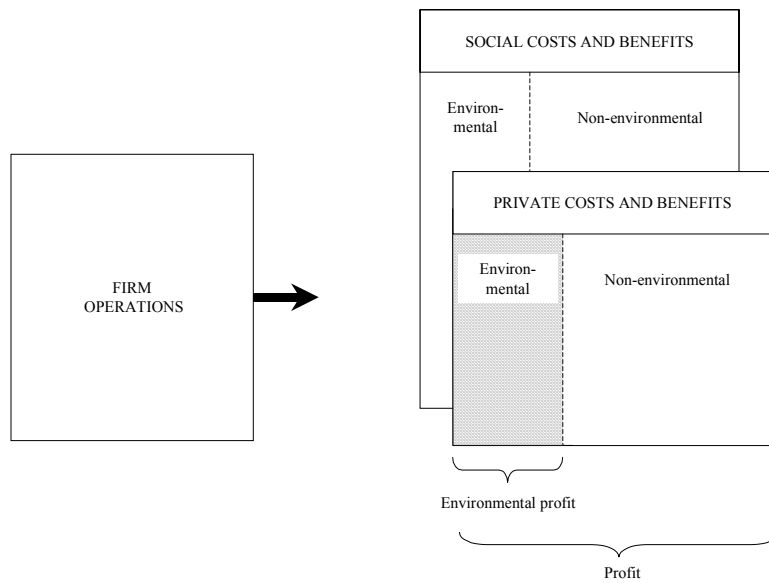


Figure 1 The scope of the study. The area covered by the study is marked by shading

1.3 Approach and design

Neilimo and Näsi (1980) divide research approaches used in business economics in conceptual, nomothetic, decision-oriented and action-oriented approaches.¹⁷ According to Neilimo and Näsi,

- in the conceptual approach, new concepts and conceptual systems are developed that can be used to increase the understanding of a phenomenon. The approach is theoretical; the research method is reasoning and testing is realised through argumentation
- in the nomothetic approach, law-like relationships between phenomena are sought with a heavy empirical emphasis, with a conceptual part usually preceding empirical analysis. A hypothetic-deductive and an inductive version of the nomothetic approach can be distinguished
- in the decision-oriented approach, the objective is to build models for decision making through reasoning. The foundations of this approach lie in microeconomics, decision-making theory, and game theory. The empirical part usually consists of an application example

¹⁷ Neilimo, K & Näsi, J. 1980. *Nomoteettinen tutkimusote ja suomalainen yrityksen taloustiede*. Series A2: Research Reports 12. Tampere, University of Tampere.

- in the action-oriented approach, the emphasis is on understanding, and the results are often conceptual systems to understand a firm's behaviour. The foundations of the action-oriented approach are in teleological explanation and intentionality of human behaviour. The approach is empirical, but uses only a few research units and a flexible methodology.

Rather than being pure representatives of a particular type, studies often share features of more than one research approach. The present study identifies somewhat with the nomothetic approach. It involves three modules that can be viewed as the conceptual, hypothetic-deductive, and inductive parts of a nomothetic study. However, strong conceptual aspects can also be recognised in the present study.

As noted above, the nomothetic approach seeks law-like relationships between phenomena. The epistemological question of how causation is viewed is an important aspect of the research approach. The following treatment of causation is based on von Wright (1971).¹⁸ Two main types of explanation can be distinguished. Whereas causal explanation points to the past (p happens because c has happened), teleological explanation points to the future (c happened in order for p to happen). The difference between the two types is thus the intentionality of action involved in teleological explanation. Another difference lies in the validity of the explanation. The validity of teleological explanation does not depend on whether the assumed connection (the connection between c and p) is valid or not. For causal explanation the validity of the assumed connection between the cause and the effect does matter. Von Wright defines as quasi-causal those relationships that appear to be causal but whose validity does not depend on the truth of the assumed underlying connection.¹⁹

Narrowly defined, a cause is a contingent sufficient condition. With the narrow definition of causation it is difficult to reduce human actions to causal laws. Indeed, teleological and quasi-causal explanations are characteristic of social sciences. The behaviour of individuals or firms can be understood through the schema of practical inference:

A intends to bring about p .
 A considers that he cannot bring about p unless he does c .
 Therefore, A sets himself to do c .

Following von Wright (1971), the "causalities" in the present study are considered to be quasi-causal relationships. The connection between "causes" and "effects" is through practical inference. It is not necessary for A to do c in the absolute sense, but

¹⁸ von Wright, G. 1971. *Explanation and understanding*. London, Routledge & Kegan Paul Ltd. 230 pages.

¹⁹ Compare this to the point that firms' choices are ex ante rational, in other words, rational in light of the expectations at the time of choosing. Firms do not maximise profit; they maximise expected profit. Expectations may later turn out to be mistaken, but this does not invalidate the ex ante rationality assumption. Randall, A. 1987. Total economic value as a basis for policy. *Transactions of the American Fisheries Society*, 116. Pages 325-335.

it is a rational choice if he is to bring about p . The law-like relationships sought in the present study are thus not pure causal connections like natural laws.

As already brought up, a three-module portfolio approach was developed for the present study: to engage in model building, statistical work, and case studies. This is because the research problem does not easily lend itself to investigation. Each research module allows a different aspect of the research problem to be studied, and together they are expected to sufficiently illuminate the relationship between firms' environmental and economic performance. The portfolio includes a theoretical approach whose main undertaking is the theoretical identification of win-win situations (chapter 4); a statistical approach whose main undertaking is the empirical identification of win-win situations (chapter 5); and a case-study approach whose main undertaking is the empirical understanding of win-win situations (chapter 6).

The theoretical research module utilises mathematical model building. The statistical module is quantitative and extensive. Panel data on all Finnish manufacturing plants in four sectors with regulated effluent discharges are studied with multivariate statistical methods. Data for this module are collected from existing emission databases and environmental permit decisions. The case-study module is also empirical, but qualitative, intensive, and cross-sectional. From among the plants, a sample is selected for an in-depth analysis based on theoretical sampling. The data collection method employed is personal interviews.

Utilising more than one research method is also a means of trying to combine some of the inherent strengths of the methods and eliminate some of their weaknesses. Whereas extensive research deals with discovering general patterns in a population, intensive research looks at how a causal process works out in a limited number of cases.²⁰ Stereotypically, quantitative research is thus sometimes considered to produce generalisable but somewhat superficial information, and qualitative research in-depth but somewhat anecdotal information.

The research methods can add to one another and findings can be triangulated between the methods. Often, qualitative research precedes quantitative research. Case studies are first carried out to develop concepts and hypotheses which are then statistically tested on a larger population. However, the order can also be reversed. Statistical methods can be used to reveal relationships between phenomena, and qualitative methods thereafter employed to improve the understanding of what produces the relationships.²¹ This is the case in the present study.

²⁰ Sayer, A. 1992. *Method in social science. A realist approach*. London, Routledge. 313 pages. Page 242.

²¹ Alasuutari, P. 1994. *Laadullinen tutkimus*. Tampere, Vastapaino. 281 pages. Pages 203-205.

The structure of the study is illustrated in Figure 2. Chapters 1 and 2 lay the ground by introducing the study and its methods and by analysing the key concepts used. Chapter 3 reviews existing theoretical and empirical literature on the topic area. Chapter 4 takes a theoretical approach, chapter 5 a statistical approach, and chapter 6 a case-study approach to examining the relationship between firms' environmental performance and economic performance. These three chapters form the core of the study. Each chapter constitutes a module with a particular contribution. However, the modules are not disconnected from each other but together build a logical whole that converges and deepens as the study proceeds. Chapter 7 discusses the findings and draws final conclusions.

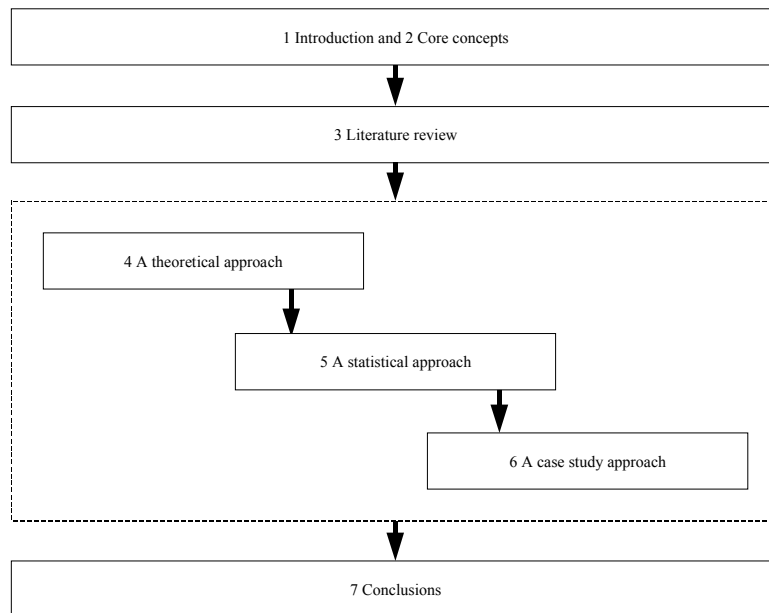


Figure 2 Structure of the study

2 CORE CONCEPTS

The task of a concept is like that of a hoop net: to catch from complex and multidimensional reality those elements that are relevant from the point of view of the research questions. An explicit conceptual analysis is thus necessary to specify what exactly is referred to with the concepts used in a study. This chapter defines and examines the five core concepts of the present study – environmental performance, economic performance, environmental profit, win-win situation, and overcompliance.

In addition to providing definitions, the chapter also discusses the operationalisation and measurement of the core concepts. According to Babbie (1990), operationalisation is the process where empirical observations are specified that can be taken as indicators of the attributes contained in a certain concept. The original concepts often summarise a variety of elements, thus having a "richness of meaning". Reducing them to specific empirical indicators is always unsatisfying, but necessary to permit empirical research.²²

Also in the present study, compromises had to be made in the operationalisation of the concepts. In particular, environmental performance is measured through emissions, not through environmental impacts, and environmental profit and win-win situations are measured through management perceptions and expectations. However, many concepts, especially in the field of social research, have no real meanings or ultimate definitions; they do not exist except as convenient summary notations for a variety of empirical observations. Consequently, such concepts cannot be measured correctly or incorrectly. They can only be measured more or less usefully with regard to developing theories or understanding the empirical data at hand.²³

2.1 Environmental performance

The concept of environmental performance pertains to the level of harmful environmental impact caused by the activities of a firm. The more "environmentally friendly" a firm is the better its environmental performance. Conversely, the more environmental damage a firm causes the worse its environmental performance.

Definition: Environmental performance refers to the level of harmful environmental impact caused by a firm so that the smaller the harmful environmental impact the better the environmental performance and vice versa.

²² Babbie, E. 1990. *Survey research methods*. Second edition. Belmont, Wadsworth Publishing Company.

²³ Babbie, E. 1990. *Survey research methods*. Second edition. Belmont, Wadsworth Publishing Company.

As the activities of a firm can have different environmental impacts, the concept of environmental performance is a vector of those impacts. Environmental impacts occur through land use, resource use, and pollutant releases into air, water, and land throughout the life-cycle of a product. Even if consideration is limited only to the direct environmental impacts of production, environmental performance has many dimensions as shown in Figure 3.

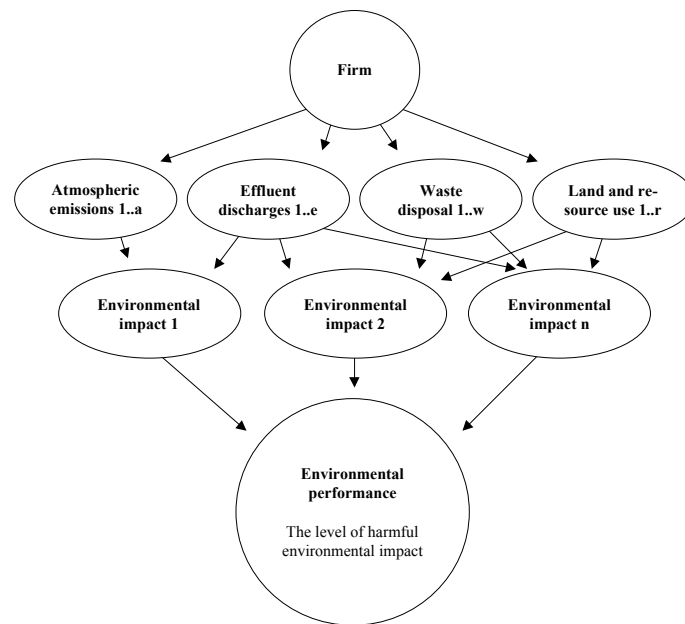


Figure 3 The concept of environmental performance (considering only the direct environmental impacts of production)

A complete measure of environmental performance necessitates the identification of all components, performance measurement with regard to each component, and the combination of the measurements into a vector of indices or one overall indicator.²⁴ Combining the dimensions of environmental performance in a single indicator requires that the relative importance of the different environmental impacts be weighed. Such weighing, in turn, results in a difficult valuation problem.

The present study does not attempt to capture the dimensions of environmental performance in a single indicator because important information might get lost in such an aggregation. Since the theoretical framework on the relationship between environmental and economic performance in chapter 4 is pollutant-specific, environmental performance must also be measured pollutant by pollutant. Guimaraes and Liska (1995) also call for disaggregation of environmental performance when they suggest that research on business benefits from high environmental performance

²⁴ Spicer, B. 1978. Investors, corporate social performance and information disclosure: An empirical study. *The Accounting Review*, volume 53, 1. Pages 94-111.

ought to examine the impact of specific programmes rather than general stages of environmental stewardship.²⁵

There are studies that measure environmental performance by whether the firm has an environmental policy, an environmental management system, or an environmental manager of its own; whether the firm produces an environmental report or discloses environmental information; or by similar proxies. For example, Henriques and Sadorsky (1996) defined an environmentally responsive firm to be one that has formulated an official plan for dealing with environmental issues.²⁶ In the present study such indicators are not considered to measure environmental performance. Only true physical inputs and outputs of a firm are counted in environmental performance since only they matter for the quality of the environment. Moreover, empirical studies have indicated that actual environmental performance may not be correlated with the disclosure of environmental information.²⁷ The measures listed above can, nevertheless, be useful. Their employment may be reflected in future levels of environmental performance as defined in the present study. For example, Dasgupta et al. (2000) found that environmental management policies had a strong effect on compliance.²⁸

Sometimes environmental performance is measured by the absolute or relative reduction in emissions and resource use that a firm has attained. For example, Lang (1996) measured firm environmental performance based on changes in the generation or release of chemical waste, measured in pounds or percentages.²⁹ In the present study such indicators are rejected because only firms with large initial emissions can achieve high absolute reductions. Due to increasing marginal abatement costs, it is also easier for them to achieve high relative reductions. Measurements based on

²⁵ Guimaraes, T & Liska, K. 1995. Exploring the business benefits of environmental stewardship. *Business Strategy and the Environment*, volume 4, 1. Pages 9-22.

²⁶ Henriques, I & Sadorsky, P. 1996. The determinants of an environmentally responsive firm: an empirical approach. *Journal of Environmental Economics and Management*, volume 30. Pages 381-395.

²⁷ See Ingram, R W & Frazier, K B. 1980. Environmental performance and corporate disclosure. *Journal of Accounting Research*. Pages 614-622; Freedman, M & Jaggi, B. 1982. Pollution disclosures, pollution performance and economic performance. *Omega*, volume 10, 2. Pages 167-176; Rockness, J W. 1985. An assessment of the relationship between US corporate environmental performance and disclosure. *Journal of Business Finance and Accounting*, volume 12, 3. Pages 339-354; Wiseman, J. 1982. An evaluation of environmental disclosures made in corporate annual reports. *Accounting, Organizations and Society*, volume 7, 1. Pages 53-63; or Ullman, A A. 1985. Data in search of a theory: a critical examination of the relationships among social performance, social disclosure, and economic performance of U.S. firms. *Academy of Management Review*, volume 10, 3. Pages 540-557.

²⁸ Dasgupta, S, Hettige, H & Wheeler, D. 2000. What improves environmental compliance? Evidence from Mexican industry. *Journal of Environmental Economics and Management*, 39. Pages 39-66.

²⁹ Lang, J. 1996. *Corporate environmentalism and regulatory interventions*. Doctoral dissertation, Boston University Graduate School of Management.

emission and resource use reductions may thus not give a correct picture of environmental performance as defined in the present study.

Furthermore, environmental performance is sometimes measured by the amount of money spent in environmental protection by a firm. But, to measure pollution abatement costs is notoriously difficult. Many cost items tend to be omitted when reporting environmental costs (for example, product quality impacts and regulatory delays) and knowledge about others is limited (for example, management time spent on environmental issues).³⁰ End-of-pipe investments may be measured more accurately but the divisibility problems involved in process investments can be serious. The present study considers that even if pollution abatement costs could be accurately gauged, they do not measure environmental performance correctly. The relationship between the money spent in environmental protection and the level of harmful environmental impacts is not necessarily monotonic. The environmental spending of a firm may be inefficient.³¹ Moreover, firms that already have high environmental performance – perhaps as a result of earlier investments – may not need to invest as much in environmental protection as do "dirtier" firms.

Environmental performance is operationalised as the absolute level of emissions, waste, and land and resource use of a firm. For the statistical module, only direct production emissions into water are measured. It is recognised that this measurement captures only part of the full life-cycle environmental impacts of a firm. It would also be conceptually more correct to measure harmful environmental impacts, that is, contributions to specific environmental problems, and not emissions. Translating emissions into environmental impacts calls for information on local conditions and on how the emissions contribute to different environmental problems, which is not yet fully understood. The use of emission data in the present study is justified by the assumption that less emissions can be equated with less harmful environmental impacts, although it must be acknowledged that this relationship need not be monotonic either.

³⁰ U.S. Congress, Office of Technology Assessment. 1994. *Industry, technology, and the environment: Competitive challenges and business opportunities*. OTA-ITE-586. Washington, D.C., U.S. Government Printing Office.

³¹ For example, it has been reported that only 12 per cent of payments on U.S. Superfund claims between 1986 and 1989 went for actual site cleanups whereas the remaining 88 per cent went for legal and administrative costs. Acton, J P & Dixon, L S. 1992. *Superfund and transaction costs: the experiences of insurers and very large industrial firms*. Working paper, Rand Institute for Civil Justice, Santa Monica, California. Ref. Porter, M E & van der Linde, C. 1995a. Green and competitive: Ending the stalemate. *Harvard Business Review*, September-October. Pages 120-134.

Operationalisation: Environmental performance is (in the statistical module) measured by the absolute emissions of pollutants into water by a firm so that the smaller the emissions the better the environmental performance with regard to that pollutant and vice versa.

2.2 Economic performance

There are several measures that are commonly used to assess the economic performance of firms. Each of these measures captures a slightly different aspect of economic performance. Some, such as profitability, gauge return; others, like sales growth and market share growth, gauge growth. Some measure profitability (return on investment, return on equity), some liquidity (quick ratio, current ratio), and some solvency (gearing). Some measures are indicators of commercial success (growth, market share) while others are indicators of financial success (profitability). Accounting measures portray past performance, and stock market measures portray expectations of future performance.

Which indicator or indicators should be chosen to measure economic performance depends on the perspective taken in a study and on its purpose. In the present study it is not necessary to select particular operational measurements of economic performance at all, since the concept is not directly measured. Expected changes in economic performance are analysed indirectly, through management perceptions and actions. Based on the profit maximisation assumption, managers voluntarily implement only such actions that they believe to promote the economic performance of the firm.

However, it is very important to note the crucial difference between economic and commercial values.³² In the present study, all costs and benefits are to be understood as economic costs and benefits, present and future, discounted to present time. In other words, the concepts are significantly broader than the ordinary accounting concepts for expenses and revenues.

2.3 Environmental profit and marginal environmental profit

Environmental profit is a new construct formulated for the purposes of the present study. It gauges the isolated net income of a firm relating to its environmental performance level, that is, the total of isolated environmental private benefits and private costs.

³² Randall, A. 1987. Total economic value as a basis for policy. *Transactions of the American Fisheries Society*, 116. Pages 325-335.

Marginal environmental profit is the corresponding concept relating to a change in environmental performance. Marginal environmental profit is positive when the private benefits from a change in environmental performance exceed the private costs. Similarly, marginal environmental profit is negative when the private costs required by a change in environmental performance exceed the private benefits, and zero when the two are equal.

Definition: Environmental profit refers to the isolated net economic impact on a firm of an environmental performance level: the stream of environment-related costs and benefits discounted to the present.

Marginal environmental profit refers to the isolated net economic impact on a firm of a change in environmental performance: the stream of costs and benefits related to an environmental performance change, discounted to the present.

Benefits and costs that are unconnected to environmental performance are not counted in environmental profit but environmental benefits and costs are counted in conventional economic profit. Hence, environmental profit is a subset of profit.³³ It can be positive, negative or zero regardless of the value of conventional profit.

As defined above, marginal environmental profit equals the net present value of a change in environmental performance. This analogy reveals how crucial temporal aspects are when thinking about environmental profit. It is typical for investments in environmental performance that while many costs accrue in the short term, the related benefits are uncertain and may accrue only in the longer term.

To empirically measure environmental profit or marginal environmental profit is very difficult, if not impossible. It would require perfect information on all present and future costs and benefits of a particular environmental performance level or environmental performance change. These are hard to obtain, partly because of the temporal aspect mentioned above and partly because of the complications involved in separating the environmental benefits and costs from the non-environmental ones. Further, the available data typically only allow for before-after comparisons whereas it would be theoretically more desirable to conduct with-without comparisons.

The present study only measures whether marginal environmental profit is positive or negative. Moreover, expected marginal environmental profit is measured. When making management decisions on changes in environmental performance, firms need to assess the related benefits and costs, no matter how intangible, as best they can: consciously or subconsciously, correctly or incorrectly. If the assumption on profit maximisation holds, firms will voluntarily implement those – and only those – environmental improvements that they believe to yield positive marginal environmental profit.

³³ See also chapter 4 for the relationship between environmental profit and profit.

Operationalisation: Expected marginal environmental profit is considered to be positive if a firm would voluntarily undertake the improvement in environmental performance.

Similarly, the starting point for Segerson and Miceli (1998) was that firms ratify a voluntary environmental agreement if and only if the costs without the agreement are expected to be higher than with the agreement.³⁴ Arora and Cason (1995) theorised that firms join a voluntary environmental programme if it increases expected profit.³⁵ Liski (1997) took the environmental compliance strategy of firms to be based on profit maximisation.³⁶ Biondi et al. (1996) also maintained that presumed benefits must exceed estimated costs in order for firms to participate in a voluntary programme, even though both are difficult to calculate.³⁷

2.4 Win-win situation

In the debate on environmental performance and economic performance, the term win-win situation has become to signify those situations where it pays to protect the environment. It appears that sometimes the term is used in a narrow sense to refer only to those situations where the cost of an improvement in environmental performance to a firm is in fact negative. This is the case when the changing of inputs or processes results in improved efficiency, reduced waste, or savings in energy and raw material costs. In the present study, win-win situations do not refer only to such cases. They equally cover cases where the improvement in environmental performance has a positive cost, but where corresponding market benefits are obtained that can offset the cost.

It is often said that in a win-win situation both the firm and the environment benefit. But, to be precise, the two parties in a win-win situation as defined in the present study are the firm and society. In a win-win situation the benefits of an individual firm and society at large coincide. The social benefits accrue through improvements in environmental quality; hence, the talk about business and environmental interests being aligned. In a win-win situation this is true. But, as chapter 4 will show, an

³⁴ Segerson, K & Miceli, T J. 1998. Voluntary environmental agreements: Good or bad news for environmental protection? *Journal of Environmental Economics and Management*, 36. Pages 109-130.

³⁵ Arora, S & Cason, T. 1995. An experiment in voluntary environmental regulation: Participation in EPA's 33/50 program. *Journal of Environmental Economics and Management*, volume 28. Pages 271-286.

³⁶ Liski, M. 1997. *On the regulation of pollution and polluters' long-term compliance strategies*. Acta Universitatis Oeconomicae Helsingiensis A-129. 152 pages.

³⁷ Biondi, V, Frey, M & Iraldo, F. 1996. *EMAS: first evaluation of a policy instrument*. Paper presented at the conference "The economics of law and voluntary approaches in environmental policy", sponsored by Fondazione ENI Enrico Mattei and Cerna, Venice, Italy, November 18-19.

improvement in environmental performance can also be a "lose situation" for society, even though it cannot be a "lose situation" for the environment.

A win-win situation is an improvement in a firm's environmental performance where the social benefits exceed the social costs and the private benefits exceed the private costs. However, as will be seen in chapter 4, the social pollution abatement costs consist of the private abatement costs and the private benefits are usually a subset of social benefits.³⁸ For this reason, a win-win situation can be recognised by looking at the environmental private costs and benefits alone. Whenever the private benefits from an improvement in environmental performance exceed private costs, social benefits also exceed social costs. Win-win situations are thus identifiable through marginal environmental profit: positive marginal environmental profit signals a win-win situation.

Definition: A win-win situation refers to a case where a firm's benefits from improved environmental performance exceed the costs of improved environmental performance, that is, where marginal environmental profit is positive.

It was noted earlier that to measure marginal environmental profit is difficult, as it would require perfect information on all present and future costs of, and benefits from, a particular environmental performance change. To empirically identify the true win-win situations available to a firm would require the same information relating to all imaginable changes in environmental performance. Such information is not available to firms themselves or anyone else. Instead of true win-win situations, what can be empirically identified are perceived win-win situations. To study perceptions is justified because they shape the actions taken when no information about true win-win situations is available.

Operationalisation: A perceived win-win situation refers to a case where a firm's expected benefits from improved environmental performance exceed the expected costs of improved environmental performance, that is, where expected marginal environmental profit is positive.

2.5 Overcompliance

The fifth and last of the core concepts in the present study is overcompliance with environmental regulations. Overcompliance refers to exceeding the environmental performance requirements prescribed by law. Overcompliance can take place through participation in voluntary programmes between the government and the industry or through a firm's own initiative.

³⁸ Section 4.2 also discusses the possibility that private benefits exceed social benefits and presents the justification for ignoring such cases in the present study.

Overcompliance relates to voluntary approaches in environmental policy-making. Consequently, it is sometimes referred to as voluntary overcompliance.³⁹ However, the term "voluntary" requires careful interpretation in this context and may convey a false intuitive message. To be counted as voluntary, overcompliance does not have to be implemented for ethical reasons only. Voluntary overcompliance in the present study is voluntary in the sense that law does not mandate it. For a firm, overcompliance may well be a commercial necessity dictated by market requirements. In an extreme case, "voluntary overcompliance" may be a prerequisite for survival and thus not really a voluntary choice for the firm at all. As *overcompliance* can, by definition, never be mandated by law, the word "voluntary" has here been dropped from the concept altogether.

Definition: Overcompliance refers to a situation where a firm's environmental performance is better than required by law.

The operationalisation of overcompliance for the statistical module is built on the operationalisation of environmental performance. Overcompliance is transformed from a dichotomous variable to a scalar by expressing actual emissions as a percentage share of permitted emissions.

Operationalisation: Overcompliance is (in the statistical module) measured by the absolute emissions of pollutants into water by a firm as a percentage share of the permitted emissions of the said pollutants, so that the closer the share is to zero the more overcompliance there is.

³⁹ See, for example, Arora, S & Gangopadhyay, S. 1995. Toward a theoretical model of voluntary overcompliance. *Journal of Economic Behavior and Organization*, volume 28, 3. Pages 289-309.

3 LITERATURE REVIEW

Because of the cumulative nature of science, the value of a single study depends both on the merits of the study itself and on how it fits with and extends previous knowledge of the subject.⁴⁰ Hence, a review of existing knowledge to build on is a necessary step in each study and an integral part of each research report. The present chapter reviews existing theoretical and empirical literature on the firm-level relationship between environmental performance and economic performance. Considering that there are contradictions both within theoretical literature and between theoretical and empirical literature, a separate account of the two is deemed best.

The purpose of the chapter is to provide a systematic picture of past knowledge of the research topic. First, both the negative and positive links that have been suggested to exist between firms' environmental and economic performance are outlined, together with a strain of literature suggesting that how these links are experienced depends on the firm's interaction with its competitors in the markets. Second, a focused review of relevant empirical studies is provided, describing the different approaches that have been used to empirically examine the topic and the results obtained. The chapter closes with a discussion on the previous knowledge and the expected contribution of the present study to that knowledge.

3.1 Theoretical literature

3.1.1 Suggested negative links

The traditional argument that increased environmental performance harms economic performance arises most often in the context of international trade theory. The environment acts as a sink for joint outputs of production such as pollution and waste. Therefore, the environment is a factor of production, and changes in the availability of this production factor induce changes in comparative advantage. Comparative advantage, in turn, determines import and export patterns and location of production.⁴¹ Rauscher (1994), for example, notes that according to standard international trade theory, restrictions in the use of environmental resources induce changes both in the international division of labour and in the composition of production within an economy. In both cases the changes are to the detriment of those sectors that are relatively intensive in the use of the environmental resource in question.⁴²

⁴⁰ Cooper, H M. 1989. *Integrating research. A guide for literature reviews*. Second edition. Newbury Park, Sage Publications. Page 11.

⁴¹ See, for example, Siebert, H, Eichberger, J, Gronych, R & Pethig, R. 1980. *Trade and environment. A theoretical enquiry*. Amsterdam, Elsevier Scientific Publishing Company.

⁴² Rauscher, M. 1994. On ecological dumping. *Oxford Economic Papers*, 46. Pages 822-840.

The argumentation goes that improved environmental performance results in increased costs. Who – producers or consumers – pays for these costs depends on whether the costs can be passed on to prices. This, in turn, depends on the elasticities of supply and demand. Two principal cases can be distinguished: a firm operating in the open sector, with international trade, and a firm operating in the closed sector, without international trade.⁴³

Figure 4 illustrates the case of a firm operating in the open sector, for example a firm exporting to the world markets. Because the market is assumed to be perfectly competitive with an identical product and many price-taking sellers, the firm cannot influence the market price and faces a horizontal demand curve D. The supply curve of the firm prior to the improvement in environmental performance is S, and the firm sells q units of its product at the price of p . Improving environmental performance results in increased costs to the firm and thus shifts the supply curve upwards to the position S'. Now the firm can sell only q' units at the price of p . The profitability of the firm is illustrated by producer surplus, the area between the supply curve and the price line. Figure 4 shows that improving environmental performance results in an unambiguous reduction in the producer surplus: from the grey triangle PS to the smaller dotted triangle PS'.

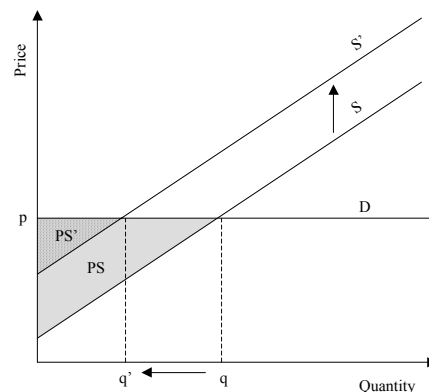


Figure 4 The impacts of improved environmental performance on a firm operating in international markets. See text for explanations

Figure 5 illustrates the second case, a firm operating in a closed domestic market. Now the market is imperfectly competitive and the firm faces a downward-sloping demand curve D. Again, the supply curve of the firm prior to the improvement in environmental performance is S, and the firm sells q units of its product at the price of p . Improving environmental performance results in increased costs and shifts the supply curve upwards to S'. Now the firm can sell only q' units, but at a higher price

⁴³ See, for example, Ollikainen, M. 1995. Ympäristönsuojelun taloudellinen ohjaus ja ympäristöpolitiikka. In: Massa, I & Rahkonen, O (editors). *Riskiyhteiskunnan talous*. Helsinki, Gaudeamus. Pages 289-318.

of p' . Figure 5 shows that again the producer surplus changes from the grey triangle PS to the dotted triangle PS'. However, the size of PS' compared to PS is no longer obvious. It depends on the elasticities of demand and supply, represented by the slopes of the D, S and S' curves. In other words, in the case of imperfectly competitive markets, part of the cost increase that results from improvements in environmental performance can be passed on to customers, which reduces the losses to firms. But how large a part can be passed on depends on how sensitive the customers and the producers are to price changes.

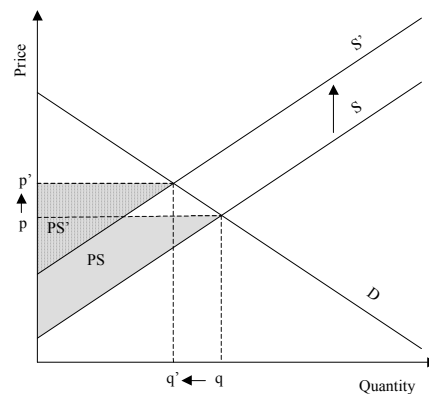


Figure 5 The impacts of improved environmental performance on a firm operating in a closed domestic market. See text for explanations

The mechanism described above rests on the premise that improved environmental performance incurs private costs to firms, resulting in increased production costs. Many arguments about the reason for this have been presented in literature. For example, Sprenger (1996) lists several potential types of negative impacts of environmental policy on individual firms, ranging from straightforward production cost increases to delays caused by environmental permitting.⁴⁴ Simpson and Bradford (1996) argue that the direct impact of stricter environmental regulation is to increase production costs. Situations where environmental regulations induce enough cost-reducing investments to reduce variable costs are theoretically possible, but remain rare exceptions.⁴⁵ Palmer et al. (1995) note as a basic point that it cannot be expected that increasing the constraints on a firm's set of choices through environmental regulation would result in increased profits. There may be overlooked opportunities

⁴⁴ Sprenger, R-U. 1996. Environmental policies and competitiveness. In: Lim, J-S (editor), *Trade and environment. International issues and policy options*. Seoul, Korea Environmental Technology Research Institute. Pages 223-266.

⁴⁵ Simpson, R D & Bradford, R L III, 1996. Taxing variable cost: environmental regulation as industrial policy. *Journal of Environmental Economics and Management*, 30. Pages 282-300.

for profitable environmental innovation, but these "pale in comparison to expenditures for pollution abatement and control".⁴⁶ Also Walley and Whitehead (1994) maintain that win-win opportunities are insignificant when put side by side with the vast amount of environmental costs that will not generate positive financial returns.⁴⁷ Xepapadeas and de Zeeuw (1999) argue that the trade-off between environmental performance and profit remains, but is less sharp because of the downsizing and modernisation caused by environmental policy.⁴⁸

Jaffe et al. (1995) summarise five ways how environmental regulations can incur costs by adversely affecting productivity. These are directing inputs to producing environmental quality that is not accounted for in productivity calculations; inducing a shift to less efficient production processes; dictating environmental investments that crowd out other investments; discouraging greenfield investment if regulations are stricter for new plants; and discouraging technological innovation because of requirements to use best available technology.⁴⁹

One obvious group of private cost increases are the costs of installing and operating pollution control or prevention technologies. Productivity losses or other opportunity costs caused by environmental performance improvements belong to another group. A third group of costs is not related to environmental performance per se, but to environmental policies implemented to regulate the environmental performance of firms. The different types of private cost increases that may accrue from environmental performance improvements are listed in Table 2.

⁴⁶ Palmer, K, Oates, W E & Portney, P R. 1995. Tightening environmental standards: the benefit-cost or the no-cost paradigm? *Journal of Economic Perspectives*, volume 9, 4. Pages 119-132.

⁴⁷ Walley, N & Whitehead, B. 1994. It's not easy being green. *Harvard Business Review*, May-June. Pages 46-52.

⁴⁸ Xepapadeas, A & de Zeeuw, A. 1999. Environmental policy and competitiveness: the Porter hypothesis and the composition of capital. *Journal of Environmental Economics and Management*, 37. Pages 165-182.

⁴⁹ Jaffe, A B, Peterson, S R, Portney, P R & Stavins, R N. 1995. Environmental regulation and the competitiveness of U.S. manufacturing: What does the evidence tell us? *Journal of Economic Literature*, volume 33, pages 132-163.

Table 2 Suggested private costs of improved environmental performance. Summarised from Jaffe et al. (1995) and other literature referred to in section 3.1.1

Direct production cost increases
<ul style="list-style-type: none"> - Search costs of identifying and analysing abatement options - Capital investments needed for pollution prevention or abatement: machinery, equipment, buildings - Operating costs needed for pollution prevention or abatement: energy, labour, materials
Productivity loss and opportunity costs
<ul style="list-style-type: none"> - Switching costs, obsolete capital in transitional phase - Production disruptions, production losses - Change to less efficient processes and production practices - Adverse product quality impacts - Environmental investments diverting scarce capital away from more productive investments - Management time, production resources, and R&D focus shifted to producing a non-saleable output (environmental quality)
Regulation-related costs
<ul style="list-style-type: none"> - Legal and other transactional costs - Delays caused by permitting procedures - Freezing of technology by regulations - Investment in new plants discouraged by new source bias in regulations

3.1.2 Suggested positive links

The first time a positive link between environmental performance and economic performance was proposed is usually attributed to Porter (1991).⁵⁰ In his one-page essay, Porter suggests that it is possible to obtain less pollution simultaneously with lower cost and / or improved quality. Environmental regulation can bring further private benefits through the growing environmental technology industry. Although similar views had been presented earlier, it was Porter's influential essay that started a wide debate on the possibility of win-win situations.⁵¹

⁵⁰ Porter, M E. 1991. America's green strategy. *Scientific American*, volume 264, 4. Page 96.

⁵¹ See, for example, Ashford, N A, Ayers, C & Stone, R F. 1985. Using regulation to change the market for innovation. *Harvard Environmental Law Review*, 9. Pages 419-466; Porter, M E. 1990. *The competitive advantage of nations*. New York, the Free Press. Pages 647-648; or Mäkelä, P. 1986. *Ympäristönsuojelun taloudelliset vaikutukset*. Working paper based on OECD work. Helsinki, Taloudellinen suunnittelukeskus. 31 pages.

These ideas were further elaborated by van der Linde (1993) and in two articles by Porter and van der Linde (1995a, 1995b).^{52,53,54} Their principal argument is that the perception of high environmental performance necessarily harming economic performance results from a static viewpoint. Indeed, in the short term compliance with environmental requirements can increase costs. But, a dynamic view is required to understand the innovation offsets taking place as a reaction to environmental regulations.

According to Porter and van der Linde, the pressure to improve environmental performance triggers innovation. Innovation is defined broadly as "a product's or service's design, the segments it serves, how it is produced, how it is marketed and how it is supported".⁵⁵ Innovation produces partial, full, or more than full offsets against the costs of improved environmental performance. Correspondingly, there can be a minimisation or elimination of compliance costs, or even a net improvement in economic performance.

Porter and van der Linde do not claim that innovation offsets can always take place and that improved environmental performance always improves economic performance. However, they think that innovation opportunities are probable, not only possible.⁵⁶ This is because pollution is a sign of economic waste: after using resources inefficiently, additional activities that do not create value have to be performed. Hence, the same basic principle of resource productivity underlies profit maximisation and pollution reduction.⁵⁷

Many other authors have embraced the idea of a positive link between environmental performance and economic performance. Elkington (1994) argues that strategies that simultaneously benefit the firm, its customers, and the environment will emerge as a major feature of doing business.⁵⁸ Corbett and van Wassenhove (1993) mention a number of economic benefits that relate to internalising environmental issues in

⁵² van der Linde, C. 1993. The micro-economic implications of environmental regulation: a preliminary framework. In: *Environmental policies and industrial competitiveness*. Paris, Organisation for Economic Cooperation and Development. Pages 69-77.

⁵³ Porter, M E & van der Linde, C. 1995a. Green and competitive: Ending the stalemate. *Harvard Business Review*, September-October. Pages 120-134.

⁵⁴ Porter, M E & van der Linde, C. 1995b. Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, volume 9, 4. Pages 97-118.

⁵⁵ Porter, M E & van der Linde, C. 1995b. Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, volume 9, 4. Pages 97-118.

⁵⁶ van der Linde, C. 1993. The micro-economic implications of environmental regulation: a preliminary framework. In: *Environmental policies and industrial competitiveness*. Paris, Organisation for Economic Cooperation and Development. Pages 69-77.

⁵⁷ Porter, M E & van der Linde, C. 1995b. Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, volume 9, 4. Pages 97-118.

⁵⁸ Elkington, J. 1994. Towards the sustainable corporation: win-win-win business strategies for sustainable development. *California Management Review*, Winter. Pages 90-100.

business.⁵⁹ Dechant and Altman (1994) discuss forces promoting corporate environmentalism and ways of deriving competitive advantage from environmental performance.⁶⁰ Barrett (1992) examines how strategy can improve profitability and simultaneously benefit the environment.⁶¹ Schmidheiny (1992) argues that there are increasing profitability opportunities in eco-efficiency, which refers to adding the most value with the least use of resources and the least pollution.⁶² Cairncross (1992) notes that many of the economic arguments in favour of good environmental performance are defensive – avoiding fees, taxes, liabilities, environmentalist attacks and so on – but that there are also competitive opportunities to be exploited.⁶³ Shrivastava (1995) emphasises the role environmental technologies can play in changing the competitive dynamics of industries, because they allow "rapid, quantum, and nonuniform" cost reductions.⁶⁴ Madu et al. (1995) note that poor environmental performance can threaten the polluting firm itself by damaging its raw material sources and the productivity of its workers.⁶⁵ Bonifant et al. (1995) write that businesses can develop a competitive edge through innovative environmental compliance strategies.⁶⁶ Repetto (1992) approaches the issue from the economy-wide perspective and suggests that economic and environmental goals need not conflict as shifting the tax burden from productive activities to unproductive ones such as pollution and resource waste would bring real economic savings.⁶⁷ The list could easily be continued.

The private benefits that these studies suggest to accrue from improved environmental performance can be divided into different categories. In very broad terms, increased efficiency brings cost savings in production. Environmental product differentiation enhances benefits from output markets. Benefits vis-à-vis regulations can be of strategic and cost-saving nature.⁶⁸ Cost savings are also available when obtaining capital and insurance, and private benefits can be seized from labour and community

⁵⁹ Corbett, C J & van Wassenhove, L N. 1993. The green fee: internalizing and operationalizing environmental issues. *California Management Review*, Fall. Pages 116-135.

⁶⁰ Dechant, K & Altman, B. 1994. Environmental leadership: from compliance to competitive advantage. *Academy of Management Executive*, volume 8, 3. Pages 7-20.

⁶¹ Barrett, S. 1992. Strategy and the environment. *Columbia Journal of World Business*, volume 27, 3&4. Pages 202-208.

⁶² Schmidheiny, S. 1992. The business logic of sustainable development. *Columbia Journal of World Business*, volume 27, 3&4. Pages 18-23.

⁶³ Cairncross, F. 1992. UNCED, environmentalism and beyond. *Columbia Journal of World Business*, volume 27, 3&4. Pages 12-17.

⁶⁴ Shrivastava, P. 1995. Environmental technologies and competitive advantage. *Strategic Management Journal*, volume 16. Pages 183-200.

⁶⁵ Madu, C N, Kuei, C & Winokur, D. 1995. Environmental quality planning. A strategic total quality management (STQM) approach. *Futures*, volume 27, 8. Pages 839-856.

⁶⁶ Bonifant, B C, Arnold, M B & Long, F J. 1995. Gaining competitive advantage through environmental investments. *Business Horizons*, July-August. Pages 37-47.

⁶⁷ Repetto, R. 1992. Environmental taxes and U.S. competitiveness. *Columbia Journal of World Business*, volume 27, 3&4. Pages 128-134.

⁶⁸ On strategic rent-seeking from regulations, see Salop, S C & Scheffman, D T. 1983. Raising rivals' costs. *AEA Papers and Proceedings*, volume 73, 2. Pages 267-271.

relations. Table 3 provides a detailed listing of the suggested private benefits under each category. Note that these benefits accrue in addition to the social benefits of environmental protection.

Table 3 Suggested private benefits from improved environmental performance. Summarised from literature referred to in section 3.1.2

Benefits from production

- More efficient use of materials and energy, resulting in higher yields or reduced use of purchased inputs
- Substitution of less expensive inputs for hazardous materials, resulting also in lower storage and handling costs and avoidance of permitting and inspection delays
- Improved purity and quality of natural resource inputs
- Elimination of risky or unnecessary production steps and simplification of designs, resulting in fewer accidents and shorter production time
- Implementing process changes that prevent pollution, thus avoiding end-of-pipe pollution abatement or clean-up that are costlier alternatives
- More careful monitoring and maintenance, resulting in less downtime, less rejects, and higher or more consistent quality
- Reducing, reusing, and recycling by-products and waste and recovering valuable materials from waste streams, resulting in reduced waste disposal costs and added revenue or savings in input costs
- Lower packaging costs

Benefits from output markets

- Improved firm image, resulting in increased customer loyalty, ability to protect market share, and avoidance of boycotts and negative publicity by the media and environmental groups
- Attractiveness to customers in environmentally conscious market segments, resulting in an ability to increase market share by creating or occupying new market niches with new or existing products
- Ability to obtain eco-labels and other means of distinction that favourably affect customer choice
- Ability to obtain an initial or permanent price premium for environmentally friendly products
- Ability to sell to firms who screen their suppliers using environmental criteria (for example, because of the trickle-down effect from their own environmental management systems), and ability to tender for contracts to public organisations with an environmental procurement policy
- Better product quality, improved product safety, lower operating and disposal costs for customers, or higher resale or scrap value, resulting in added customer value
- Ability to enter the growing market for environmental goods and services
- Ability to obtain early mover advantages both in the market for environmental goods and services and in the environmentally conscious niche of other goods and services
- Ability to build an inimitable strategy as an environmental leader since not everyone can become equally environmentally friendly

Regulatory benefits

- Reduced environmental taxes and charges
- Ability to sell and not buy pollution rights in emission trading markets
- Dramatic emergency measures such as output restrictions avoided
- Ensured continuous compliance with regulations, resulting in less time, money, and reputation lost and less uncertainty created in litigation

- Reduced liability costs
- Anticipating future regulations, resulting in more flexibility and thus less costs, reduced regulatory pressure and postponement of some regulatory costs, and in longer-term planning horizons
- A possibility to influence, in accordance with own strategy, the shape and content of new standards required of the industry, and thus create an entry barrier to rivals or raise their costs

Benefits from capital markets

- Less expensive and easier borrowing due to reduced risk
- Protecting collateral and balance sheet values
- Favourable stock price impact
- Attractiveness to non-speculative ethical investors

Benefits from insurance markets

- Reduced insurance premia due to reduced risk

Benefits from labour markets

- Ability to hire and retain high quality staff, especially young workers who tend to be environmentally conscious
- Improved worker health and morale; no whistle-blowing

Community benefits

- Good community relationships, facilitating, for example, siting or expansion

3.1.3 Vertical product differentiation literature

The results from the previous theoretical literature are somewhat changed in the case of an oligopoly. Oligopolistic firms are interdependent so that a firm's profits are also affected by the other firms' decisions. In an oligopoly, environmental performance thus affects profits in two ways: through the customary trade-off between the costs of and market benefits from provision of environmental performance, and also through the disparity in environmental performance that reduces the intensity of price competition between the firms.⁶⁹

A strain of theoretical literature addressing this issue is the vertical product differentiation literature. Vertical product differentiation refers to differentiation where a change in a product attribute makes the product more attractive to all customers. This contrasts with horizontal differentiation where a change in a product attribute makes the product more attractive to some customers but less so for some other customers. More formally, differentiation is vertical when all customers have the same ranking of the product variants if they are offered at the same price.⁷⁰

The vertical product differentiation literature initially developed to address quality choices but has recently been increasingly applied to the provision of environmental

⁶⁹ Crampes, C & Hollander, A. 1995. Duopoly and quality standards. *European Economic Review*, 39. Pages 71-82.

⁷⁰ Lancaster, K J. 1979. *Variety, equity and efficiency*. New York, Columbia University Press. Chapter 2.

performance.⁷¹ Reinhardt (1999b), however, notes that, in practice, opportunities for vertical environmental differentiation may be rare since augmenting environmental performance often entails sacrifices in some other product attributes and not all customers have the same preferences for environmental performance.⁷²

Applied to the provision of environmental performance, in the absence of regulations the reasoning in vertical product differentiation models is as follows.⁷³ There are two firms, one producing the high environmental performance (H) variant of the product and the other producing the low environmental performance variant (L) of the product. Consumers have in their utility function the argument θ , which denotes preferences for environmental performance (willingness to pay for environmental performance) and varies between consumers so that $\theta \in [\underline{\theta}, \bar{\theta}]$. A consumer's utility from consuming the high environmental performance variant of the product is $u_i = \theta e_H - p_H$ and from consuming the low environmental performance variant of the product is $u_j = \theta e_L - p_L$, where e stands for environmental performance and p for the price.

In full market coverage models, all consumers participate in the market. A consumer is indifferent between purchasing the high environmental performance product and purchasing the low environmental performance product when $\theta e_H - p_H = \theta e_L - p_L$.

This gives us $\theta^* = \frac{p_H - p_L}{e_H - e_L}$ which segments the market so that the consumers with $\theta \in [\underline{\theta}, \theta^*]$ purchase the low environmental performance product and the consumers with $\theta \in [\theta^*, \bar{\theta}]$ purchase the high environmental performance product.

In incomplete market coverage models some consumers may not participate in the market. A consumer is indifferent between purchasing the low environmental performance product and not purchasing any product when $\theta e_L - p_L = 0$. This gives us $\theta' = \frac{p_L}{e_L}$ which segments the market so that the consumers with $\theta \in [\underline{\theta}, \theta']$ do not

⁷¹ Examples include Arora, S & Gangopadhyay, S. 1995. Toward a theoretical model of voluntary overcompliance. *Journal of Economic Behavior & Organization*, volume 28, 3. Pages 289-309; Amacher, G S, Fina, M, Koskela, E & Ollikainen, M. 2000. *Environmental quality competition and eco-labeling*. Mimeo; and Lombardini-Riipinen, C. 2000. *Taxation, environmental quality choice and welfare in a vertically differentiated duopoly*. Paper presented at the European Association of Environmental and Resource Economists (EAERE) conference, University of Crete, June 30 - July 2.

⁷² Reinhardt, F L. 1999b. *Down to earth: applying business principles to environmental management*. Boston, Harvard Business School Press. 291 pages. Pages 37-38.

⁷³ See, for example, Crampes, C & Hollander, A. 1995. Duopoly and quality standards. *European Economic Review*, 39. Pages 71-82, or Motta, M. 1993. Endogenous quality choice: price vs. quantity competition. *The Journal of Industrial Economics*, volume 41, 2. Pages 113-131, or Arora, S & Gangopadhyay, S. 1995. Toward a theoretical model of voluntary overcompliance. *Journal of Economic Behavior & Organization*, volume 28, 3. Pages 289-309.

purchase any product, the consumers with $\theta \in [\theta', \theta^*]$ purchase the low environmental performance product, and the consumers with $\theta \in [\theta^*, \bar{\theta}]$ purchase the high environmental performance product. Since each consumer participating in the market is assumed to purchase one unit of the product, each firm's demand q is obtained from the number of customers purchasing its product.

The profit of the firm producing the high environmental performance product is $\pi_H = (p_H - c_H)q_H$ and the profit of the firm producing the low environmental performance product is, similarly, $\pi_L = (p_L - c_L)q_L$. As is typical for the case of a non-collusive oligopoly, game theory is next used to examine the optimal strategies of the two firms. The firms engage in a two-stage game, where they first choose their level of environmental performance and thereafter compete either in prices or in quantities.

The general result from such vertical product differentiation models is that duopoly firms always choose to provide distinct levels of environmental performance at the optimum. The details on the selected environmental performance levels vary, but the general result is robust to several model assumptions such as whether the costs of provision of environmental quality are assumed to be fixed or variable, and whether competition occurs in prices or in quantities.⁷⁴

Hence, one firm may find it the most profitable to provide low environmental performance and another firm may simultaneously find it the most profitable to provide high environmental performance. This implies that the firm-level relationship between environmental performance and economic performance is not uniform across cases and depends on the actions of competitors when there is interdependence between the firms.⁷⁵

3.2 Empirical literature

The empirical review below is strictly focused on studies that are directly pertinent to the research question at hand. This is typical of literature reviews such as the present one that serve as introduction to new original work.⁷⁶ Moreover, although the review

⁷⁴ Motta, M. 1993. Endogenous quality choice: price vs. quantity competition. *The Journal of Industrial Economics*, volume 41, 2. Pages 113-131.

⁷⁵ In fact, the focal point in vertical product differentiation literature is that the levels of environmental performance selected by the two firms are not socially optimal, which invites regulatory intervention. The literature then analyses the impacts of different regulatory policies on environmental performance levels, profits, and welfare. For the purposes of the present study, however, these results are of less interest than the general finding that the most profitable level of environmental performance for a firm depends on the level selected by the other firm.

⁷⁶ Cooper, H M. 1989. *Integrating research. A guide for literature reviews*. Second edition. Newbury Park, Sage Publications. Page 12.

is relatively comprehensive, its goal is to be selective rather than exhaustive, and "timeless rather than timely".⁷⁷

To facilitate obtaining a quick overview of the studies, they are grouped based on the main approach utilised (section headings) and labelled based on the main type of result (individual study headings). However, each reviewed study is also reported in depth because many of the problems and controversies with the studies originate from details in their designs, assumptions and measurements. These will be summarised in the discussion at the end of the chapter.

3.2.1 *Environmental performance and accounting performance*

Perhaps the most straightforward approach to examining empirically the relationship between firms' environmental and economic performance is to take some measures of environmental performance and regress them against some accounting measures of economic performance. This strain of studies began already in the early 1970s. However, the results remain unsettled, as can be seen from the studies reviewed below.

The body of literature on corporate social responsibility and economic performance is much larger than that of environmental performance and economic performance. Some of the corporate social responsibility studies explicitly use environmental performance as a proxy for corporate social responsibility. Such studies have been included in the present review.

*Bragdon and Marlin (1972): positive relationship*⁷⁸

Bragdon and Marlin examined 17 firms in the pulp and paper industry using a Council on Economic Priorities (CEP) environmental rating. They found a positive relationship between the environmental rating and 5-year return on equity, 5-year return on capital, and 5-year earnings growth. However, no tests for significance were conducted.

⁷⁷ Wolcott, H F. 1990. *Writing up qualitative research*. Qualitative Research Methods Volume 20. Newbury Park, Sage Publications. 94 pages.

⁷⁸ Bragdon, J & Marlin, J. 1972. Is pollution profitable? *Risk Management*, volume 19, 4. Pages 9-18. Reviewed as reported in Johnson, S. 1995. *An analysis of the relationship between corporate environmental and economic performance at the level of the firm*. Doctoral dissertation, University of California, Irvine, and in Aupperle, K E, Carroll, A B & Hatfield, J D. 1985. An empirical examination of the relationship between corporate social responsibility and profitability. *Academy of Management Journal*, volume 28, 2. Pages 446-463.

*Bowman and Haire (1975): inverted U-shaped relationship*⁷⁹

Bowman and Haire questioned whether the same relationship between the costs and benefits of social responsibility holds across the entire scale; in other words, whether more is always better. Taking pollution control as an example, they recomputed the data in Bragdon and Marlin (1972).⁸⁰ Bowman and Haire grouped 15 of the pulp and paper firms in the sample into low, middle and high performers with regard to pollution control. They found that measured by return on equity, middle performers were more profitable than either low or high performers. Thus, extreme performance in both directions was associated with reduced profitability. Nevertheless, high performers were somewhat more profitable than low performers. Again, no tests for significance were performed.

These results led Bowman and Haire to conclude that the relationship between environmental performance and profitability follows an asymmetrical inverted U-shaped curve where the low-end tail is lower than the high-end tail. Bowman and Haire did not suggest that environmental performance, or corporate social responsibility in general, was a causal factor of high profitability. Instead, they argued that both corporate social responsibility and profitability were signals of the presence of a third, causal factor: sensitivity to the external requirements facing the firm.

*Spicer (1978a): positive relationship, but reducing over time*⁸¹

Spicer noted a seemingly widespread view among investors that there was a moderate to strong association between a firm's performance on key social issues and the investment worth of the firm's securities. He set out to empirically ascertain whether such a perception was warranted. Spicer tested associations between firm pollution control performance and a number of economic indicators of investment worth. The hypotheses developed were that firms with better pollution control records have higher profitability, are larger in size, have lower total risk, have lower systematic risk, and have higher price per earnings ratios than firms with poorer pollution control records.

Spicer's sample consisted of 18 pulp and paper firms whose environmental performance had been rated by the Council on Economic Priorities (CEP). Spicer derived a pollution control index from the CEP data and combined the index with financial indicators. He found that, as hypothesised, the financial indicators were better for firms with better pollution control records. However, he also found a marked reduction in these associations over time.

⁷⁹ Bowman, E & Haire, M. 1975. A strategic posture toward corporate social responsibility. *California Management Review*, volume 18, 2. Pages 49-58.

⁸⁰ Bragdon, J & Marlin, J. 1972. Is pollution profitable? *Risk Management*, volume 19, 4. Pages 9-18.

⁸¹ Spicer, B. 1978a. Investors, corporate social performance and information disclosure: An empirical study. *The Accounting Review*, volume 53, 1. Pages 94-111.

*Chen and Metcalf (1980): no relationship*⁸²

The first purpose of Chen and Metcalf was to show that the evidence on a moderate to strong association between a firm's pollution control record and financial indicators was not as definitive as Spicer (1978a) had indicated. Chen and Metcalf criticised the validity of Spicer's study and argued that its conclusions were not justified. They examined Spicer's results at the 0.05 significance level and found that only three of the five financial variables were positively correlated with pollution control record. These were profitability, size, and price per earnings ratio. The measures of total risk and systematic risk did not exhibit a correlation with pollution control record at the 0.05 significance level. Furthermore, Chen and Metcalf questioned the fact that there were significant associations of pollution indices with the three financial indicators in the 1969-71 period but not in the 1971-73 period.

On pollution control and profitability, Chen and Metcalf maintained that it was difficult to see how a firm's pollution control record could have a significant positive impact on profitability. On pollution control and size, they similarly wrote that it "hardly seems possible for the result of controlling pollution to have a positive effect on the size of operation." Instead, they suggested reversed causation: firms with high earnings were more likely to incur pollution abatement costs than were firms with low earnings, and large firms tended to do more on pollution control, voluntarily or involuntarily.

The second purpose of Chen and Metcalf was to show that the relationship between pollution control record and financial indicators was not genuine but spurious, as it was created through one or more intervening variables. One possible third variable in this case could be size, measured by total assets. Besides affecting pollution control record, which was Spicer's independent variable, size may have a significant effect on the other four dependent financial variables.

Chen and Metcalf replicated Spicer's study using product-moment correlations between size and the other financial indicators. When the effects of size variations were held constant, there were no significant relationships between pollution control record and profitability, price per earnings ratio, total risk, or systematic risk. Thus, in direct conflict with Spicer's conclusions, Chen and Metcalf concluded that size was an explanatory variable for both pollution control and financial indicators and that there was no genuine relationship between pollution control and financial indicators.

In his reply to Chen and Metcalf, Spicer (1980) argued that Chen and Metcalf had fundamentally misinterpreted his study. Spicer's purpose had been to determine whether the perceived association between firms' pollution control record and a number of financial indicators was borne out by observation. The objective had not been to establish a causal relationship from pollution control record to the financial

⁸² Chen, K & Metcalf, R. 1980. The relationship between pollution control record and financial indicators revisited. *The Accounting Review*, volume 55, 1. Pages 168-177.

indicators. Spicer suspected that, in fact, the real relationship between pollution control record and profitability was of a reciprocal nature. Furthermore, background variables such as social pressure could affect both the pollution control record and profitability.⁸³

*Freedman and Jaggi (1982): negative relationship for large firms, otherwise no relationship*⁸⁴

Strictly speaking, the study by Freedman and Jaggi relates economic performance to environmental disclosures, not to environmental performance. It is included in the review, but with reference to section 2.1 where the potential discrepancy between environmental performance and environmental disclosures was noted.

Freedman and Jaggi studied the link between the disclosure of pollution information and economic performance for 109 firms in the chemical, oil refining, steel, and pulp and paper industry. They developed an index of pollution disclosure and correlated it with different indices of economic performance such as return on assets, return on equity and operating ratio. Freedman and Jaggi found that in the total sample and in small firms there was no relationship between the extensiveness of pollution disclosures and economic performance. However, in large firms there was a significant negative correlation between pollution disclosures and economic performance, especially return on equity. Pollution disclosures were more detailed for large firms with poor economic performance. Freedman and Jaggi suggested that this might imply that pollution disclosures were used to justify poor economic performance by large firms.

*McGuire, Sundgren and Schneeweis (1988): reverse causality*⁸⁵

The study by McGuire, Sundgren and Schneeweis addressed corporate social responsibility in general, not only environmental performance. However, the study is included in the review because it is relevant for consideration of the possible direction of causality. The authors examined whether corporate social responsibility predicted financial performance, and whether prior financial performance predicted corporate social responsibility. They found that a firm's prior economic performance was more closely related to corporate social responsibility than subsequent economic performance, and concluded that it might be better to consider financial performance a variable influencing corporate social responsibility than vice versa.

⁸³ Spicer, B. 1980. The relationship between pollution control records and financial indicators revisited: Further comment. *The Accounting Review*, volume 55, 1. Pages 178-185.

⁸⁴ Freedman, M & Jaggi, B. 1982. Pollution disclosures, pollution performance and economic performance. *Omega*, volume 10, 2. Pages 167-176.

⁸⁵ McGuire, J, Sundgren, A & Schneeweis, T. 1988. Corporate social responsibility and firm financial performance. *Academy of Management Journal*, volume 31, 4. Pages 854-872.

McGuire et al. further found that risk was closely associated with corporate social responsibility. This led them to conclude that instead of looking for increased profitability from corporate social responsibility one should look for reduced risk. Lower risk would justify lower returns in socially responsible firms.

*Sjöblom (1994): positive or no relationship depending on environmental performance measure*⁸⁶

Sjöblom, using Finnish data, measured the environmental performance of firms in two different ways: by incurred environmental protection costs and a pollution index. Financial performance was measured with several financial indicators calculated for firms for 1988-1992. The financial data were received from the large corporations database of the *Talouselämä* magazine.

The cost-based measures of environmental performance were the share of environmental investments in total investments and the share of environmental costs in gross production value. Environmental protection costs consisted of investment costs and operating costs. Site-specific data for 1027 sites in 1992 were obtained from Statistics Finland, which had collected the data through a detailed questionnaire to firms. It is noteworthy that in the questionnaire environmental investments were defined to be investments that are made for environmental protection purposes but do not meet firms' general profitability requirements. Cost savings from environmental protection were also not registered in the data.

Correlation analysis and factor analysis of 121 firms in the industrial, mining and energy sectors were performed. No statistically significant relationship was found between environmental performance (measured by the share of environmental investments in total investments, share of environmental costs in gross production value, share of environmental costs in total costs) and profitability (measured by return on investment).

Environmental performance was also measured by a pollution index. The pollution index data were obtained for 54 firms in 1990 and 1991 to measure the emissions per turnover and the changes in emissions.⁸⁷ When correlation analysis and factor analysis were performed with the pollution-index-based measures of environmental friendliness, a positive correlation was found between emission reduction and profitability. Sjöblom did not take a stand on the possible direction of causality.

⁸⁶ Sjöblom, M. 1994. *Yrityksen ympäristöystävällisyys ja liiketaloudelliset tunnushuvut*. Master's thesis, Helsinki School of Economics and Business Administration.

⁸⁷ See Reinikainen, T. 1993. *Suomen suurimmat pistekuormittajat vuosina 1990 ja 1991*. Ympäristökatsaus, March, special issue.

*Johnson (1995): no relationship for most industries and environmental issues*⁸⁸

The research hypothesis of Johnson was that firms with superior environmental performance also have superior economic performance. To test this hypothesis, Johnson examined associations between various measures of environmental and economic performance for a sample of firms in the Fortune 500 Industrials in 1987-1992. The sample size varied between 105 and 381 for different analyses.

Johnson measured environmental performance by oil and chemical spills, number of Superfund sites⁸⁹, toxic chemicals emissions per sales, Council on Economic Priorities (CEP) rating, regulatory fines and violations, and required cleanups and corrective actions. Financial performance was measured by return on assets, return on investment, return on equity, net income growth, and total return. Johnson controlled for market risk level and industry sector in the analysis. Firm size was also "controlled" for by restricting the sample to large firms.

The findings of Johnson did not support his research hypothesis. Superior environmental performance was related to superior economic performance only for some environmental issues such as oil spills, RCRA sites,⁹⁰ and Superfund sites in some industry sectors (chemicals; jewellery, metals and metal products; and motor vehicles). In most cases, economic performance was not affected by environmental performance. Furthermore, poor environmental performance with regard to chemical spills and chemical emissions was economically rewarded. From these findings, Johnson drew the conclusion that environmental regulations were not creating economic incentives for firms to improve their environmental performance.

*Repetto (1995): no relationship for most industries and environmental issues*⁹¹

Repetto examined whether firms with superior environmental performance tended to be more or less profitable than firms with inferior environmental performance within the same industry. To address this question he merged production cost, sales and revenue data on thousands of industrial establishments with information on emissions and pollution control expenditures. The number of establishments within an industry ranged between 10 and 429.

⁸⁸ Johnson, S. 1995. *An analysis of the relationship between corporate environmental and economic performance at the level of the firm*. Doctoral dissertation, University of California, Irvine.

⁸⁹ Hazardous waste sites under the Comprehensive Environmental Response, Compensation, and Liability Act that addresses uncontrolled or abandoned historical hazardous waste sites.

⁹⁰ Hazardous waste sites where corrective actions had been required by authorities under the Resource Conservation and Recovery Act that addresses the control of hazardous wastes from cradle to grave.

⁹¹ Repetto, R. 1995. *Jobs, competitiveness and environmental regulation: What are the real issues?* Washington, D.C., World Resources Institute. 43 pages.

Repetto developed three measures of environmental performance and two measures of profitability. The environmental performance measures were total airborne particulate emissions per dollar of output; water-borne emissions, measured as biological oxygen demand (BOD) plus total suspended solids (TSS) per dollar of output; and toxic releases per dollar of output. The profitability measures were gross operating margin and net return on capital.

Repetto undertook several measures to reduce the possibility that factors affecting both environmental performance and profitability could create spurious correlations between the two variables. First, the study was confined to specialised industrial sectors at the 5-digit Standard Industrial Classification level that produced a relatively narrow range of homogeneous products. Repetto argued that firms within such sectors would use similar materials and technologies, have similar capital intensity, and face similar inflationary trends and tax regimes. Second, Repetto controlled for plant age and size as well as for recent investments in plant and equipment.

Repetto found that environmental performance varied considerably even within the narrowly defined industrial sectors. However, he found few correlations between environmental performance and profitability that were significant at the 0.05 level. There was a significant positive association for one out of the six industrial sectors studied with regard to airborne emissions and a significant negative association for one out of the 14 industrial sectors studied with regard to waterborne emissions. Four out of the 25 industrial sectors studied with regard to toxic emissions exhibited a positive association between environmental performance and profitability. However, the fact that different toxic emissions were simply added up by weight to construct this measurement, ignoring the important differences in toxicity, casts doubt on the validity of this particular indicator.

Based on these findings, Repetto concluded that the associations between environmental performance and profitability were weak. Other factors than environmental performance were determining the profitability of firms. At least, there was no overall tendency for firms with superior environmental performance to be less profitable, and in some cases there was a positive correlation between environmental performance and profitability.

*Hart and Ahuja (1996): positive relationship*⁹²

Hart and Ahuja studied the relationship between emission reduction and financial performance for a sample of 127 firms on the Standard & Poor's 500 list. They measured environmental performance with the help of the Investor Responsibility Research Center (IRRC) emissions efficiency index: total emissions in pounds as reported in the Toxics Release Inventory, standardised by firm revenues. Hart and

⁹² Hart, S L & Ahuja, G. 1996. Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. *Business Strategy and the Environment*, volume 5. Pages 30-37.

Ahuja calculated the percentage change in the emissions efficiency index between 1988 and 1989 for each firm and used this as the environmental performance measure.

Financial performance was measured by return on sales, return on assets, and return on equity. Hart and Ahuja used multiple regression and controlled for R&D intensity, advertising intensity, capital intensity, leverage, and four-digit industry average performance. They found that emission reduction efforts showed positively on the bottom line within one to two years of initiation. As hypothesised, there was no relationship with concurrent economic performance. This was taken as an indication that there was a time lag before the emission reduction efforts materialised as financial benefits. Note, however, that Hart and Ahuja measured environmental performance only at time t , and economic performance at times t , $t+1$, $t+2$, and $t+3$. They did not control for changes in environmental performance that may have occurred at times $t+1$, $t+2$, and $t+3$. Hart and Ahuja further found that those firms that had the highest initial emissions stood to gain the most, and argued that this was because many unutilised low-cost emission reduction possibilities remained for such firms.

Hart and Ahuja could not rule out reverse causation in their study. In fact, they put forth an argument that a "virtuous circle" exists between pollution prevention and economic performance: good economic performance enables good environmental performance, which again contributes towards good economic performance.

*Russo and Fouts (1997): positive relationship*⁹³

The hypothesis of Russo and Fouts was that high levels of environmental performance are associated with enhanced profitability. Furthermore, Russo and Fouts hypothesised that this relationship is moderated by industry growth rate, so that in high-growth industries the returns to environmental performance are higher.

Russo and Fouts measured environmental performance by an independent environmental rating produced by Franklin Research and Development Corporation. The rating was based on compliance records, abatement expenditures, and firm initiatives to improve environmental performance. Profitability was measured by return on assets. In addition, Russo and Fouts controlled for industry concentration, firm growth rate, firm size, capital intensity, advertising intensity, and industry growth rate.

In their sample of 243 firms, Russo and Fouts found that, as hypothesised, higher environmental performance was associated with higher financial performance. However, the share of variance in firm performance that was explained by environmental performance was modest. Also, as hypothesised, the relationship was

⁹³ Russo, M & Fouts, P. 1997. A resource-based perspective on corporate environmental performance and profitability. *Academy of Management Journal*, volume 40, 3. Pages 534-559.

strengthened by industry growth. Improved environmental performance enhanced financial performance in all cases where de-meaned industry growth exceeded -3.14 per cent.

3.2.2 *Environmental performance and stock market performance*

Another major strain of empirical studies on the firm-level relationship between environmental and economic performance uses stock market measures instead of accounting measures of financial performance. The logic behind these studies is based on the efficient market hypothesis, according to which stock prices reflect the present value of future cash flows and thus do capture the economic impacts of environmental performance. When reviewing these studies, it is necessary also to include studies that focus on environmental disclosures: because stock markets react to publicly available information, disclosures play a central role.

Most of the studies reviewed below use the event study methodology that calculates the change in market valuation, termed abnormal return, the result of a specific event such as the publication of environment-related news. Abnormal returns are obtained by comparing observed actual returns during the event window to "normal" returns predicted by the capital asset pricing model (CAPM). The event study methodology thus isolates the event-related change by correcting for general market movements and individual firm variability.⁹⁴

Again, the studies show varying results as disclosed below. However, the majority of the studies document a positive relationship between environmental performance and stock market reaction.

*Fogler and Nutt (1975): no relationship*⁹⁵

Fogler and Nutt hypothesised that if investors were socially conscious, demand for, and hence price of, the stock of socially irresponsible firms would be reduced. Thus, firms with better pollution ratings would have higher price per earnings ratios than firms with lower ratings. Fogler and Nutt combined the data in Bragdon and Marlin (1972)⁹⁶ with data on quarterly price per earnings ratios. They found that there was no statistically significant relationship between a firm's pollution rating and its price per

⁹⁴ See, for example, Klassen, R D & McLaughlin, C P. 1996. The impact of environmental management on firm performance. *Management Science*, volume 42, 8. Pages 1199-1214. The methodology was originally developed in Fama, E F, Fisher, L, Jensen, M C & Roll, R. 1969. The adjustment of stock prices to new information. *International Economic Review*, volume 10, 1. Pages 1-21.

⁹⁵ Fogler, H & Nutt, F. 1975. A note on social responsibility and stock valuation. *Academy of Management Journal*, volume 18, 1. Pages 155-160.

⁹⁶ Bragdon, J & Marlin, J. 1972. Is pollution profitable? *Risk Management*, volume 19, 4. Pages 9-18.

earnings ratio in subsequent quarters. However, a lack of stable earnings histories limited the sample to only nine pulp and paper firms.

Fogler and Nutt also tested whether publicity on firms' pollution performance results in short-term stock price changes. By examining daily stock prices for 10 days before and 10 days after the release of pollution ratings they found that the pollution information had no discernible impact on the market.

*Belkaoui (1976): positive relationship*⁹⁷

Belkaoui studied two groups of U.S. firms: an experimental group of 50 firms from different industries that disclosed pollution control information in annual reports and had pollution control expenditure of at least one per cent of sales, and a control group of 50 firms of a similar industrial classification and asset size. Using monthly closing common stock prices 12 months before and 12 months after the publication of the annual reports, he found that the effect of the disclosure of pollution control information had an immediate but temporary (four months) positive effect on the market.

*Spicer (1978b): positive relationship*⁹⁸

In another study based on the same data as Spicer (1978a)⁹⁹, Spicer addressed the question whether firms' relative pollution control records conveyed relevant information to investors about the riskiness of the common stocks of firms in pollution-prone industries. He examined the relationship between market measures of risk and firms' pollution control records and concluded that, tentatively, there seemed to be an inverse association between the two even after the effects of other non-market measures of risk were removed.

*Shane and Spicer (1983): positive relationship*¹⁰⁰

Shane and Spicer investigated whether movements in security prices were associated with the release of externally produced information about firms' pollution control performance and pollution control costs. They hypothesised that if investors were using such information, an overall movement in the share prices of the firms reported on should be observable. Shane and Spicer found that firms in their sample of 72 firms in the pulp and paper, electric power, iron and steel, and petroleum refining sectors suffered relatively large negative abnormal returns in connection with the

⁹⁷ Belkaoui, A. 1976. The impact of the disclosure of the environmental effects of organizational behavior on the market. *Financial Management*, volume 5, 4. Pages 26-31.

⁹⁸ Spicer, B. 1978b. Market risk, accounting data and companies' pollution control records. *Journal of Business Finance and Accounting*. Pages 67-83.

⁹⁹ Spicer, B. 1978a. Investors, corporate social performance and information disclosure: An empirical study. *The Accounting Review*, volume 53, 1. Pages 94-111.

¹⁰⁰ Shane, P & Spicer, B. 1983. Market response to environmental information produced outside the firm. *The Accounting Review*, volume 58, 3. Pages 521-538.

release of their pollution control record by the Council on Economic Priorities (CEP). Firms rated to have low pollution control performance suffered a more adverse price movement than firms with a high pollution control rating. Shane and Spicer attributed these results to CEP studies changing investors' perceptions of the probability distributions of future cash flows of the rated firms. They also suggested that investors were using the CEP information to discriminate between firms with different pollution control records.

Muoghalu, Robison and Glascock (1990): positive relationship¹⁰¹

Muoghalu et al. examined the impact that hazardous waste mismanagement lawsuits were having on stockholder returns. They used the event study methodology with a 121-day event window on 128 lawsuits against firms in the United States between 1977 and 1986, and found that the filing of such lawsuits resulted in significant abnormal losses for the firms concerned. The adjustment in stock price was interpreted to reflect changes in the present value of expected future earnings, as well as penalties imposed by court. The average reduction in a firm's market value due to a hazardous waste mismanagement lawsuit was 1.2 per cent.

Cormier, Magnan and Morard (1993): positive relationship¹⁰²

Cormier et al. studied the relationship between the pollution record and market valuation of 74 publicly listed Canadian industrial and mining firms in 1986-1988. They measured a firm's pollution record as effluent discharges relative to environmental regulations, and inserted this pollution index into regression equations based on the accounting identity framework (equity equals assets less liabilities).

The results of Cormier et al. lent weak support to the existence of a premium in the stock market for firms that meet environmental regulations and a discount for firms that do not. This was both because investors assessed bad environmental performance to incur future liabilities for a firm, and, perhaps to a lesser extent, because ethical investors bid up the share price for firms with good environmental performance. Cormier et al. concluded that environmental performance had a multi-dimensional impact on stock prices through multiple factors.

Blacconiere and Patten (1994): positive relationship¹⁰³

Blacconiere and Patten set out to analyse the market reaction that Union Carbide's chemical leak in Bhopal in 1984 had on other firms in the chemical industry. Using

¹⁰¹ Muoghalu, M I, Robison, H D & Glascock, J L. 1990. Hazardous waste lawsuits, stockholder returns, and deterrence. *Southern Economic Journal*, volume 57, 2. Pages 357-370.

¹⁰² Cormier, D, Magnan, M & Morard, B. 1993. The impact of corporate pollution on market valuation: some empirical evidence. *Ecological Economics*, 8. Pages 135-155.

¹⁰³ Blacconiere, W G & Patten, D M. 1994. Environmental disclosures, regulatory costs, and changes in firm value. *Journal of Accounting & Economics*, volume 18. Pages 357-377.

the event study methodology with a 5-day event window, they found that there was a significant negative overall reaction on a sample of 47 firms. However, this reaction was less negative in firms that had, prior to the accident, disclosed extensive environmental information in their financial reports. Blacconiere and Patten took this as an indication that because managers have incentives to withhold "bad news", such disclosures were a positive sign for investors about the firm's exposure to environmental risk and regulatory costs. They could not, though, rule out the possibility that the measure for the extensiveness of environmental disclosures was proxying for some other, unidentified variable.

Laplante and Lanoie (1994): positive, negative, or no relationship depending on the environmental event¹⁰⁴

Laplante and Lanoie studied, with the event study methodology, the impact of news of 47 environment-related events on the equity value of Canadian firms between 1982 and 1991. They found that announcements of investments in pollution control equipment were followed by a negative stock market reaction (about 1.2 per cent). There was also a negative stock market reaction to announcements of suit settlements resulting in fines (about 2.0 per cent). However, the effects were temporary and could be observed on the day of the announcement only. No market reaction was found relating to environmental lawsuits, non-compliance, or spills. Based on these results, Laplante and Lanoie felt they could not conclude that the market had the power to discipline firms not complying with environmental regulations.

Diltz (1995): positive relationship¹⁰⁵

In order to determine whether ethical screening affected portfolio performance, Diltz studied 28 common stock portfolios, covering 159 firms, over three years (1989-1991). He compared estimated market model alphas as well as excess returns for fourteen portfolio pairs of high and low performers. Diltz found that although in general there was little impact, the market appeared to reward good environmental performance. The environmental performance measure was based on a Council on Economic Priorities (CEP) rating.

Hamilton (1995): positive relationship¹⁰⁶

Hamilton set out to examine stock market reactions to the release of pollution figures. Using the event study methodology and a sample of 436 firms, he found that firms

¹⁰⁴ Laplante, B & Lanoie, P. 1994. The market response to environmental incidents in Canada: a theoretical and empirical analysis. *Southern Economic Journal*, volume 60, 3. Pages 657-672.

¹⁰⁵ Diltz, J D. 1995. The private cost of socially responsible investing. *Applied Financial Economics*, volume 5, 5. Pages 69-77.

¹⁰⁶ Hamilton, J T. 1995. Pollution as news: media and stock market reactions to the Toxics Release Inventory data. *Journal of Environmental Economics and Management*, 28. Pages 98-113.

reporting Toxics Release Inventory (TRI) pollution figures experienced negative abnormal returns when the information was first released, especially if the TRI information diverged negatively from the market's previous perceptions of pollution patterns.

*Klassen and McLaughlin (1996): positive relationship*¹⁰⁷

Again using the event study methodology, Klassen and McLaughlin examined whether environmental performance was related to a firm's stock market valuation. They identified strong environmental performance through environmental awards and weak environmental performance through environmental accidents and crises, mentioned in a database of newswire services. The resulting sample consisted of 140 environmental awards to 96 firms and 22 environmental crises of 16 firms.

The findings were that environmental awards resulted in positive returns on the stock market, and environmental crises resulted in even larger negative returns within a 3-day event period. There was also an industry difference in the market reaction: in "dirty" industries the positive reaction to environmental awards was smaller. Klassen and McLaughlin considered that this might be due to market scepticism. Against their hypothesis, no change in the market's reaction to positive environmental events could be observed over time.

*Feldman, Soyka and Ameer (1996): positive relationship*¹⁰⁸

Feldman, Soyka and Ameer hypothesised that good environmental management systems and environmental performance lead to reduced risk, which in turn is valued by financial markets. The link between the environmental indicators and risk goes through environmental signalling. Such signalling can be unmanaged, like regulatory compliance reporting and media coverage, or managed, like press releases, advertisements, corporate environmental reports, and industry codes of conduct.

Feldman et al. used the change in a firm's systematic risk as the dependent variable that they regressed against financial and environmental variables. The two environmental variables were environmental performance and environmental management systems. Environmental performance was measured as the average annual change in toxic releases per capital. The environmental management systems were measured using a proprietary, qualitative rating system based on the firms' public environmental communications. The financial variables were intended to capture non-environmental factors affecting a firm's systematic risk. They included, for example, measures of financial and operating leverage and variability in operating income and productivity.

¹⁰⁷ Klassen, R D & McLaughlin, C P. 1996. The impact of environmental management on firm performance. *Management Science*, volume 42, 8. Pages 1199-1214.

¹⁰⁸ Feldman, S, Soyka, P & Ameer, P. 1996. *Does improving a firm's environmental management system and environmental performance result in a higher stock price?* ICF Kaiser International, Inc.

Feldman et al. found both environmental management system and environmental performance to be significantly and inversely related to firm risk. They considered the findings to suggest that an increase of up to five per cent in stock price was obtainable to firms from improved environmental performance, in addition to the environmental benefits and potential cost savings. Thus, firms could increase shareholder value by going beyond regulatory compliance.

Note that as the model was proprietary, the rating system for one of the key variables, environmental management systems, was not reported. The regression coefficients were also not reported for the same reason. Hence, it is not possible to evaluate the study by Feldman et al.

*Niskanen and Halme (1997): negative relationship*¹⁰⁹

Niskanen and Halme examined market reactions to print media news of 64 environmental investments that had been implemented by 10 listed Finnish forest industry firms during 1970-1996. Using the event study methodology with a 21-day event window and regression analysis, Niskanen and Halme found that the firms' shareholders experienced abnormal losses around the date of publication of the investment news. Thus, environmental investments were "bad news for the capital market". Contrary to expectations, the effect was even more pronounced during 1987-1996 than it had been during 1970-1986. The authors further found that unknown firm-specific factors were involved that caused the stock market effect to vary between firms. The effect did not, however, vary between mandatory and voluntary environmental investments.

*Lanoie, Laplante and Roy (1998): no relationship*¹¹⁰

The Ministry of the Environment of British Columbia in Canada regularly publishes a list of firms that are not complying with the environmental regulations, or that are otherwise of concern to the Ministry because of their high levels of pollution. Lanoie et al. examined whether appearing on such lists had an effect on firms' equity values. Their sample consisted of 19 firms in total and they used a single-index market model version of the event study methodology. Lanoie et al. found that appearing on the Ministry's list affected the equity values of neither non-complying firms nor firms that were "of concern". To explain this result, Lanoie et al. suggested that the list may not provide unexpected information to investors, or that the listing may not be perceived by investors to present a significant threat to the firms.

¹⁰⁹ Niskanen, J & Halme, M. 1997. *Stock market response to environmental investments of forest industry firms: Finnish evidence*. Series A2: Research Reports 69. Tampere, University of Tampere. 46 pages.

¹¹⁰ Lanoie, P, Laplante, B & Roy, M. 1998. Can capital markets create incentives for pollution control? *Ecological Economics*, 26. Pages 31-41.

Khanna and Damon (1999): positive relationship with stock market measure, negative relationship with accounting measure¹¹¹

Khanna and Damon examined the impact that participation in the 33/50 programme had on firms' short-term and long-term economic performance. The 33/50 programme is a voluntary initiative by the U.S. Environmental Protection Agency to reduce the release and transfer of 17 high priority toxic chemicals by 33 per cent from 1988 levels by 1992 and by 50 per cent by 1995.

Khanna and Damon argued that short-term and long-term economic impacts on firms were likely to differ since the costs of participation were likely to be incurred in the short term but the benefits only in the long run. They used an accounting-based measure, current return on investment (ROI), to measure short-term economic performance. Long-term economic performance was measured through a market-based measure, EV/S, which is defined as the excess of market value over the book value of assets, normalised by sales. Using regression analysis and a panel data set for 123 firms over the years 1988-1993, and after controlling for firm-specific factors, Khanna and Damon found that participation in the voluntary 33/50 programme had a negative impact on ROI (1.2 per cent on the average) but a positive impact on EV/S (2.2 per cent on the average). They interpreted this finding to suggest that participation in the 33/50 programme imposed costs that were not fully offset in the current period, but that investors expected those costs to be offset over the longer term.

3.2.3 Other cross-sectional studies

Various other methods have been employed to examine the link between firms' environmental and economic performance or parts thereof. The approach in these studies to the topic area of the present study is less direct, but the same basic issue can be identified. These studies are also ambivalent in their results, but compared to the accounting and stock market studies they show much more variation in the relationship.

¹¹¹ Khanna, M & Damon, L A. 1999. EPA's voluntary 33/50 program: impact on toxic releases and economic performance of firms. *Journal of Environmental Economics and Management*, 37. Pages 1-25.

*Färe, Grosskopf, Lovell and Yaisawarng (1993): negative relationship, but with large variation*¹¹²

Färe et al. developed an analytical framework for calculating plant-specific shadow prices for pollutants. Such shadow prices reflect the opportunity cost of pollution abatement and hence the impact of pollution control regulations faced by the firms. Applying this framework to a sample of 30 pulp and paper mills operating in Michigan and Wisconsin in 1976, Färe et al. found that the shadow prices for pollutants were negative, reflecting forgone output and thus revenue. However, there was large variation in the shadow prices both by production process and by mill. Färe et al. interpreted this to suggest that environmental regulations did not result in an efficient allocation of pollution control resources.

*Brännlund, Färe and Grosskopf (1995): no relationship for most firms, but significant variation*¹¹³

The aim of Brännlund et al. was to analyse the impact that mill-specific environmental regulations were having on profits in the Swedish pulp and paper industry. They used a panel data set for 41 Swedish pulp and paper mills in 1989-1990 that contained annual data on inputs, production, emissions, input and output prices, and environmental regulations. As no data on investment in abatement capital were available, the authors viewed the model as a short-run model with fixed capital.

Using a non-parametric programming model of the technology Brännlund et al. calculated both the regulated and unregulated short-term profits for firms. A profit ratio was calculated as the share of regulated profits in unregulated profits to measure the regulatory "cost", that is, forgone profits due to environmental regulations.

Brännlund et al. found that the impact of environmental regulations on profitability varied substantially between mills. As expected by the researchers, some firms did encounter a loss in profits. However, for 66 per cent of the firms in 1989 and 88 per cent in 1990, profit was unaffected by environmental regulations. Overall, the profit ratios increased between 1989 and 1990 in all processing categories, suggesting that the regulations had become less strict. Technological development, together with the fact that almost all firms studied had an unchanged permit level between 1989-1990, was offered as an explanation for this.

Firm size and processing category were found to have an impact on the profit ratio. The profit of small firms was less affected by environmental regulations than that of

¹¹² Färe, R, Grosskopf, S, Lovell, C & Yaisawarng, S. 1993. Derivation of shadow prices for undesirable outputs: A distance function approach. *Review of Economics and Statistics*, volume 75. Pages 374-380.

¹¹³ Brännlund, R, Färe, R & Grosskopf, S. 1995. Environmental regulation and profitability: An application to Swedish pulp and paper mills. *Environmental and Resource Economics*, volume 6. Pages 23-36.

large firms. Integrated mills and mills producing unbleached sulphate pulp were less affected than other processing categories.

Based on their findings the authors concluded that the prevailing regulation scheme may be ineffective. However, two qualifications were made. First, weak disposability of pollution was imposed in the model. This means that a firm cannot reduce pollution freely but only if some of the desirable output is also given up. The possibility of win-win situations could thus not be tested as those situations were ruled out from the model altogether.

Second, environmental regulations were expressed as absolute limits and firms polluting below the permitted level were considered in the model to be unconstrained by environmental regulations. However, the regulations may be affecting the firm even in such a case. This is because if there are random fluctuations in the production of pollution, and if a firm decides not to violate the permit by a certain probability, it must on the average pollute less than permitted.

*Arora and Cason (1995): variation in the relationship*¹¹⁴

Arora and Cason studied the factors that lead firms to participate in the 33/50 programme. They theorised that a firm joins the 33/50 programme if its expected profit with participation is larger than expected profit without participation. From this basic tenet they developed the hypotheses that industrial sector, firm size, financial health and profitability, industry concentration, research and development intensity, consumer contact, and releases of the 17 toxic chemicals covered by the 33/50 programme affect the participation decision.

Arora and Cason studied 302 large publicly traded firms in seven industrial sectors and found that the most likely participants in the 33/50 programme were large firms with substantial chemical releases. Moreover, participation in the programme was highest in unconcentrated industries. Note that the dependent variable was whether firms announced to participate in the voluntary programme, not actual emission reductions. Since there are no enforcement sanctions in the 33/50 programme, the achievement of reductions may not automatically follow from participation.

*Arora and Cason (1996): variation in the relationship*¹¹⁵

In another study similar to Arora and Cason (1995), Arora and Cason expanded their sample to 6265 firms. They also studied the interaction between the 33/50 programme

¹¹⁴ Arora, S & Cason, T. 1995. An experiment in voluntary environmental regulation: Participation in EPA's 33/50 program. *Journal of Environmental Economics and Management*, volume 28. Pages 271-286.

¹¹⁵ Arora, S & Cason, T. 1996. Why do firms volunteer to exceed environmental regulations? Understanding participation in EPA's 33/50 program. *Land Economics*, volume 72, 4. Pages 413-432.

and environmental regulations, and focused more on the role of consumer contact in the participation decision.

The findings again indicated that the most likely participants in the 33/50 programme were large firms with the greatest toxic releases. Participation was higher in industries that had greater consumer contact. However, the impact of industry concentration was ambiguous.

*Hetemäki (1996): positive relationship in some cases, negative in others*¹¹⁶

Hetemäki used output distance functions and a plant level panel data set of eight Finnish sulphate pulp plants between 1972-1990 to examine the impact that water pollution abatement had on the production of the pulp mills. He separated the analysis of an unregulated pollution output, namely total wastewater flow, and regulated pollution outputs, namely biological oxygen demand (BOD) and total suspended solids (TSS).

Hetemäki calculated the shadow prices of pollution that represent costs of pollution abatement to the mills. He found that the shadow price for total wastewater flow was positive, indicating that reductions in total wastewater flow had brought cost savings to the mills through improved efficiency. The shadow price for biological oxygen demand was less clear as the findings showed to be dependent on model specifications. However, with most specifications the shadow price was negative, implying that reductions in biological oxygen demand of the effluents had resulted in forgone profit.

Hetemäki attributed these findings to the fact that total wastewater flow was abated through pollution prevention methods, whereas biological oxygen demand was mainly addressed with end-of-pipe methods. However, another explanation might be that the reductions in the total wastewater flow were voluntary – thus, firms only implemented such reductions in cases where economic gains were in sight.

On the efficiency impacts of environmental regulations, Hetemäki found that an increase in environmental regulation led to a decrease in production efficiency. Hetemäki interpreted this finding as evidence against the central argument of the Porter hypothesis that properly designed environmental regulations can trigger efficiency gains in the regulated firms.¹¹⁷ Note, however, that the regulations involved may not have been "properly designed" in Porter's sense.

¹¹⁶ Hetemäki, L. 1996. *Essays on the impact of pollution control on a firm: A distance function approach*. Finnish Forest Research Institute, Research Papers 609.

¹¹⁷ See, for example, Porter, M E & van der Linde, C. 1995a. Green and competitive: Ending the stalemate. *Harvard Business Review*, September-October. Pages 120-134; or Porter, M E & van der Linde, C. 1995b. Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, volume 9, 4. Pages 97-118.

*Cordeiro and Sarkis (1997): negative relationship*¹¹⁸

Cordeiro and Sarkis argued that both accounting and stock market data were unsatisfactory measures of economic performance and used industry analyst 1- and 5-year earnings per share performance forecasts instead. Environmental performance was measured with data from the Toxics Release Inventory: the difference of total waste generated and total releases, standardised by firm sales. This measure was designed to capture proactive treatment and recycling. Controlling for firm size, leverage, and industry, Cordeiro and Sarkis found a negative relationship between environmental performance and economic performance for a sample of 523 U.S. firms in 1992.

*Dasgupta, Hettige and Wheeler (2000): variation in the relationship*¹¹⁹

Dasgupta et al. hypothesised that the cost-minimising level of emissions for a plant was determined by the abatement costs, and by the penalty from pollution that could be expected from regulatory authorities, local communities, and market agents. These, in turn, were determined by plant or firm characteristics, informal regulation or community pressure, and environmental management practices.

Using survey data from 236 Mexican facilities in the food, chemicals, nonmetallic minerals, and metal industries, Dasgupta et al. found that significant determinants of cost-minimising emissions and, hence, compliance included the adoption of environmental management systems; the selected environmental management strategy (mainstreaming vs. specialisation); the amount of regulatory pressure through inspections; exposure to public scrutiny through stock market presence; plant size; being part of a multiplant company; and workforce education. Contrary to conventional wisdom, technology vintage was found to have no effect on compliance.

*Christmann (2000): variation in the relationship*¹²⁰

Christmann analysed how factors that are internal to the firm affect the relationship between environmental and economic performance. She hypothesised that implementing "best practices" of environmental management might not create competitive advantage for all firms, only for firms with resources and capabilities that enable them to capitalise on such best practices.

¹¹⁸ Cordeiro, J J & Sarkis, J. 1997. Environmental proactivism and firm performance: evidence from security analyst earnings forecasts. *Business Strategy and the Environment*, volume 6. Pages 104-114.

¹¹⁹ Dasgupta, S, Hettige, H & Wheeler, D. 2000. What improves environmental compliance? Evidence from Mexican industry. *Journal of Environmental Economics and Management*, 39. Pages 39-66.

¹²⁰ Christmann, P. 2000. Effects of "best practices" of environmental management on cost advantage: The role of complementary assets. *Academy of Management Journal*, August, forthcoming.

Using data from a mail questionnaire survey of 88 business units in the chemical industry in the United States, Christmann found that capabilities for process innovation and implementation were complementary assets that moderated the relationship between environmental "best practices" and cost advantage. Proactive environmental measures such as implementation of pollution prevention and early timing of environmental strategies brought cost advantage to firms that possessed capabilities for process innovation and implementation, not to all firms on the average. Christmann concluded that the findings highlighted the importance of firm heterogeneity.

3.2.4 Case studies

Besides large-scale quantitative studies, the relationship between firms' environmental and economic performance has invited a considerable number of case studies. The most often quoted case is perhaps that of 3M and its Pollution Prevention Pays programme. Between 1975 and 1990, 3M are reported to have reduced their total emissions by 50 per cent while simultaneously saving over \$500 million through lower raw material, compliance, disposal, and liability costs.¹²¹

Several similar examples appear in the literature. For instance, Schmidheiny (1992) describes 38 cases that illustrate how firms have achieved commercial success while improving their environmental performance.¹²² Porter and van der Linde (1995a) support their argument of a positive link between environmental and economic performance with the help of a series of case studies from six industries that are significantly affected by environmental regulations.¹²³

These and the many other cases reported will not be reviewed in detail. Suffice it to note what they prove: that it has been possible, at least in some cases, for firms to obtain economic benefits from improved environmental performance. However, the case-study evidence remains anecdotal in the sense that a systematic approach to examining how generalisable the findings are has been lacking. It is typical that only successful cases are reported – never those with no impacts and very seldom cases with negative economic impacts. A rare exception of the latter kind is the StarKist case reported by Reinhardt (1998).¹²⁴

¹²¹ Hart, S L & Ahuja, G. 1996. Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. *Business Strategy and the Environment*, volume 5. Pages 30-37.

¹²² Schmidheiny, S. 1992. *Changing course. A global business perspective on development and the environment*. Cambridge, MIT Press. 374 pages.

¹²³ Porter, M E & van der Linde, C. 1995a. Green and competitive: Ending the stalemate. *Harvard Business Review*, September-October. Pages 120-134.

¹²⁴ Reinhardt, F L. 1998. Environmental product differentiation: implications for corporate strategy. *California Management Review*, volume 40, 4. Pages 43-73.

3.2.5 Macro-level studies

Much of the empirical research on the economic impacts of environmental performance has been undertaken not at the firm level, but at the country or industry level. These studies have typically focused on environmental regulation instead of environmental performance, and analysed its impacts on economic growth, productivity, trade flows, and investment flows.

Fundamentally, these macro-level studies address the same issue as does the present study. The often-quoted conclusion from the review by Jaffe et al. (1995) is that the studies "have produced estimates that are either small, statistically insignificant, or not robust to tests of model specification".¹²⁵ However, the higher aggregation level may mask important differences between firms or industries in the relationship. Aggregate results are of limited value from an environmental strategy viewpoint since firms do not operate "on the average" or "in most industries", but in specific individual circumstances. Thus, the results are of minor importance for the present study. The methods employed by most of the macro-level studies are also not applicable in the present study. For these reasons, the macro-level studies are excluded from a detailed review. For other reviews, see, for example, Dean (1992)¹²⁶, Cropper and Oates (1992)¹²⁷, or Jaffe et al. (1995).¹²⁸

3.3 Discussion on previous knowledge

3.3.1 Theoretical links

Two different views in theoretical literature were reviewed: one according to which there is a negative link between environmental performance and economic performance, and one according to which the link is a positive one. Another distinction that can be made in the theoretical literature is between economics and management literature. Broadly speaking, economics literature tends to support the negative view and management literature tends to support the positive view. The emerging literature on vertical product differentiation in an environmental context, also reviewed in the chapter, is beginning to point to the direction that not all firms

¹²⁵ Jaffe, A B, Peterson, S R, Portney, P R & Stavins, R N. 1995. Environmental regulation and the competitiveness of U.S. manufacturing: What does the evidence tell us? *Journal of Economic Literature*, volume 33, pages 132-163. Pages 157-158.

¹²⁶ Dean, J. 1992. Trade and the environment: a survey of the literature. In: Low, P (editor). *International trade and the environment. World Bank Discussion Papers 159*. Washington, D.C., the World Bank. 365 pages. Pages 15-28.

¹²⁷ Cropper, M L & Oates, W E. 1992. Environmental economics: A survey. *Journal of Economic Literature*, volume 30, June. Pages 675-740.

¹²⁸ Jaffe, A B, Peterson, S R, Portney, P R & Stavins, R N. 1995. Environmental regulation and the competitiveness of U.S. manufacturing: What does the evidence tell us? *Journal of Economic Literature*, volume 33, pages 132-163.

may experience the relationship between environmental and economic performance in a similar manner.

Four major problem areas can be identified in past theoretical knowledge of the relationship between firms' environmental and economic performance. First, the two views disagree fundamentally with each other. If interpreted strictly, the views are not compatible. And, even if proponents of the positive view admit that win-win situations are not always possible, and vice versa, the two sides still disagree over the extent and significance of win-win situations.

Second, the views are not systematically supported by empirical evidence. As was seen above, it has not been possible to empirically confirm or reject either of the views. This has lead many analysts asking which is wrong: theory or data?

Third, the existing theoretical literature has, in fact, to a large extent grown to address the issue of how environmental *regulations* affect economic performance. It is thus not wholly adequate to address the issue of how environmental performance per se affects economic performance. Nehrt (1996) notes that when an environmental innovation reduces costs or enhances sales, differences in environmental regulations between countries become irrelevant.¹²⁹ Explicit theoretical analysis of the impacts of environmental performance per se on economic performance is rare.

Fourth, there are problems within each of the views. The negative view sees competitiveness narrowly in terms of cost competitiveness only. It cannot accommodate private benefits from environmental differentiation, even though there is evidence from practice that obtaining such benefits is possible.

Much of the literature in support of the positive view, on the other hand, lacks theoretical rigour. The literature is normative and speculative, contingent on significant green consumerism in the future. For example, Shrivastava (1995) notes that "*if* the world economy shifts towards an ecological orientation, it will change the competitive landscape of industries in terms of consumer preferences and demands, industrial regulations, and competitive opportunities".¹³⁰ Further, the literature has tended to simply extrapolate the benefits obtained from improved environmental performance, assuming that further improvements will bring further benefits.

3.3.2 *Empirical studies*

It is evident from the preceding review of previous empirical studies on the firm-level relationship between environmental performance and economic performance that the

¹²⁹ Nehrt, C. 1996. Timing and intensity effects of environmental investments. *Strategic Management Journal*, volume 17. Pages 535-547.

¹³⁰ Shrivastava, P. 1995. Environmental technologies and competitive advantage. *Strategic Management Journal*, volume 16. Pages 183-200. Emphasis added.

findings have not converged. What may, at best, be concluded from the existing empirical studies is that at present levels of environmental performance, on the average, there has not appeared to be a significant systematic uniform link between environmental performance and economic performance. Because of the many disclaimers required, such a conclusion provides inadequate guidance for competitive strategy or environmental policy. In 1985, Ullman characterised the situation concerning the relationships between social performance, social disclosure, and economic performance as "empirical data in search of an adequate theory".¹³¹ The same could be said about firms' environmental performance and economic performance fifteen years later.

Several reasons have been offered to explain why there has not been a strong systematic relationship between environmental performance and economic performance – or, why the relationship has not been borne out by empirical data, even if it exists.

One such reason is the small size of environmental costs. Environmental costs have constituted such a minor share in production costs (perhaps 1-2.5 per cent of total costs in most industries¹³²) that their impact on economic performance has been negligible. Other issues have been more important in determining economic performance. Thus, even if there in principle were a link between environmental and economic performance, its magnitude is so small that it is difficult to observe empirically. This, however, is not necessarily true for all industries and all firms. Also, if competition is fiercer in the future, smaller and smaller cost impacts may begin to matter.¹³³

An explanation for the relatively low environmental costs may be that firms have been situated on the flat portion of their marginal abatement cost curves.¹³⁴ If environmental performance is further improved in the future, the costs may rise, perhaps steeply, and the economic impacts become more pronounced. The result may, therefore, not hold for future levels of environmental performance. Since full environmental cost internalisation has not taken place, its economic impacts cannot have been empirically studied. Knowledge of the relationship at past levels of environmental performance cannot automatically be extrapolated to future levels of environmental performance. For example, Hart and Ahuja (1996) qualify their results by noting that their data originate from a time when important industries had not yet

¹³¹ Ullman, A. A. 1985. Data in search of a theory: a critical examination of the relationships among social performance, social disclosure, and economic performance of U.S. firms. *Academy of Management Review*, volume 10, 3. Pages 540-557.

¹³² Cropper, M L & Oates, W E. 1992. Environmental economics: A survey. *Journal of Economic Literature*, volume 30, June. Pages 675-740.

¹³³ Ekins, P & Speck, S. 1999. Competitiveness and exemptions from environmental taxes in Europe. *Environmental and Resource Economics*, 13. Pages 369-396.

¹³⁴ OECD. 1993. *Environmental policies and industrial competitiveness*. Paris. Marginal abatement cost curves will be discussed more closely in chapter 3.

implemented large-scale environmental improvements.¹³⁵ The only way to gain some insight into possible future impacts is to understand the underlying mechanism that may link environmental and economic performance at the firm level.

Further, the differential between the environmental costs of competitors has (again, on the average) been small as environmental regulations have moved roughly in tandem in many OECD countries.¹³⁶ This can, indeed, limit the economic impacts of improved environmental performance between competing producers of the same product, but not necessarily between competing substitutes.¹³⁷

In fact, it should not come as a surprise that large-scale economic impacts of environmental policies have not been observed. The timing and content of environmental policies are often designed so as to minimise adverse effects on economic performance in the first place.¹³⁸ The very purpose of effective environmental policies is to affect production and consumption patterns by promoting sustainable and discouraging unsustainable economic activities. While such changes promote overall economic efficiency, their distributional and transitional effects raise political concerns. As a result, the effects of environmental policies may not materialise as measurable economic impacts but as downward pressure on environmental regulations. This "chilling effect" is hard to measure.¹³⁹

Offsetting effects may also have masked the relationship between environmental and economic performance. Such offsetting effects may include pollution abatement subsidies and trade protection of polluting industries.¹⁴⁰ Long (1995) notes that exemptions, subsidies, rebates, or time differentials are granted precisely to minimise adverse economic effects of environmental policies.¹⁴¹

Finally, there are many data and methodological problems in attempting to study the relationship between firms' environmental and economic performance. Ullman (1985) attributed inconsistencies in results concerning general corporate social responsibility and economic performance to lack of theory, inappropriate definition of key terms,

¹³⁵ Hart, S L & Ahuja, G. 1996. Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. *Business Strategy and the Environment*, volume 5. Pages 30-37.

¹³⁶ Cropper, M L & Oates, W E. 1992. Environmental economics: A survey. *Journal of Economic Literature*, volume 30, June. Pages 675-740.

¹³⁷ Lankoski, L & Lankoski, J. 1999. Economic globalisation and the environment. *The Finnish Environment 336*. Helsinki, Ministry of the Environment. 66 pages. Page 43.

¹³⁸ OECD. 1993. *Environmental policies and industrial competitiveness*. Paris.

¹³⁹ Esty, D. 1996. *Environmental regulation and competitiveness*. Paper presented at the Asia Conference on Trade and the Environment, organised by the National University of Singapore and the Global Environment and Trade Study, June 27-28, Singapore.

¹⁴⁰ Fredriksson, P G. 1997. *Why don't environmental regulations influence trade patterns?* Paper presented at the European Association of Environmental and Resource Economists (EAERE) conference, Tilburg University, June 26-28.

¹⁴¹ Long, B L. 1995. Global competition: the environmental dimension. *Business Economics*, April. Pages 45-50.

and deficiencies in the available empirical databases.¹⁴² On the same subject, Aupperle et al. (1985) found the following weaknesses: lack of valid measures of performance, no testing of significance, no adjustment for risk, small samples, subjectively selected and biased samples, short time period, and failure to identify curvilinear relationships.¹⁴³ All these problems can also be identified in studies on environmental and economic performance. The remainder of this section will take a critical look at data and methodology issues in the reviewed studies.

There has been some discussion on whether accounting or stock market data should be used to measure economic performance, and which particular indicators within each type ought to be employed. This is such an important issue that it was used as the basis of dividing the cross-sectional empirical studies in the present review to accounting-based, stock-market-based, and other studies.

Davidson and Worrell (1990) contend that accounting measures are inappropriate in large cross-sectional comparisons that relate corporate social responsibility and financial performance across industries and across time. They note that, first, there are general problems with accounting data that relate to industry and regulatory differences, accounting and demographic differences, risk, leverage, inflation, and timing. Second, particular accounting measures of economic performance also carry with them specific problems. For example, net income is not comparable between firms, and return on equity is highly sensitive to debt usage. Thus, studies using accounting data should control at least for industry, leverage and risk. Studies based on stock market data need to control only for risk.¹⁴⁴

McGuire, Sundgren and Schneeweis (1988) note that accounting measures tap only historical performance, are subject to manipulation allowed by different accounting procedures, and would need to be adjusted for risk, industry, and other characteristics. Stock-market-based measures, on the other hand, reflect a firm's expected future economic performance, and are less susceptible to manipulation.¹⁴⁵ According to Cordeiro and Sarkis (1997), accounting measures are retrospective, noisy, unidimensional, easily manipulated, ignorant of risk-taking differences, and imperfectly comparable because of idiosyncratic industry- and country-specific practices. However, stock-market-based measures are also noisy, and suffer from an

¹⁴² Ullman, A. A. 1985. Data in search of a theory: a critical examination of the relationships among social performance, social disclosure, and economic performance of U.S. firms. *Academy of Management Review*, volume 10, 3. Pages 540-557.

¹⁴³ Aupperle, K E, Carroll, A B & Hatfield, J D. 1985. An empirical examination of the relationship between corporate social responsibility and profitability. *Academy of Management Journal*, volume 28, 2. Pages 446-463.

¹⁴⁴ Davidson, W & Worrell, D. 1990. A comparison and test of the use of accounting and stock market data in relating corporate social responsibility and financial performance. *Akron Business and Economic Review*, volume 21, 3. Pages 7-19.

¹⁴⁵ McGuire, J, Sundgren, A & Schneeweis, T. 1988. Corporate social responsibility and firm financial performance. *Academy of Management Journal*, volume 31, 4. Pages 854-872.

information asymmetry between managers and stockholders.¹⁴⁶ Stock market data, obviously, are available only for listed firms.

Accounting data are unable to consider long-term impacts, but stock market data in principle reflect the present value of all future costs and revenues. This may be one reason why the studies based on stock market data tend to be more positive on the relationship between firms' environmental and economic performance. To a large extent, benefits are expected to arise from future customer requirements and from reductions in future liabilities, which are not yet reflected in accounting figures.

The present study argues that it is not appropriate to directly relate environmental performance to either accounting performance or stock market performance. Both types of studies suffer from a fundamental problem that is illustrated in Figure 6. What the studies ought to measure is the relationship (a): the link between environmental performance and environmental profit. Schaltegger and Figge (1998) refer to this very point when they note that environment-oriented business analysis cannot explain the overall commercial success of a firm; it can only analyse whether the firm's environmental performance has the general effect of increasing or reducing enterprise value.¹⁴⁷

However, in all studies that directly correlate environmental performance with economic performance – regardless of whether economic performance is measured through accounting or stock data – the dependent variable is not environmental profit but profit. The basic point remains the same even if profit is replaced by some other indicator. Instead of link (a), the studies examine link (b). Stock market studies based on the event study methodology avoid this particular problem but suffer from other problems as will be discussed later.

The implication of this is that the problem of confounders becomes serious. Because economic performance is a multicausal issue, the causal effect of any one factor cannot be that great. Moreover, it seems reasonable to believe that, at least in many cases, the magnitude of the non-environmental costs and benefits surpasses that of environmental costs and benefits. The contribution of environmental profit to overall profit is thus likely to get lost in the noise of all the other factors affecting profit. To get to the impact of environmental performance on economic performance, one should control for the effects that private non-environmental costs and benefits have on profit. However, in many of the studies, especially the earlier ones, little or no attempts were made to this end. It is very difficult to control for all the non-environmental factors affecting economic performance – in fact, the task is impossible because the determinants of economic performance are not exhaustively known.

¹⁴⁶ Cordeiro, J J & Sarkis, J. 1997. Environmental proactivism and firm performance: evidence from security analyst earnings forecasts. *Business Strategy and the Environment*, volume 6. Pages 104-114.

¹⁴⁷ Schaltegger, S & Figge, F. 1998. *Environmental shareholder value*. WWZ (University of Basel) Study 54. 39 pages.

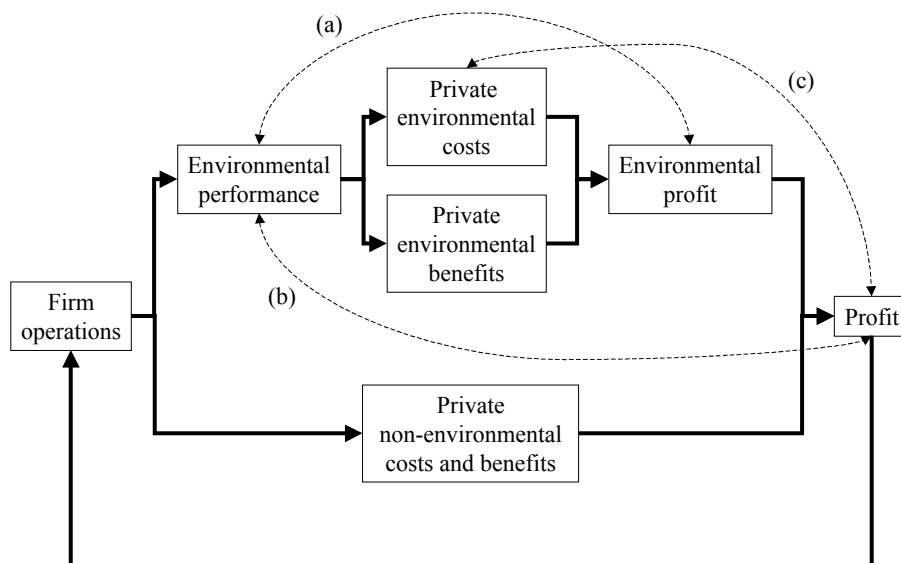


Figure 6 Links addressed in empirical studies on environmental and economic performance. Instead of link (a), many studies address links (b) or (c)

Furthermore, many of the studies contain conscious or subconscious assumptions with the consequence that environmental costs become a proxy for environmental performance and the studied relationship is in fact link (c) in Figure 6. Sometimes environmental performance is measured through cost-based measures. Often, potential private benefits from environmental performance are ignored. Occasionally, there are explicit assumptions that by definition rule out some or all win-win possibilities. For example, in Sjöblom's (1994) data environmental investments were defined to be such that they do not fulfil general economic investment criteria.¹⁴⁸ Brännlund et al. (1995) imposed weak disposability of pollution, thus effectively assuming negative impacts.¹⁴⁹ Since Hetemäki (1996) did not a priori restrict shadow prices to be negative as was done in previous similar studies, he allowed for win-win situations resulting from cost savings in his model. However, potential benefits arising from customer preferences for environmentally friendly products were still not included in his model.¹⁵⁰

As noted, a stock-market-based study utilising the event study methodology can help overcome the problem of confounders. If the event window is short and other

¹⁴⁸ Sjöblom, M. 1994. *Yrityksen ympäristöystävällisyys ja liiketaloudelliset tunnushuvut*. Master's thesis, Helsinki School of Economics and Business Administration.

¹⁴⁹ Brännlund, R, Färe, R & Grosskopf, S. 1995. Environmental regulation and profitability: An application to Swedish pulp and paper mills. *Environmental and Resource Economics*, volume 6. Pages 23-36.

¹⁵⁰ Hetemäki, L. 1996. *Essays on the impact of pollution control on a firm: A distance function approach*. Finnish Forest Research Institute, Research Papers 609.

simultaneous events are ruled out, the impact of environmental performance on economic performance can be isolated and the relationship (a) in Figure 6 seized. But, since the use of the event study methodology requires that a single event can be identified, and since only new information will be reflected in share prices, its applicability to measuring the impacts of regular day-to-day activities may be reduced.¹⁵¹ For example, Konar and Cohen found that firms experiencing the largest stock price impacts upon the release of pollution information were not necessarily those with the highest quantities of pollutant emissions, because the market was already aware of the level of pollution of the largest emitters.¹⁵² Cormier et al. (1993) criticise event studies on the basis that much of the environmental information may reach the markets before formal announcements, which makes establishing an event date speculative. And, the short-term shifts in share values revealed by event studies do not necessarily imply the existence of a long-term impact.¹⁵³

Moreover, the event study methodology is based on the efficient market hypothesis. If this hypothesis holds, stock prices represent the present value of future cash flows, and thus measure the economic performance of a firm. However, if the hypothesis does not hold – for example, if the stocks do not trade frequently enough – stock prices rather represent investors' perception of future stock price development, which may or may not correctly reflect the economic performance of a firm. Davidson and Worrell (1990) note that it is possible that customers and investors react to different stimuli.¹⁵⁴ Then, a perception that good environmental performance positively affects share price can easily become a self-fulfilling prophecy. If, for any reason, a widespread belief emerges among investors that environmental performance and stock market performance are positively related, news of good environmental performance will translate into a higher share price. If this is the case, the only fact proven by studies relating environmental performance to increased share price is that investors believe there to be a positive relationship. Kvale (1996) has noted that according to the Thomas theorem, even empirically false beliefs may have real social consequences.¹⁵⁵

If the measurement of economic performance is not straightforward, neither is the measurement of environmental performance. The two most common ways of measuring environmental performance in the reviewed studies are based on emissions data from the U.S. Toxics Release Inventory (TRI), and some kind of third-party

¹⁵¹ See also Cochran, P L & Wood, R A. 1984. Corporate social responsibility and financial performance. *Academy of Management Journal*, volume 27, 1. Pages 42-56.

¹⁵² Konar, S & Cohen, M A. 1997. Information as regulation: the effect of community right to know laws on toxic emissions. *Journal of Environmental Economics and Management*, 32. Pages 109-124.

¹⁵³ Cormier, D, Magnan, M & Morard, B. 1993. The impact of corporate pollution on market valuation: some empirical evidence. *Ecological Economics*, 8. Pages 135-155.

¹⁵⁴ Davidson, W & Worrell, D. 1990. A comparison and test of the use of accounting and stock market data in relating corporate social responsibility and financial performance. *Akron Business and Economic Review*, volume 21, 3. Pages 7-19.

¹⁵⁵ Kvale, S. 1996. *InterViews. An introduction to qualitative research interviewing*. Thousand Oaks, Sage Publications. 326 pages. Page 223.

environmental rating, usually that of the Council on Economic Priorities (CEP) that has been available on certain U.S. firms.

Measuring environmental performance through TRI emission data can be considered to give a correct, albeit limited picture of the true physical impact of a firm on the natural environment. However, all of the studies using TRI data commit the crucial flaw of simply summing up various emissions by weight, even though the toxicity and the volumes of the emissions differ widely. This is perhaps done because no established valuation method for the different environmental impacts exists. But, as Helminen (1998) notes, "it must be recognised that also a decision not to value chemicals with strikingly different properties is indeed valuation."¹⁵⁶

Reputation indices or environmental ratings risk being subjective. They also are often proprietary and thus hard to evaluate. Some other ways of measuring environmental performance, such as reductions in emissions, environmental costs, and environmental disclosures, were already critically discussed in section 2.1.

Selecting the appropriate research unit is also not simple in studies relating environmental and economic performance. The analysis is complicated by the fact that legal, physical, and economic entities are often different. Environmental performance data are usually available on physical entities, such as plants. It would be better not to aggregate environmental performance data across physical entities unless the scope of the environmental problem – local, regional, or global – matches the scope of the aggregation. Depending on the country and issue, environmental regulations may also be issued at the plant level.

Economic performance data, by contrast, are usually available on economic entities and reported on legal entities. More often than not, these are different from the physical entities. Plant-level economic performance data would match the environmental performance data best, but are seldom available. Company-level economic performance data may be unreliable because corporations may influence them, for example, for taxation reasons, or because the financial health of the parent corporation may affect environmental performance investments in individual companies. Corporate-level economic performance data, on the other hand, are problematic because a large share of the economic performance may relate to non-polluting activities, or foreign units whose environmental performance is unknown.

The questions of sample size and sample selection arise with many studies. The early studies were based on very small samples. Moreover, the case studies suffer from a self-selection bias. Cases abound of firms who voluntarily undertook environmental performance improvements that turned out to be profitable. However, if only expectedly profitable activities are voluntarily undertaken, the selection is biased. Palmer et al. (1995) argue that it would be easy to assemble a matching list of case

¹⁵⁶ Helminen, R-R. 1998. Eco-efficiency in the Finnish and Swedish pulp and paper industry. *Acta Polytechnica Scandinavica* 90. Espoo. 183 pages. Page 68.

studies where costs were increased and profits were reduced because of environmental improvements.¹⁵⁷ Walley and Whitehead (1994) point out that firms, eager to demonstrate their commitment to environmental protection, have been active in making the success stories known.¹⁵⁸ It is also worth noting that most of the previous studies include only large firms in their samples, and the stock-market-based studies, necessarily, cover only listed companies.

Causality considerations would also deserve more attention. Alternative explanations, like reversed causation, reciprocal causation, or causation by a third factor have not always been ruled out. For example, not all studies have included the possibility of a feedback link from economic performance to environmental performance. Christmann (2000) notes that causality cannot be established on the basis of the case studies since their sampling does not vary on the dependent variable.¹⁵⁹

It is usually considered that cause must precede effect in time. However, the direction of causation may not be definitely proven even if one measures subsequent instead of prior or concurrent profitability. This is because knowledge of the cause can precede the effect in time even if the actual cause does not. In other words, a firm may have knowledge of good economic prospects for the next couple of years, which may encourage it to undertake certain environmental performance improvements.

When environmental performance activities are undertaken, adaptation at the firm level occurs to soften the eventual adverse economic impacts. Thus, the studies show before-after comparisons and not with-without comparisons: opportunity costs are not taken into account. This criticism is often directed at case studies. For instance, Palmer et al. (1995) note that even if investment in environmental performance paid for itself, opportunity costs of forgone return are still there, because the money could have been spent somewhere else with a 20 per cent return rate.¹⁶⁰ However, this problem can hardly be overcome since the impacts cannot be observed *ceteris paribus*.

One significant aspect that has received scant attention in previous empirical studies is the possible non-uniformity of the relationship between environmental and economic performance. If there are factors affecting the relationship, it is possible that certain findings hold only for a subgroup of the sample but are cancelled out in the total sample. Studying aggregate samples would in such cases lose information. Already in 1978, Ingram found that whether firms' social responsibility disclosures had a market

¹⁵⁷ Palmer, K, Oates, W E & Portney, P R. 1995. Tightening environmental standards: the benefit-cost or the no-cost paradigm? *Journal of Economic Perspectives*, volume 9, 4. Pages 119-132.

¹⁵⁸ Walley, N & Whitehead, B. 1994. It's not easy being green. *Harvard Business Review*, May-June. Pages 46-52.

¹⁵⁹ Christmann, P. 2000. Effects of "best practices" of environmental management on cost advantage: the role of complementary assets. *Academy of Management Journal*, August, forthcoming.

¹⁶⁰ Palmer, K, Oates, W E & Portney, P R. 1995. Tightening environmental standards: the benefit-cost or the no-cost paradigm? *Journal of Economic Perspectives*, volume 9, 4. Pages 119-132.

impact was conditional on the market segment. Thus, Ingram noted, rather than conduct studies on a general cross-section of firms, it was important to analyse the impacts on market segments or segments identified by firm-specific characteristics.¹⁶¹

Nevertheless, empirical research on firms' environmental and economic performance has allowed little scope for the possible non-uniformity of the link to emerge. Some potential factors affecting the relationship have been explicitly proposed; several others can be inferred from the literature. The most common ones are industry and firm size, but others include firm and industry growth rate, environmental performance, economic performance, environmental issue, abatement method, plant vintage, consumer contact, capital intensity, industry concentration, production process, R&D intensity, and social pressure. However, the approach has been fragmented and unsystematic, and in very few cases the factors affecting the relationship have been the actual focus of investigation. Studies classified under "other quantitative studies" in the present review have paid the most attention to the possible non-uniformity of the link, and they have also tended to find variation in the relationship between firms' environmental and economic performance.

Finally, methodologies that are based on discovering linear relationships may not be suitable if the relationship is in fact curvilinear in its form.

In sum, general methodological sophistication has increased dramatically over the many years that the firm-level relationship between environmental and economic performance has been investigated. Yet, several problems remain that decrease the confidence with which the results of previous empirical studies can be viewed.

3.3.3 *Gaps and expected contribution*

Building on previous literature, the present study attempts to fill certain gaps and pay special attention to some problems that have emerged.

On the theoretical side, a systematic and consistent theoretical model is lacking that is able to accommodate the arguments of both sides as well as the conflicting empirical evidence. The model should also be explicitly developed to address the firm-level relationship between environmental performance, instead of environmental regulations, and economic performance. To accomplish this, the following extensions are made to previous theory:

- The traditional neoclassical framework needs to be extended to take into account the possibility of private market benefits to firms from environmental performance.

¹⁶¹ Ingram, R W. 1978. An investigation of the information content of (certain) social responsibility disclosures. *Journal of Accounting Research*, volume 16, 2. Pages 270-285.

- The Porterian framework needs to be extended to take into account that the relationship may not be constant across environmental performance levels, which means that it should be considered a function of environmental performance.
- The Porterian framework also needs to be extended to take into account that the relationship may not be uniform across cases, wherefore a systematic analysis of the conditions on which the relationship may depend is required. Such work is only now starting to emerge, exemplified by Reinhardt (1999b).¹⁶²

On the empirical side, the study attempts to improve upon some of the previous studies in a few respects regarding data and methodology.

First, the study allows for possible reciprocal causality between environmental and economic performance, possible non-linearity of the relationship, as well as possible non-uniformity of the relationship. The latter receives special focus.

Second, even if past correlations between environmental and economic performance could be appropriately measured, they are of little value for predicting impacts under future circumstances unless there is also some insight into the mechanisms producing the correlation. Speaking about social performance and economic performance, Ullman (1985) noted that "rather than accumulating studies and trying to control for an increasing number of variables, another research direction is advisable ... what should be looked for is the missing element that, when included in the model, would help to explain the varying nature of the relationships ... thereby making it possible to forecast the circumstances under which correlations and their directions can be expected."¹⁶³ The present study places special emphasis on identifying and understanding the mechanisms affecting the relationship between environmental and economic performance.

Third, environmental performance is measured through actual physical emission data, but these are not aggregated across emissions. Moreover, studies have been consistent in showing that regulations are the most important driving force of improved

¹⁶² Reinhardt, F L. 1999b. *Down to earth: applying business principles to environmental management*. Boston, Harvard Business School Press. 291 pages.

¹⁶³ Ullman, A A. 1985. Data in search of a theory: a critical examination of the relationships among social performance, social disclosure, and economic performance of U.S. firms. *Academy of Management Review*, volume 10, 3. Pages 540-557.

environmental performance.¹⁶⁴ The present study is of interest since, through overcompliance, it is able to abstract from the impacts of regulation.¹⁶⁵

Fourth, impacts of environmental performance on economic performance are measured indirectly through overcompliance and management perceptions. The measurement relies on observed as opposed to stated behaviour. This approach avoids the problems of accounting and stock-market-based studies, and is able to examine isolated impacts on environmental profit (link a in Figure 6, above). It is also able to take into account both short-term and long-term impacts on economic performance. Moreover, since managers have access to more information than investors or analysts, problems of information asymmetry are avoided.

Fifth, the sample is inclusive. Both ends of the compliance continuum, non-complying and overcomplying plants, are present. The sample includes both listed and unlisted companies, and both small and large firms. The panel data set in the statistical module is relatively long and wide, with 9 years and 108 plants. Finally, since most of the previous studies are based on U.S. data, Finnish data are of interest and new.

Overall, the expected contribution of the present study is to improve both theoretical and empirical understanding of the firm-level relationship between environmental and economic performance. The three main gaps in the previous knowledge of the subject that the present study focuses on are the following:

- The relationship may not be constant across environmental performance levels, which means that it needs to be considered a function of environmental performance.
- The relationship may not be uniform across cases, which means that the determinants of environmental profit need to be identified.
- The relationship may not be static across time, which means that changes in the determinants of environmental profit over time need to be discussed.

¹⁶⁴ See, for example, Baylis, R, Connell, L & Flynn, A. 1998b. Company size, environmental regulation and ecological modernization: further analysis at the level of the firm. *Business Strategy and the Environment*, 7. Pages 285-296.

¹⁶⁵ Dasgupta et al. (2000) argue that there must be other abatement incentives than conventional enforcement to explain the fact that many plants in developing countries comply with environmental regulations even if enforcement is weak or nonexistent. What the present study grasps through overcompliance, Dasgupta et al. thus seize through focusing on compliance under weak enforcement. Dasgupta, S, Hettige, H & Wheeler, D. 2000. What improves environmental compliance? Evidence from Mexican industry. *Journal of Environmental Economics and Management*, 39. Pages 39-66.

4 A THEORETICAL APPROACH

The preceding literature review pointed out that more attention ought to be paid to the possibility that the firm-level relationship between environmental and economic performance is not constant across environmental performance levels. For example, firms that have derived net economic benefits from improving their environmental performance may perhaps not continue to do so up to zero pollution or the socially optimal level of pollution.¹⁶⁶ Thus, the relationship may change as a function of environmental performance. This would explain why fears of future competitiveness impacts persist even though firms seem to have largely been able to adapt to the present levels of environmental protection.¹⁶⁷ Furthermore, the link between environmental and economic performance is not likely to be uniform across sectors, firms or pollutants, which may partly explain the lack of systematic empirical findings.

This chapter develops mathematically an environmental profit curve that represents the relationship between environmental performance and economic performance at the firm level. The curve is developed by extending the traditional neoclassical environmental economics framework to account for environmental private benefits. The result is a formal argument that the firm-level relationship between environmental performance and economic performance takes the form of an inverted U-shaped function of environmental performance. The chapter further shows how changes in determinants of environmental profit – either between cases or between time periods – are reflected in the environmental profit curve.

Note that throughout the chapter, for simplicity, the graphical presentations are based on linear marginal abatement cost and marginal private benefit curves. However, the mathematical treatment uses general functional forms. The results thus do not assume linearity but hold more generally. The basic points illustrated in the graphical presentations are also not changed even if the marginal abatement cost and marginal private benefit curves are nonlinear, as they probably are.

¹⁶⁶ Nehrt (1998) notes that this is why one should not expect to find a positive linear relationship but indeed an inverted U-shaped relationship between pollution reduction and cost reduction or sales enhancement. Nehrt, C. 1998. Maintainability of first mover advantages when environmental regulations differ between countries. *Academy of Management Review*, volume 23, 1. Pages 77-97.

¹⁶⁷ UNCTAD 1996. *The relationship of environmental protection to international competitiveness, job creation and development*. Background paper No. 21 for the Commission on Sustainable Development, Fourth Session, 18 April - 3 May, New York. Pages 4-5.

4.1 Socially optimal level of environmental performance

First, the standard treatment for determining the socially optimal level of environmental performance is presented.¹⁶⁸ To improve its environmental performance, a firm may invest in pollution abatement technology (the so-called end-of-pipe solution) or switch to cleaner inputs or processes (so-called pollution prevention).¹⁶⁹ These alternatives may involve fixed and variable abatement cost elements. A firm may also reduce pollution or resource use by reducing output. In this case, the cost of the environmental performance improvement is the opportunity cost of forgone profits.¹⁷⁰

A firm's costs of environmental performance improvements are commonly described in terms of the marginal abatement cost (MAC) curve. It is defined as a measurement of the change in economic costs incurred by a firm when improving environmental performance using the least-cost method of abatement at some point in time.¹⁷¹ Here it is assumed that the costs of output reduction are already incorporated in the MAC curve. The shape and position of the MAC curve is source- and pollutant-specific, but a typical curve increases with improving environmental performance as in Figure 7. According to Cropper and Oates (1992), nearly all cost studies have shown the MAC functions to exhibit the typical textbook shape: "They are low and fairly flat over some range and then begin to rise, often quite rapidly. Both the first and second derivatives of these abatement cost functions are positive – and rapidly increasing marginal abatement costs often set in with a vengeance."¹⁷²

The counterpart of MAC in the establishment of socially optimal environmental performance levels is the marginal social benefits (MSB) curve. It measures the additional gains to society from improved environmental performance. These gains include, for example, improved health and ecological conditions, and typically decrease with increasing environmental performance.¹⁷³ Whereas the regulated firms carry the costs of environmental performance improvements, the benefits mostly accrue to society at large. Usually the firm directly experiences only part of the social benefits of environmental performance improvements, for example, in the form of improved worker health or quality of natural inputs. It is just this asymmetry that has

¹⁶⁸ See, for example, Baumol, W & Oates, W. 1988. *The theory of environmental policy*. Second edition. New York, Cambridge University Press.

¹⁶⁹ Jorgenson, D & Wilcoxon, P. 1990. Environmental regulation and U.S. economic growth. *RAND Journal of Economics*, volume 21, no. 2. Pages 314-340.

¹⁷⁰ Akashi, K & Yabe, M. 1994. *A note on the optimal level of pollution: Integrated approach to abatement and output reduction*. Research paper No. 12. National Research Institute of Agricultural Economics, Tokyo.

¹⁷¹ Callan, S & Thomas, J. 1996. *Environmental economics and management: theory, policy and applications*. Irwin. Page 112.

¹⁷² Cropper, M L & Oates, W E. 1992. Environmental economics: A survey. *Journal of Economic Literature*, volume 30, June. Pages 675-740. Page 730.

¹⁷³ Callan, S & Thomas, J. 1996. *Environmental economics and management: theory, policy and applications*. Irwin. Page 110.

resulted in the debate that environmental regulations might harm economic performance at the firm level.

Thus, $MAC = MAC(e)$ and $MSB = MSB(e)$, where environmental performance $e \geq 0$. Recall that environmental performance was defined so that the smaller the harmful environmental impact caused by a firm the better the environmental performance. The objective function for society is to maximise welfare W , that is, the sum of producer and consumer surplus

$$\underset{\{e\}}{\text{Max}} W = \int_0^E [MSB(e) - MAC(e)] de \quad (4-1)$$

The necessary condition for locating the maximum is obtained by setting $W' = 0$, that is, $MSB(e) - MAC(e) = 0$.¹⁷⁴ Thus, the socially optimal level of the decision variable environmental performance, e^{s*} , satisfies $MSB(e^{s*}) = MAC(e^{s*})$.

The sufficient condition for the maximum is obtained by setting $W''(e^{s*}) < 0$, that is, $MSB'(e^{s*}) - MAC'(e^{s*}) < 0$. Since MSB is a decreasing function of e and MAC is an increasing function of e , $MSB'(e^{s*}) < 0$ and $MAC'(e^{s*}) > 0$. The second order condition, therefore, holds and e^{s*} , where $MSB = MAC$, is the socially optimal level of environmental performance.

Hence, the familiar condition for Pareto-efficiency – a situation where it is impossible to make anyone better off without making someone else worse off – is obtained by equating marginal abatement cost with the marginal social benefit from environmental performance improvements. This is illustrated in Figure 7 by the intersection T.

The MAC curve was defined through the costs of environmental performance improvements using the least-cost method. In other words, the MAC curve organises pollution abatement alternatives in the order of increasing costs. It is possible that the MAC curve can take negative values in the beginning, as in Figure 7. The interpretation for the negative MAC values is that the firm is wasting resources or that the pollution generated disturbs the firm's own production processes.

¹⁷⁴ Throughout, derivatives are noted by primes and partial derivatives by subscripts.

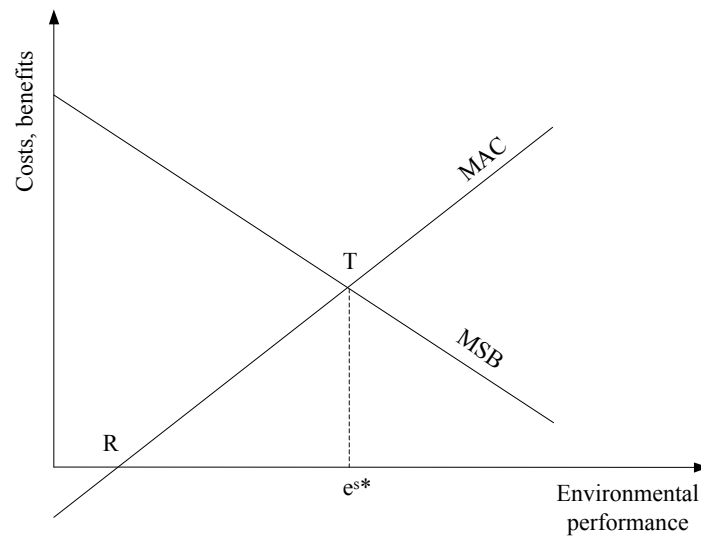


Figure 7 Determining the socially optimal level of environmental performance (e^{s*})

Theoretically, firms implement environmental performance improvements in the order prescribed by the MAC curve. In practice, however, this may not happen, due to lack of information, for instance, and firms can lie above their theoretical MAC curve.¹⁷⁵ Situations where firms suddenly discover cost-saving environmental performance improvements can thus be explained by the firms having implemented their previous environmental performance improvements “in the wrong order”. Another possible explanation is that the MAC curves shift in time with changing technology and regulations.

Being the Pareto-optimal solution, e^{s*} represents an efficient allocation of resources for environmental performance in society. Nevertheless, the solution may create resistance in individual firms. This is because in practice the criterion applied in cost-benefit analysis is usually the compensation criterion, meaning that those made better off by a policy could potentially compensate those made worse off.¹⁷⁶ In reality, such compensations are seldom implemented, which gives rise to distributional impacts

¹⁷⁵ For further reasons why rational economic agents may have overlooked cost-saving environmental investments, see Panayotou, T & Zinnes, C. 1994. Free-lunch economics for industrial ecologists. In: Socolow, R, Andrews, C, Berkhout, F & Thomas, V (editors). *Industrial ecology and global change*. Cambridge University Press. Pages 383-397. See also Gabel, H L & Sinclair-Desgagné, B. 1993. Managerial incentives and environmental compliance. *Journal of Environmental Economics and Management*, 24. Pages 229-240.

¹⁷⁶ Formally, consider two allocations, x and x' . According to the compensation criterion, x' is potentially Pareto preferred to x if it is possible to reallocate x' so that everyone prefers the reallocation to the original allocation x . Varian, H R. 1992. *Microeconomic analysis*. Third edition. New York, W. W. Norton & Company. 506 pages. Page 405.

even though the solution is efficient. Hence, while society benefits, individual firms may lose.

The standard treatment described above emphasises only the private costs of environmental performance improvements and assumes no environmental private benefits for firms. For the location of the social optimum this makes no difference, but for the private optimum it does. Without environmental private benefits, firms have an economic incentive not to exercise pollution control in the absence of regulations if pollution control has a positive cost. R in Figure 7 marks the level of environmental performance chosen by a firm under this view. The discrepancy between the socially optimal level of environmental performance and the level preferred by the firm is shown in the figure.

4.2 Privately optimal level of environmental performance

As already discussed, more recognition has recently been given to the possibility that firms may derive direct private benefits from environmental performance. If there are private economic benefits to be gained from environmental performance improvements, environmental performance investment decisions become more like other investment decisions for firms, with the present value of required costs compared to the present value of the flow of expected benefits. With environmental private benefits above environmental costs, firms have a private optimum for environmental performance exceeding R in Figure 7. Hence, it pays for the firm to improve its environmental performance to some extent, regardless of regulation and regardless of the social benefits. It thus becomes interesting to see where this private optimum of the firm is located. For this purpose, it is necessary to derive an environmental marginal private benefits (MPB) curve and integrate it in the standard treatment presented above.

The potential environmental private benefits can be divided into two groups. The first group consists of instances where the cost of an environmental performance improvement is negative. As discussed above, such instances may exist at the lowest levels of environmental performance. Alternatively, these efficiency benefits are interpreted as the firm moving towards its theoretical MAC curve. The second group consists of cases where the cost of an environmental performance improvement may also be positive, but where corresponding market benefits are obtained that can at least partly offset the cost. The MPB curve accounts for this type of environmental private benefits that accrue in the markets through customer preferences and, thus, demand.

Traditional microeconomic analysis assumes perfect competition with homogeneous offerings and many price-taking sellers. For example, Figure 4 in section 3.1.1 is based on this assumption. In such a case, the price is an exogenous parameter for the firm. Figure 5 in the same section removes the assumption of many price-taking

sellers, but keeps that of homogeneous offerings. The price and quantity of an offering may change, but there is no differentiation.

With differentiation, however, an offering enters a new private market with less intense competition. This increases the seller's price-setting freedom.¹⁷⁷ In effect, when price elasticity is reduced, the demand curve becomes more steeply downward-sloping. Allowing for differentiation thus allows for a downward-sloping demand curve that can explain the environmental private benefits. Since differentiation is, in practice, a crucial element of competitive strategy, the following treatment applies to such imperfect (monopolistic) competition.

Let price = p , quantity = q , and environmental performance = e . The firm's cost function is $c(q,e)$, and it faces an inverse demand function $p(q,e)$. Let $p_e > 0$ and $p_{ee} < 0$, signifying that the marginal private benefit from environmental performance provision is a downward-sloping curve as in Figure 8, panel b, below. Also, let $c_e > 0$ and $c_{ee} > 0$, corresponding to the upward-sloping shape of the marginal abatement cost curve as in Figure 8b.

The firm's profit maximisation problem is

$$\underset{\{q,e\}}{\text{Max}} \pi = p(q,e)q - c(q,e) \quad (4-2)$$

The first order conditions for profit maximisation are

$$\pi_q = p_q q + p - c_q = 0 \quad (4-3)$$

$$\pi_e = p_e q - c_e = 0 \quad (4-4)$$

Condition 4-3 tells us that, at the profit-maximising level of output, the marginal revenue from producing one more unit of the good must equal the marginal cost of producing the extra unit. Similarly, condition 4-4 shows that, at the profit-maximising level of environmental performance, the marginal revenue from improving environmental performance must equal the marginal cost of environmental performance provision.

The sufficient condition for the private optimum for environmental performance is

$$\pi_{ee} = p_{ee} q - c_{ee} < 0 \quad (4-5)$$

¹⁷⁷ Mathur, S S & Kenyon, A. 1997. *Creating value: shaping tomorrow's business*. Oxford, Butterworth-Heinemann. 451 pages.

Since $p_{ee} < 0$ and $c_{ee} > 0$, the second order condition holds, and e^{p*} , where $MPB(e) = MAC(e)$, is the privately optimal level of environmental performance. Figure 8 illustrates graphically the determination of q , e , and p .

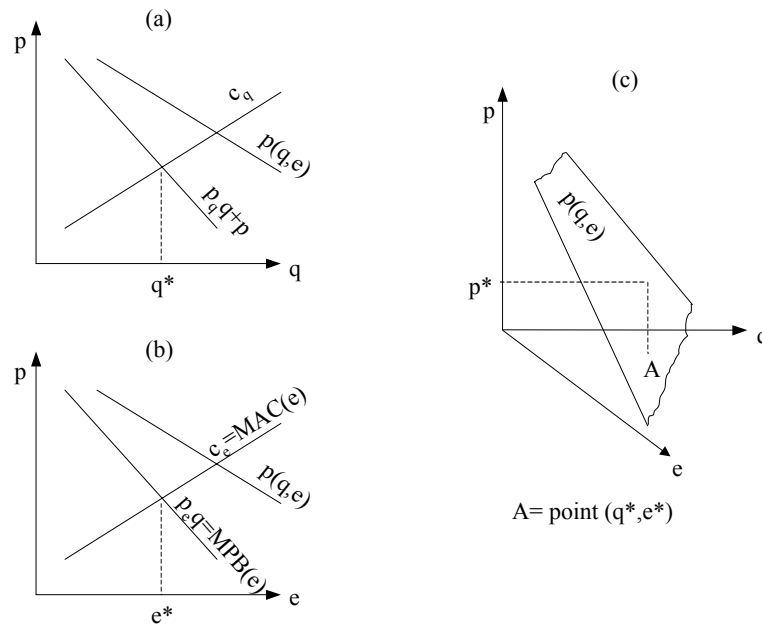


Figure 8 The determination of quantity (panel a), environmental performance level (panel b) and price (panel c) in the case of a profit-maximising firm with environmental differentiation. Panel b also shows the MAC and MPB curves

In Figure 9, the MPB curve is inserted in Figure 7. Two alternative situations are drawn in the figure. If the full value of social benefits does not accrue to the firm from the markets, the MPB curve lies below the MSB curve and the privately optimal level of environmental performance e^{p*1} is lower than the socially optimal level. On the other hand, if environmental private benefits exceed social benefits, the MPB curve lies above the MSB curve and the privately optimal level of environmental performance e^{p*2} is higher than the socially optimal level. The MPB curve could also be equal to the MSB curve, in which case the private and social optima would coincide. If the MPB curve takes the value of zero, that is, if no environmental private benefits are obtainable in the case analysed, the private optimum lies at point R.

In a situation where the private benefits from environmental performance exceed the social benefits, the profit maximisation objective of a firm leads to too high environmental performance from the social point of view. Such a situation is theoretically possible if, for example, customers overvalue certain investments in environmental performance. However, in such a situation there must be some other

party experiencing private costs from the environmental performance improvement; otherwise an increase in environmental private benefits for a firm would also increase the social benefits by the same amount.

Moreover, there is reason to believe that such cases are exceptions and that the rule is a situation where environmental private benefits fall short of social benefits. Both theory and empirical evidence support this assumption. Theoretically, because environmental quality is a public good and there is a failure in incorporating its value in the market system, private costs and benefits regarding the environment are only a subset of the full costs and benefits. In practice, since environmental problems are being felt in society, the level of environmental performance selected by unregulated firms must, in general, be too low and not too high. From now on, the present study will focus only on the situation represented by the curve MPB^1 . Note that even if the conflict between the firm's preferred level of environmental performance and the social optimum is not removed in this situation, it is nevertheless reduced compared to the point R where no environmental private benefits were accounted for.

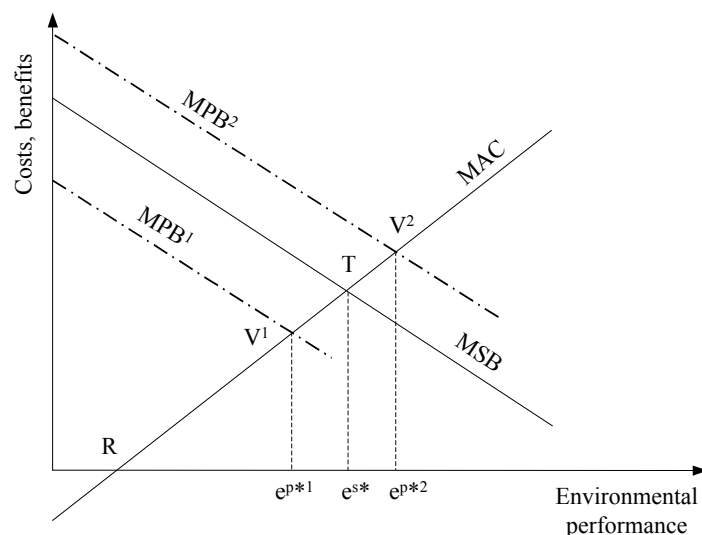


Figure 9 Determining the privately optimal level of environmental performance (e^p*)

Figure 9 discloses an interesting notion concerning the role of technology. Technological development shifts the MAC curve down. If there is sufficiently widespread diffusion of a technological innovation, this pushes the private optimum to the right.¹⁷⁸ But, at the same time, it also pushes the social optimum to the right. In other words, if environmental performance becomes less expensive, firms provide

¹⁷⁸ Milliman, S R & Prince, R. 1989. Firm incentives to promote technological change in pollution control. *Journal of Environmental Economics and Management*, 17. Pages 247-265.

more of it, but society also demands more of it: the social optimum escapes away.¹⁷⁹ The straightforward implication of this would be that in principle technological development cannot solve the underlying conflict between the social and private optima. If a solution is to be found, it must come from the markets and customer preferences. However, this statement must be qualified depending on the exact shapes of the MAC, MPB and MSB curves. There may well be thresholds or other irregularities that invalidate the above speculation.

4.3 Environmental profit and marginal environmental profit

Ignoring the social benefits, a firm's net benefit from environmental performance is its environmental profit. Environmental profit represents the firm-level link between environmental performance and economic performance. Some information on the environmental profit function can be obtained indirectly through examining the marginal environmental profit function.

Marginal environmental profit (MEP) is obtained by subtracting marginal abatement costs from marginal private environmental benefits. Formally, marginal environmental profit

$$MEP(e) = MPB(e) - MAC(e). \quad (4-6)$$

Since the slope of the marginal environmental profit curve

$$MEP'(e) = \underset{-}{MPB'(e)} - \underset{+}{MAC'(e)} < 0 \quad (4-7)$$

marginal environmental profit is a decreasing function of environmental performance, with the horizontal intercept at $MEP(e) = 0$.

The slope of the marginal environmental profit curve is simultaneously the second derivative of the environmental profit function. We know that if $f''(x)$ is negative for all x , then the primitive function $f(x)$ must be a concave function.¹⁸⁰ Correspondingly, the environmental profit function is concave and takes the form of an inverted U-shaped function of environmental performance.¹⁸¹

¹⁷⁹ Downing and White use the term “ratcheting” to describe the authorities making the appropriate adjustments in regulations as the marginal conditions change. Downing, P B & White, L J. 1986. Innovation in pollution control. *Journal of Environmental Economics and Management*, 13. Pages 18-29.

¹⁸⁰ Chiang, A. 1984. *Fundamental methods of mathematical economics*. Third edition. Singapore, McGraw-Hill. Page 243.

¹⁸¹ The environmental profit curve should not be confused with another inverted U-shaped curve relating environmental and economic variables, that is, the environmental Kuznets curve that depicts the suggested relationship between per capita income and environmental quality.

Figure 10 illustrates the environmental profit curve and the marginal environmental profit curve. The environmental performance of a firm with regard to a pollutant determines where on its environmental profit curve or marginal environmental profit curve the firm is located. To repeat, these curves incorporate the isolated costs and benefits resulting from environmental performance, even though these are in most instances likely to be dwarfed by the non-environmental costs and benefits of business. The curves thus show the direction of the link between environmental performance and economic performance, but not its relative magnitude.

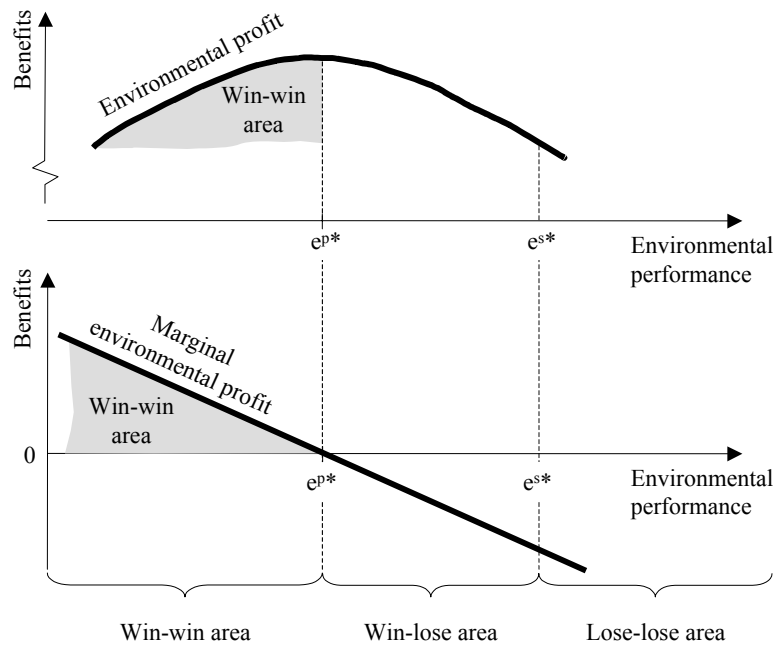


Figure 10 Environmental profit curve and marginal environmental profit curve. Note that maximal environmental profit may lie above, below, or at zero. An example of a possible location of the socially optimal level of environmental performance (e^{s}) is inserted in the picture*

The marginal environmental profit curve is not only useful to derive the environmental profit curve. Marginal values are also convenient to examine. Knowing one point on the environmental profit curve is not sufficient to tell whether the value is high or low, or whether the firm has passed its private optimum for environmental performance or not. By contrast, knowing one point on the marginal environmental profit curve suffices to determine whether the firm is located in the win-win area or not.

Based on Figure 10, it can be established that improving environmental performance is profitable for a firm up to the privately optimal level of environmental performance e^{p*} . At this point, marginal environmental profit equals zero and total environmental profit is maximised. Any further investments in improving environmental performance would decrease profit, but any fewer investments would leave profitable opportunities unused. The area up to the point e^{p*} represents a win-win area where

improving environmental performance benefits both the firm and society, and the drive for profit coincides with sustainable development objectives.¹⁸² Only in the win-win area do profit-maximising firms voluntarily undertake environmental performance improvements.

The fact that there is a turning point in the environmental profit curve renders understandable the conflicting empirical evidence of the profitability of environmental performance improvements. Positive cases can be found in firms that are in the rising portion of their environmental profit curve, and negative cases in firms that are in the falling portion of their environmental profit curve. It may be difficult for firms to perceive their entire environmental profit curve at once; what is usually perceived is only the region around the current location.

An example of a possible location of the socially optimal level of environmental performance is inserted in Figure 10 to enable a further analysis of the different outcomes. The social optimum is located based on the assumption discussed earlier that, in most cases, the socially optimal level of environmental performance is higher than the privately optimal level.

Environmental performance improvements occurring between the private optimum e^p^* and the social optimum e^s^* represent a win-lose situation: society gains when a firm moves towards the socially optimal level of pollution, but the individual firm loses as it is exceeding its private optimum for environmental performance. Environmental performance improvements beyond the social optimum e^s^* represent a lose-lose situation. The level of environmental performance is too high both from the firm's and society's perspective. How the latter is possible is explained by a misallocation of resources. Elsewhere employed, the resources needed to achieve the high environmental performance would have produced more environmental or other benefits.

Table 4 summarises some key points on profit, environmental profit, and marginal environmental profit. A summary of environmental profit under various competitive assumptions is shown in Appendix I.

¹⁸² These results are in line with those of van Ewijk and van Wijnbergen who modelled pollution and productivity and also found an inverted U-shaped relationship peaking at the optimal level of pollution abatement. They note that such a figure is useful in assessing the possibility of win-win policies: an increase in abatement can have a positive effect on net production only if initial abatement was suboptimal. Van Ewijk, C and van Wijnbergen, S. 1995. Can abatement overcome the conflict between environment and economic growth? *De Economist*, volume 143, 2. Pages 197-216.

Table 4 Summary of key points on profit, environmental profit, and marginal environmental profit

Concept	Notation	Technical description	Economic description	Graphical form
Profit	π	Function of several variables, one of which is environmental performance	Measure of overall economic performance	N-dimensional surface with unknown shape
Environmental profit	EP	Subset of profit; function of environmental performance	Measure of the impact of environmental performance on economic performance	Concave curve
Marginal environmental profit	MEP	Partial derivative of profit and first total derivative of environmental profit; function of environmental performance	Measure of the impact of environmental performance on economic performance at the margin	Curve with a negative slope

4.4 Impacts of changes in MAC and MPB curves

The chapter has until now described the relationship between environmental and economic performance in terms of the passage of a firm along its environmental profit curve (point moving on curve). This discussion addressed the need, identified from previous literature, to consider the possibility that the relationship is not constant across environmental performance levels.

However, two other important gaps in the previous literature were the possible non-uniform and non-static properties of the relationship. The environmental profit curve was determined based on the costs of environmental performance improvements, represented by the MAC curve as well as the market benefits available from such improvements, represented by the MPB curve. Factors that cause shifts in the underlying MAC and MPB curves – in effect, determinants of environmental profit – are immediately reflected in the marginal environmental profit curve and thus in the environmental profit curve itself (curve moving in space). Consequently, the determinants of environmental profit influence the location of the privately optimal level of environmental performance and the size of the win-win area.

Case-specific differences in determinants of environmental profit produce variation in the relationship between environmental and economic performance across cases. And, time-specific changes in these determinants produce variation in the relationship over time. For example, the recently observed increase in corporate environmentalism may be explained, even without any fundamental change in the profit maximisation

objective of firms, by a shift in customer preferences and the resulting MPB curve. The following discussion applies equally to changes in MAC and MPB curves between cases or across time.

In general terms, the single most obvious source of changes in the MAC curve is technology. Improved environmental technology reduces c_e and thus shifts the MAC curve down, and the privately optimal level of environmental performance increases. Similarly, the single most important source of changes in the MPB curve is preferences. Increased customer preferences for the environment increase p_e , shift the MPB curve up, and the privately optimal level of environmental performance again increases. Both these results are straightforward and are illustrated in Figure 11.

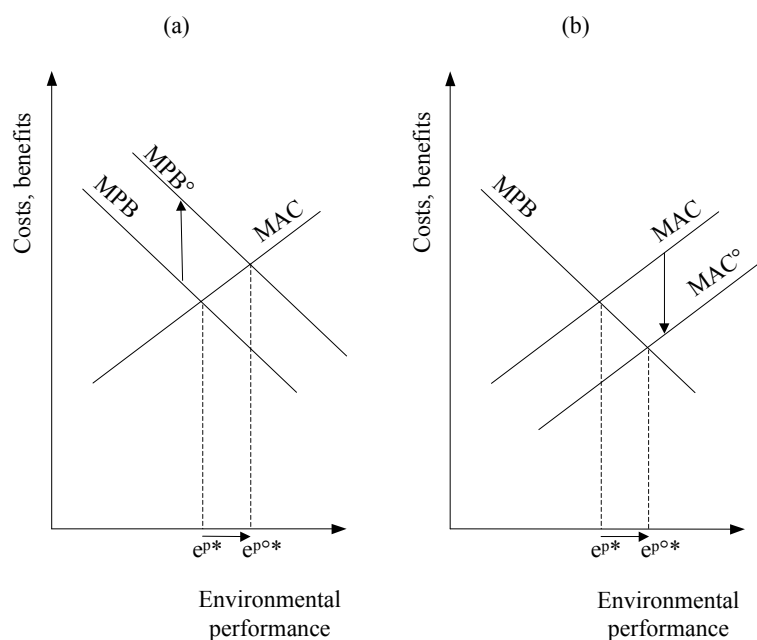


Figure 11 Impacts of an increase in environmental preferences (panel a) and an improvement in environmental technology (panel b) on the privately optimal level of environmental performance

Introducing regulations brings one more important source of shifts in the environmental profit curve into the picture. It is obvious that economic instruments such as environmental taxes directly affect the costs and benefits of environmental performance. For example, an emission tax may change both the shape and location of the cost curve. However, command-and-control instruments also affect costs through fines or other sanctions from non-compliance.

4.5 Discussion

The objective of the chapter was to theoretically derive and present the firm-level relationship between environmental and economic performance. The chapter does not claim to break new theoretical ground in the sense that it is entirely based on standard procedures. Nevertheless, the resulting environmental profit curve is an original and useful tool that helps to clarify thinking about the firm-level relationship between environmental and economic performance.

Environmental profit represents the contribution of one particular element, environmental performance, to profit. It should be re-emphasised that the environmental profit curve incorporates any and all private costs and benefits that relate to environmental performance. Hence, by definition, there can be no trade-offs between environmental profit and "non-environmental profit". Put differently, there may well initially have been trade-offs between environmental performance and some other product attributes, but these are already counted in the costs and benefits of environmental performance. The isolation of costs and benefits to components that relate to environmental performance and components that do not is important. It guarantees that when environmental profit is maximised, total profit is also maximised, *ceteris paribus*. Such isolation can, of course, only be made in the abstract.

The chapter suggests that the relationship between environmental performance and economic performance is a polluter- and pollutant-specific, inverted U-shaped function of environmental performance. It shows that win-win situations are conceivable, but present only under certain circumstances and not necessarily permanent. The size of the win-win area is determined by the shape and location of the environmental profit curve. This, in turn, is determined by the underlying cost and benefit curves.

The chapter devoted some discussion to how determinants of environmental profit cause variation in the relationship between environmental and economic performance across cases and over time. Next, the empirical examination of such determinants follows.

5 A STATISTICAL APPROACH

The preceding theoretical module suggested that there is likely to be variation in the firm-level relationship between environmental and economic performance, caused by determinants of environmental profit that vary from case to case. In the literature review, this issue was also identified as a significant gap requiring further analysis. These notions give rise to the empirical question: What are the determinants of environmental profit?

In the present study, this empirical question has been divided in two parts. The first part, addressed in this chapter, is to identify the locus of variation in the relationship between firms' environmental performance and economic performance. Determinant identification efforts, to be undertaken in the case-study module, below, can be guided in the right direction if the relative importance of the sources of the variation is ascertained first. This is done through statistical analysis, using overcompliance of Finnish manufacturing plants with effluent discharge regulations as an empirical example.

Three questions will be posed to the statistical data. The first question is whether the empirical data show any signs of such systematic non-uniformity of the relationship as suggested by the theoretical module. The second question is, if there is evidence of non-uniformity, what is the relative importance of the sources of this non-uniformity? The third question is, at the level identified as the most important source of non-uniformity, which cases have exhibited the most and the least perceived win-win situations?

5.1 Overcompliance as perceived win-win situation

We cannot observe environmental profit or win-win situations from large-scale statistical data, but we can observe the decision to overcomply that coincides with a perceived win-win situation. Thus, win-win potential in the present module is measured through overcompliance with environmental regulations.

It is a crucial question whether overcompliance is a valid indicator of perceived win-win situations. The answer is that overcompliance is a sufficient but not necessary condition for perceived win-win situations. Assuming that the profit maximisation assumption holds, all overcompliance situations are perceived win-win situations, but all perceived win-win situations are not overcompliance situations. For example, if a perceived win-win situation is not implemented, overcompliance fails to materialise. Or, all aspects of environmental performance are not even regulated, wherefore there cannot be overcompliance.

It is also important to note that regulatory strictness, which affects the possibilities for overcompliance, may vary between plants. On the one hand, there are valid reasons for differences in regulatory strictness between two plants: their socially optimal levels of environmental performance may differ, for example, because of a different receiving water body. On the other hand, the permit limits may not represent the socially optimal level of pollution. This may be due to less than perfect information, transaction costs of regulation, and the political economy of regulation, like the influence of lobbying. Because the social optima are not known, it is not possible to separate the two effects in the present data and estimate whether for some plants the permits were further removed from the social optimum than for others. The presence of overcompliance, nevertheless, remains a valid indicator of a perceived win-win situation, but the reverse logic does not apply to the lack of overcompliance.

It is worth noting that even though the data will show that overcompliance has been widespread, the conclusion cannot be drawn based on the analysis in the present study that effluent discharge regulations have been too lax. Neither can it be concluded that the environmental performance of firms has been "good enough" from society's perspective. Such conclusions would require a study that compares the social costs and social benefits of environmental performance levels. The present study compares – indirectly through overcompliance – the private costs and private benefits of environmental performance levels. Thus, it cannot comment on the appropriateness of environmental regulations or of plants' environmental performance at all.

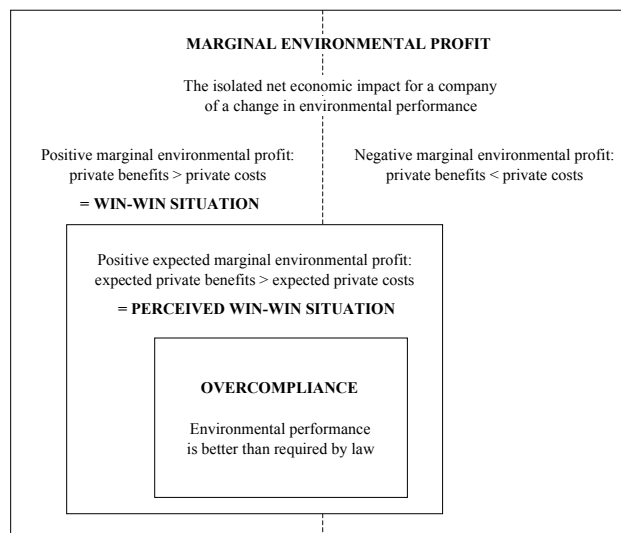


Figure 12 The relationship between marginal environmental profit, overcompliance, perceived win-win situation, and true win-win situation

Perceived win-win situations may coincide more or less with true win-win situations. Figure 12 illustrates the relationship between marginal environmental profit, overcompliance, perceived win-win situation, and true win-win situation. Although

less than a perfect indicator, on a large scale overcompliance is perhaps the only way to empirically observe perceived win-win situations from actual behaviour.

The above discussion of overcompliance as a sufficient indicator of a perceived win-win situation relied on the profit maximisation assumption. But can it safely be assumed that this assumption holds in the case of Finnish manufacturing plants and their compliance with effluent discharge regulations? Environmental performance improvements can, in principle, occur for a variety of reasons. One such reason is regulation. This reason can be ruled out here since, as noted, overcompliance cannot be mandated by regulation. Plants may overcomply in the anticipation of future regulations, but this is still voluntary. Overcompliance could be mandated by voluntary agreements between the government and business, but no such agreements have been in existence which could have influenced the data in the present study.¹⁸³ It could also be urged by participation in environmental management schemes such as the European Union Eco-Management and Audit Scheme (EMAS) or the ISO 14001 standard that promote continuous improvement, but the impact of these schemes has been felt in Finland only after the research period of the statistical module of the present study.

Another possible reason are ethical considerations that, in general, can be important motives for environmental performance improvements. However, in this specific case ethical considerations are likely to play a less significant role. This is because no activity that could result in water pollution may be carried out without a prior permit where environmental authorities specify effluent discharge limits that have been individually determined for that particular case. Overcompliance for ethical reasons would amount to a commentary by managers that ordinary compliance with these plant-specific effluent discharge limits would somehow be unethical. This may not be a convincing assumption on a large scale. If, on the contrary, many believe that emissions within legal limits are not especially harmful,¹⁸⁴ there would be no ethical reason to overcomply.

The remaining reason for overcompliance is that it is perceived to be good for the business. This motive corresponds to the profit maximisation assumption. The business benefits can be anticipated to arise from two main sources: from increasing the expected value of the operations, or from reducing the risk surrounding that expectation.¹⁸⁵

¹⁸³ COWI. 1997. *Study on voluntary agreements concluded between industry and public authorities in the field of the environment*. Final report and annexes. Prepared for the European Commission Directorate General III.01 - Industry.

¹⁸⁴ A confidential study in 1995 reported that this was a common belief among manufacturing firms. The study was conducted in EU countries prior to Finland's joining the EU.

¹⁸⁵ Reinhardt, F L. 1997. *Environmental quality and economic advantage: A framework for understanding corporate environmental management*. Harvard Business School Working Paper 97-071. 35 pages. Page 2.

Finally, overcompliance may not always be the result of a conscious strategy. It can also be unintentional. For example, investments in wastewater treatment are often of a bulky nature, or effluent discharges may be reduced as a by-product of a process change that has nothing to do with environmental objectives. Such cases do not present problems for the present study – they are excellent examples of win-win situations originating through the cost curve.

5.2 Model and hypotheses

The empirical model of factors affecting compliance is illustrated in Figure 13. Based on the theoretical module, because the MAC and MPB curves are source- and pollutant-specific and may shift in time, non-uniformity might be found between industries, firms, pollutants, and years. The unobserved individual factors behind the various measured groups of effects are not addressed at this stage. The objective is solely to identify the locus of variation, no matter how it was created.¹⁸⁶ Once the main sources of variation are identified, the next chapter will turn to seeking an understanding of the individual factors that produce the variation.

This approach was selected since there was incomplete a priori knowledge of the possible individual effects. Nominal measures of industry membership and so on are used to capture all of the unobserved individual effects, even if it is not yet known what they are. A few factors that may affect the relationship between environmental and economic performance have been suggested in literature, as discussed in section 3.3.2. However, explicit and systematic work on such factors was so limited that a gradual approach was judged necessary. This was considered all the more important because the mechanisms producing variation in compliance may be rooted deep in the business logic of the various plants and industries. Collecting manifest characteristics of firms – inevitably in a somewhat random manner in the absence of an established theory – and correlating them with compliance might not reveal much of the underlying mechanisms. By contrast, such hypothesis testing on a subject for which theory is not yet well developed risks resulting in premature rationalisation and oversimplification.¹⁸⁷

¹⁸⁶ This approach draws from the award-winning paper by Rumelt (1991) who used variance components estimation to find the locus of variation in business-unit returns. See Rumelt, R P. 1991. How much does industry matter? *Strategic Management Journal*, volume 12. Pages 167-185.

¹⁸⁷ Daft, R L. 1985. Why I recommended that your manuscript be rejected and what you can do about it. In: Frost, P & Cummings, L L (editors). *Publishing in the organizational sciences*. Homewood, Ill., Richard D Irwin, Inc.

Note that in the empirical model firm effects are approximated by plant effects. The economic concept of a "firm" refers to an autonomous competitive unit with a single offering, and is not synonymous with a "company".¹⁸⁸ The closest empirically observable approximation in this case was judged to be a plant. Whereas companies may operate within several industries, plants are defined to be production units that are usually owned by one company, located on one site, and produce goods of mainly one particular type.¹⁸⁹

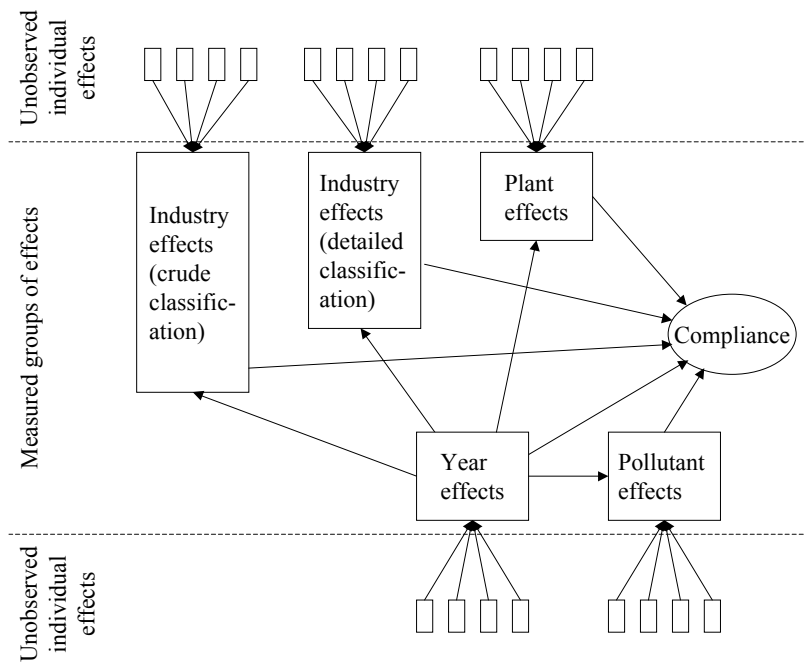


Figure 13 The empirical model of factors affecting compliance

The empirical model translates into the following hypotheses:

H1: There is variation in compliance between industries

H2: There is variation in compliance between plants

H3: There is variation in compliance between pollutants

H4: There is variation in compliance between years

¹⁸⁸ See, for example, Mathur, S S & Kenyon, A. 1997. *Creating value: shaping tomorrow's business*. Oxford, Butterworth-Heinemann. 451 pages. Page 73; or Rumelt, R P. 1991. How much does industry matter? *Strategic Management Journal*, volume 12. Pages 167-185.

¹⁸⁹ Statistics Finland. 1995. *Standard Industrial Classification*. Annex 3: Summary. 124 pages. Page 84.

5.3 Data

The empirical data consist of annual compliance situations with regard to effluent discharges in Finnish chemical forest industry, chemical industry, metal industry, and food industry plants. These industries are both environmentally and economically important in Finland. A compliance situation is created each time a plant faces an environmental standard (in this case, an effluent discharge limit that can be expressed as kg/a) to comply with. An attempt was made to cover all compliance situations during the research period 1988-1996. First, all plants with compliance situations in the studied industries were identified. Then, all compliance situations for the identified plants were listed.

In the Finnish environmental regulatory system, activities that may have significant environmental impacts fall under the environmental permit and notification scheme.¹⁹⁰ All plants in the selected four industries whose effluents were covered by this scheme were identified from the Industrial Waste Water Register and the VAHTI database of the Finnish Environment Institute, a research institute under the Ministry of the Environment. The resulting list covered all plants in the selected industries on mainland Finland that discharge liquid effluents into a water body. Plants discharging their effluents to a municipal sewage system were not covered by the data. Four "plants" – a prison metal workshop, an airport, an arms depot, and a hazardous waste treatment facility – were dropped from the list as they were judged not to represent manufacturing plants in the sense of the present study. Plants that had ceased to emit liquid effluents into a water body during the study period were also dropped. Finally, one plant was dropped from the analysis because its situation was a very particular one and its extreme compliance values would have had undue influence on the results.¹⁹¹ The final sample consisted of all plants in the selected four industries that discharged effluents into a water body in January 1997.

The detailed industry classification of the plants was taken from the Industrial Waste Water Register. This classification was preferred to the Standard Industrial Classification (SIC) especially as it provided a more detailed classification scheme for chemical forest industry: eight subgroups according to production technology, as opposed to only two (pulp production and paper and paperboard production) in SIC

¹⁹⁰ The discussion of the environmental regulatory system in Finland refers to the system that was in place during the research period of the present study. The environmental regulatory system was amended in early 2000 to make it compatible with the European Union Integrated Pollution Prevention and Control (IPPC) directive.

¹⁹¹ The plant does not discharge effluents; yet analysis of a nearby ditch shows high pollutant values. Neither the plant nor the authorities know where the pollutant load originates from. Outliers that occur as the result of an extraordinary event should be deleted from the analysis if the analyst decides that they do not represent a valid observation in the population. See Hair, J F, Anderson, R E, Tatham, R L & Black, W C. 1995. *Multivariate data analysis with readings*. Fourth edition. London, Prentice-Hall International, Ltd. 745 pages. Page 58.

1995.¹⁹² This more detailed classification may be relevant for the purposes of the present study.¹⁹³

Effluent discharges. Annual effluent discharge data for 1988-1996 were retrieved for the selected plants for all pollutants that could be expressed as kg/a.¹⁹⁴ The VAHTI emission database was obtained from the Finnish Environment Institute for this purpose. The emission figures in VAHTI are reported by plants as part of their monitoring obligations under the environmental permit and notification system. As the VAHTI database was still in the development process when the study began, specific measures were taken to ensure the quality of the data. Before the final statistical runs, the data were updated to reflect the status of VAHTI as of February 1999. In addition, the effluent discharges of each plant were graphically examined to detect possible errors. Suspect values were rechecked from the original discharge reports of the plants to the authorities. This procedure led to correcting or excluding roughly 0.3 per cent of the observations.

Permit limits. The Water Act of 1961 in Finland includes a ban on polluting water bodies. Obtaining a permit from the Water Rights Court is therefore a precondition for carrying out activities that may result in water pollution. When deciding whether to grant a permit to an industrial plant to emit effluents into a water body, the authorities conduct a weighing of interests and a weighing of costs. (This does not, however, constitute a cost-benefit analysis on a national economic basis.) The permit is granted if the damages caused are relatively small compared to the benefits obtained, and if it is not otherwise possible to eliminate the discharge at a reasonable cost. The permit usually contains provisions specifying, inter alia, effluent discharge limits and monitoring and reporting requirements.¹⁹⁵

Those of the plants that were holders of a Water Rights Court effluent discharge permit were identified and their effluent discharge permits for the period 1988-1996 were traced and studied at the archives of the Finnish Environment Institute. For some plants with minor effluent discharges, prior notification or a permit from a local authority may suffice. Such permits may also include effluent discharge limits, but they are not covered in the present study, only Water Rights Court effluent discharge permits. There is one exception, however: a plant that held permits from the Finnish-Swedish Border River Commission was included in the study. In this case, the lack of a Water Rights Court effluent discharge permit was due not to the nature of the effluent discharges but to the geographic location of the plant. In three cases, effluent

¹⁹² Statistics Finland. 1995. *Standard Industrial Classification*. Annex 3: Summary.

¹⁹³ Also McGahan and Porter (1997) note that SIC industries primarily err in being too broad; data with finer industry classification would better bring out the influence of industry. McGahan, A M & Porter, M E. 1997. How much does industry matter, really? *Strategic Management Journal*, volume 18. Pages 15-30.

¹⁹⁴ Including, for example, Al, AOX, BOD, COD, Hg, Cd, P, Cr, N, Cu, Pb, Ni, Fe, Zn, and 25 others.

¹⁹⁵ Kuusiniemi, K. 1993. Environmental law. In: Pöyhönen, J (editor). *An introduction to Finnish law*. Helsinki, Finnish Lawyers' Publishing.

discharge data for two or three chemical forest industry plants were aggregated because the plants were treated as an entity in Water Rights Court permit decisions. The detailed sector for these cases was coded as "other forest industry integrates".

Effluent discharge standards and effluent discharge targets were compiled from the permit decisions and entered into the database containing the effluent discharge data. Effluent discharge standards are limit values that must not be exceeded under any circumstances. To provide plants with a reasonable margin for unexpected situations, effluent discharge standards may be set so that average effluent discharges under normal circumstances and careful operation of the effluent treatment plant remain somewhat lower than the standard limit. Effluent discharge targets, which are stricter than effluent discharge standards, are guideline values that may be temporarily exceeded. But, if effluent discharge targets are exceeded in a manner that cannot be considered temporary, the plant must notify the authorities and take measures to reduce the effluent discharges. To be conservative, when discussing permit limits and compliance, the present study always refers to limits that include both effluent discharge standards and effluent discharge targets.¹⁹⁶

All time-based effluent discharge limits were collected and expressed as kg/a. Limits expressed as kg/d were translated into kg/a using calendar days unless otherwise indicated in the permit decision. When effluent discharge limits changed during a year, a weighted effluent discharge limit was calculated for the year using the old and new permit limits weighted with their respective numbers of days in force. To determine these, the date of legal validity was established for all permit limits. The appeal period for the Water Rights Court decisions is two months. The appealed decisions were followed through the appeal process in the Water Court of Appeal and eventually the Supreme Administrative Court. The decisions by the Ministry of the Environment to postpone certain compliance deadlines were also taken into account. Finally, 57 plants were contacted by telephone to confirm details that could not be learned from the permit decisions.

Compliance. A compliance indicator was calculated from effluent discharge and permit data for all compliance situations. Those cases were excluded where regulating a particular pollutant had began or ceased during a year, and the plant thus operated under no discharge limit for part of the year. As all plants do not emit all pollutants, the 108 plants, 39 pollutants, and 9 years produced 2195 compliance situations in the final database.

Compliance was expressed as the percentage share of the actual effluent discharges in the permitted effluent discharges. Thus, compliance values exceeding 100 per cent indicate non-compliance. However, compliance values below 100 per cent do not

¹⁹⁶ Effluent discharge targets have been established for only ca. six per cent of the compliance situations in the data. Moreover, in half of these cases, there are no simultaneous effluent discharge standards. In the ca. three per cent of the compliance situations where both effluent discharge standards and targets exist, the targets range from 32 to 96 per cent of the standards.

automatically indicate overcompliance. The daily effluent discharges of a plant may fluctuate because of climatic conditions, variations in the quality of the raw material, and so on. If the effluent discharge measurement periods are short, effluent discharges must on the average be below permitted levels to ensure that permit limits are not exceeded.¹⁹⁷

The resulting variables in the final database and their measurement scales are shown in Table 5.

Table 5 Variables in the final database

Variable name	Variable label	Data type/ measurement scale
Independent variables		
CRUDSECT	Crude industry classification (4 levels)	Nonmetric/Nominal
DETAECT	Detailed industry classification (34 levels)	Nonmetric/Nominal
PLANT_#	Plant identification code (108 levels)	Nonmetric/Nominal
POLL_ID	Pollutant identification code (39 levels)	Nonmetric/Nominal
YEAR	Year (9 years)	Metric/Interval
EMITTED	Amount of pollutant emitted, kg/a	Metric/Ratio
PERMITTE	Amount of discharges permitted, kg/a	Metric/Ratio
Dependent variable		
COMPLIAN	Compliance (EMITTED/PERMITTE * 100%)	Metric/Ratio

Appendix II contains the detailed data description. An examination of the data in Appendix II reveals that there is, indeed, notable variation in COMPLIAN. For example, the ratio of the standard deviation to the mean of COMPLIAN is 2.36. This variation in compliance is investigated in the remainder of this chapter.

5.4 Methods

The data were analysed with the statistical software system SPSS[®] version 8.0. Before selecting the methods to be employed, the data needed to be examined for potential violations of the assumptions that several statistical techniques rely on: normality, homoscedasticity, linearity, and absence of correlated errors.

The high positive values for skewness and kurtosis for the dependent variable COMPLIAN (see Appendix II) suggest that the variable does not follow a normal distribution but is both substantially right-skewed and peaked. This is confirmed by the histogram in Figure 14, and by the Kolmogorov-Smirnov test with a Lilliefors significance correction that indicates significant departure from normality. The shape of the distribution may be understood against the fact that there is a restriction in the range of variation of the variable: the values cannot go below zero and should not – but sometimes do – exceed 100.

¹⁹⁷ See also Brännlund, R & Löfgren, K-G. 1996. Emission standards and stochastic waste load. *Land Economics*, volume 72, 2. Pages 218-230.

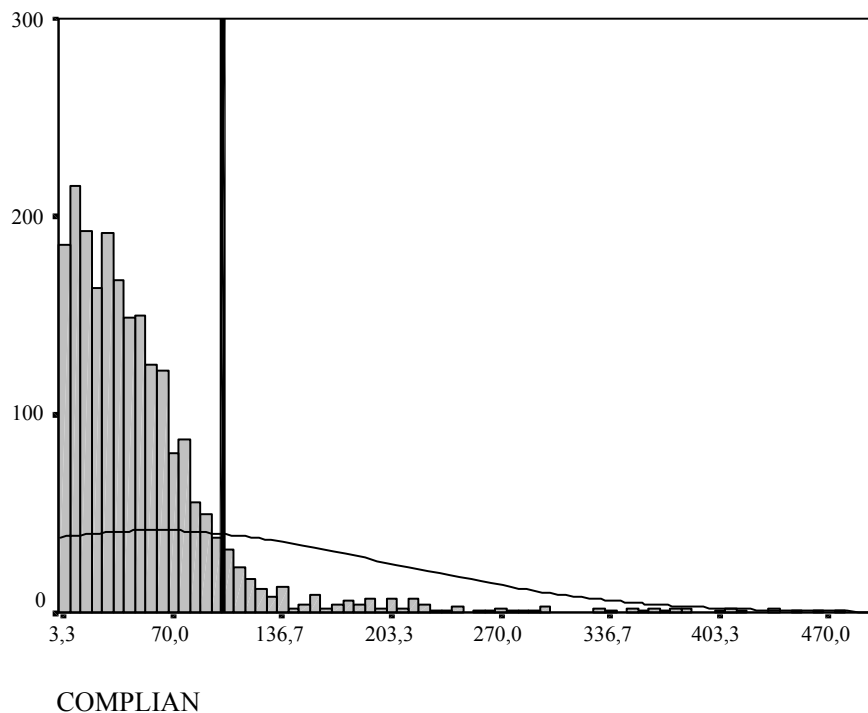


Figure 14 Histogram of the variable COMPLIAN. The horizontal axis is truncated. The vertical line of 100 per cent compliance is inserted for reference

According to Hair et al. (1995), normality and homoscedasticity for data that represent proportions are best achieved using the arcsin transformation, where the new variable equals two times the arcsin of the square root of the original variable expressed as a proportion.¹⁹⁸ Indeed, the arcsin transformation achieves normality for the variable COMPLIAN. However, all of the non-compliance observations will be missing in the new variable, because for them $\sqrt{(x/100)} > 1$ and the arcsin cannot be calculated. This would amount to a loss of 10 per cent of the data and introduce a definite bias to the results. If the data are rescaled so that no observations are missing, the resulting transformed variable is no longer normal.

Several other common transformations were experimented with, but none was able to remedy the nonnormality of the variable COMPLIAN. As normality is the most fundamental one of the assumptions of parametric statistical techniques, it was necessary to turn to non-parametric techniques. Although non-parametric techniques are not free from assumptions either, they do not place requirements for the

¹⁹⁸ Hair, J F, Anderson, R E, Tatham, R L & Black, W C. 1995. *Multivariate data analysis with readings*. Fourth edition. London, Prentice-Hall International, Ltd. 745 pages. Page 70.

underlying distributions. The downside of non-parametric techniques is that they are considered less powerful than parametric techniques.

The power of a statistical test, calculated as $1-\beta$, relates to the probability that statistical significance will be indicated if it is present. Beta (β) is the probability for a Type II error: failing to detect a statistically significant relationship even though it exists. When power is reduced, the probability for a Type II error increases. At the same time, however, the probability for a Type I error (α) decreases. In practical terms, α is the probability that statistically significant relationships are claimed when in fact there are none.¹⁹⁹ It was considered better to select tests that tend to understate the relationships rather than the opposite. With hindsight, it can be said that differences between groups were detected even with the less powerful non-parametric techniques.

The median test was used to test for differences in compliance between groups. Albeit less powerful than the commonly used Kruskal-Wallis test, the median test was preferred since it does not assume equal variances between groups – a restriction of the Kruskal-Wallis test that would be violated in this case. The median test assumes only that the observations are independent and random, and detects differences in both location and shape of the distribution between groups. The median tests were conducted separately for each year to prevent serial correlation from violating the independence assumption.

The median test first calculates an overall median for the sample, ignoring group membership. A $2 \times k$ contingency table is then created from the counts of values in the k groups that are greater or not greater than the overall median. If the groups do not differ from each other, the overall median will split each group evenly. The contingency table is tested by the chi-square test that compares the observed frequencies of the two categories to those that would be expected if the null hypothesis of no difference between groups were true. The alternative hypothesis is two-tailed. The formula for the chi-square statistic is

$$\chi^2 = \sum_{i=1}^k \frac{(o_i - e_i)^2}{e_i} \quad (5-1)$$

where o_i is the observed value for the i th category, e_i is the expected value for the i th category, and k is the total number of categories. In other words, the chi-square is the sum of the squared differences between the observed and expected values, divided by the expected values.²⁰⁰

¹⁹⁹ Hair, J F, Anderson, R E, Tatham, R L & Black, W C. 1995. *Multivariate data analysis with readings*. Fourth edition. London, Prentice-Hall International, Ltd. 745 pages. Pages 10-12.

²⁰⁰ SPSS Inc. 1998. *SPSS Base 8.0 Applications guide*. 372 pages.

Statistical inference like the above is inappropriate if a census has been conducted of the entire population.²⁰¹ In the present study, an attempt was made to include all compliance situations in the sample. However, in this case, inferential analysis is nevertheless warranted since inference is made from the sample not to the tangible population but to a so-called superpopulation. This approach may be useful in situations such as this one where the population includes a limited number of research units and observations are collected from all or nearly all of them. In addition to the real research units, the idea of a superpopulation includes also potential, non-existing research units.²⁰²

After examining differences between groups with the median test, the next stage was to assess the relative importance of the identified sources of variation in compliance. The appropriate method for this is variance components estimation. It is a procedure that can be utilised for estimating how much each random factor in a model contributes to the overall variance of the dependent variable.²⁰³ The random effects assumption in variance components estimation does not relate to random sampling. It means that each observed random effect is considered to have been randomly drawn from a population of possible effects about which inferences are to be made.²⁰⁴

As will be shown in the Results section, the median test results suggested conducting variance components estimation with data aggregated at the plant level. The plant-level data did not initially satisfy normality, either. However, the selected variance components estimation method, MINQUE (minimum norm quadratic unbiased estimator), is robust to moderate departures from normality, and can also accommodate unbalanced data.²⁰⁵ A logarithmic transformation of the plant-level data was able to correct the skewness of the distribution. Some positive kurtosis remains even after the transformation (kurtosis = 1.481 with a standard error of 0.167), as is shown in Figure 15. This was considered a moderate departure from normality, and a new variable, LOGCOMP (N=855) was created and used for variance components estimation.

²⁰¹ Hair, J F, Anderson, R E, Tatham, R L & Black, W C. 1995. *Multivariate data analysis with readings*. Fourth edition. London, Prentice-Hall International, Ltd. 745 pages. Page 10.

²⁰² Lehtonen, T. 1990. *Tilastotieteen jatkokurssi*. Helsingin kauppakorkeakoulun kuvalaitos. 196 pages. Page 50.

²⁰³ See, for example, SPSS Inc. 1997. *SPSS Advanced Statistics 7.5*. 579 pages; or Rumelt, R P. 1991. How much does industry matter? *Strategic Management Journal*, volume 12. Pages 167-185; or Hsiao, C. 1986. *Analysis of panel data*. Econometric Society Monographs No. 11. Cambridge University Press. 246 pages; or Wetherill, G B. 1981. *Intermediate statistical methods*. London, Chapman and Hall. 390 pages; or McGahan, A M & Porter, M E. 1997. How much does industry matter, really? *Strategic Management Journal*, volume 18. Pages 15-30.

²⁰⁴ McGahan, A M & Porter, M E. 1997. How much does industry matter, really? *Strategic Management Journal*, volume 18. Pages 15-30.

²⁰⁵ SPSS Inc. 1997. *SPSS Advanced Statistics 7.5*. 579 pages. Page 44.

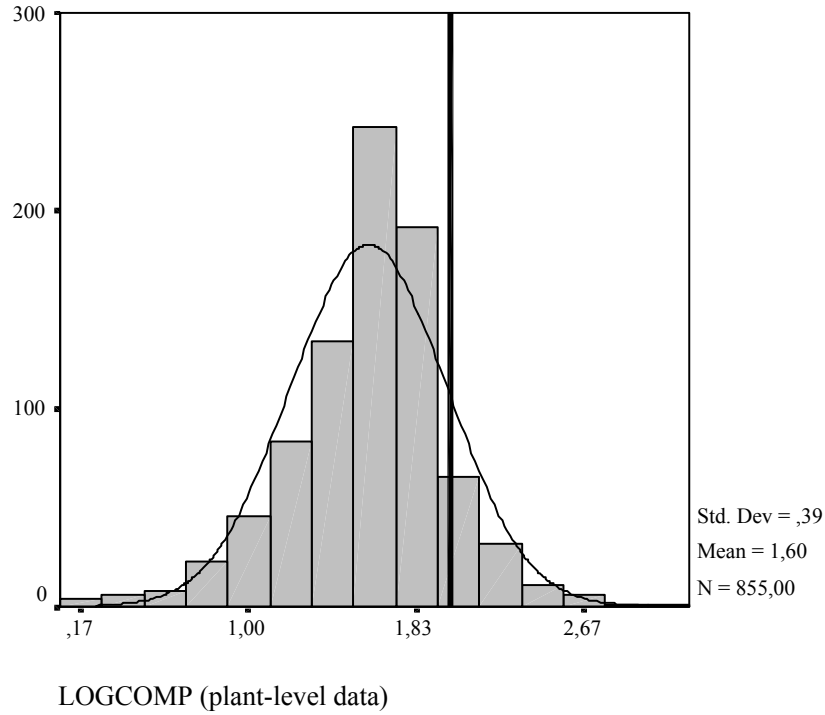


Figure 15 Histogram of the logarithmic transformation of the variable COMPLIAN with plant-level data. The vertical line of 100 per cent compliance is inserted for reference

The design of the random-effects model was partly nested and partly crossed. The mathematical model corresponding to the empirical model in Figure 13 (without pollutant effects, as the estimation was conducted at the plant level) is

$$l_{yp(d(c))} = \mu + \alpha_c + \beta_{d(c)} + \gamma_{p(d(c))} + \delta_y + \zeta_{yc} + \eta_{yd(c)} + \varepsilon_{yp(d(c))} \quad (5-2)$$

where $l_{yp(d(c))}$ is the logarithm of compliance, the α_c are industry effects with the crude industry classification, the $\beta_{d(c)}$ are industry effects with the detailed industry classification, nested within crude industries, the $\gamma_{p(d(c))}$ are plant effects nested within detailed industries, the δ_y are year effects, the ζ_{yc} are crude industry - year interaction effects, the $\eta_{yd(c)}$ are detailed industry - year interaction effects, and the $\varepsilon_{yp(d(c))}$ are random disturbances. The residual can also be interpreted as the interaction term between the plant and the year. But, since there was no replication in measurement, the error term is pooled with this interaction.

However, it is not the equation 5-2 that will be estimated but the individual variance components as in the equation 5-3:

$$\sigma^2_l = \sigma^2_\alpha + \sigma^2_\beta + \sigma^2_\gamma + \sigma^2_\delta + \sigma^2_\zeta + \sigma^2_\eta + \sigma^2_\varepsilon \quad (5-3)$$

The variance components model is based on several assumptions regarding the random effect parameters and the residual term. The random effect parameters (that

is, the $\alpha_c, \beta_{d(c)}$ and so on) are assumed to have zero means and finite constant variances. They are assumed to be mutually uncorrelated, and uncorrelated with parameters from different random effects. The residual term is assumed to have a zero mean and finite constant variance, too, and to be uncorrelated with any random effect parameters and with residual terms from different observations. Based on these assumptions, observations are correlated from the same level of a random factor.²⁰⁶

The selected MINQUE estimation method requires a set of prior values for the variance components. Uniform prior values were used, implying that all random effects and the residual have equal impact on the observations. A system of linear equations is then established based on the prior values and the data, and solved to obtain the MINQUE estimates.²⁰⁷

Finally, the 2195 compliance situations were coded in three categories: non-compliance, ordinary compliance, and overcompliance. Non-compliance is straightforward, since at any time, values of COMPLIAN that exceed 100 represent non-compliance. However, for reasons already discussed, there is no similar natural cut-off point for overcompliance. The solution was to compute annual median values for COMPLIAN and use those as the cut-off point for overcompliance. The cut-off points are listed in Table 6; values of COMPLIAN below the cut-off points are taken to represent overcompliance. In other words, the overcompliance code was awarded to plants that not only emitted less than 100 per cent of the permitted amount of effluents, but that also outperformed an average plant that year. Values of COMPLIAN that represent full compliance with the regulations but that are not particularly low (that is, do not belong to the lowest 50 per cent) were coded as ordinary compliance.

Table 6 Annual cut-off points below which values of COMPLIAN were coded as overcompliance

	Year								
	88	89	90	91	92	93	94	95	96
Cut-off	57.7	55.5	47.6	34.7	36.0	31.0	37.0	38.1	32.9

For every plant, the share of each compliance category over the entire research period was calculated and recorded in the variables OVERCOMP, ORDICOMP, and NONCOMPL. The share of overcompliance situations, ordinary compliance situations, and non-compliance situations in the 108 plants is shown in Appendix III. These three variables were then used to cluster the plants based on their compliance performance.

Cluster analysis is a technique whereby cases are grouped into clusters based on variables specified by the researcher. The clusters are formed so that there is high within-cluster homogeneity and high between-cluster heterogeneity. In other words,

²⁰⁶ SPSS Inc. 1997. *SPSS Advanced Statistics 7.5*. 579 pages. Pages 43-44.

²⁰⁷ SPSS Inc. 1997. *SPSS Advanced Statistics 7.5*. 579 pages. Page 177.

the cases that belong to the same cluster are more like one another than they are like cases belonging to other clusters.²⁰⁸ The cluster analysis is a suitable technique for classifying the plants for the purposes of the present study since the objective is not to make any inferences to a population; of interest are only the plants in the sample and how they fall into different groups based on their compliance behaviour.

The two main clustering algorithms are hierarchical clustering, and nonhierarchical or K-means clustering. The K-means clustering with Euclidean distances was used. According to Hair et al. (1995), nonhierarchical clustering algorithms have several advantages over hierarchical clustering algorithms if there is some practical, objective, or theoretical basis on which the initial cluster seeds needed in nonhierarchical clustering can be selected.²⁰⁹ In the present study, both the number of clusters and the initial cluster seeds could be naturally established. Moreover, the sensitivity of the Euclidean distance measures to the scale of the variables was of no concern since all the variables were measured on a similar scale.

5.5 Results

Three questions were posed at the outset of the chapter. The first question was whether there is such variation in compliance as suggested by the theoretical module. It was hypothesised that there is variation in the dependent variable, compliance, according to several independent variables: industry (measured at two levels), plant, pollutant, and year. Table 7 shows the relevant median test results. Note that Table 7 is a summary of 36 separately conducted tests that do not take into account the hierarchical structure of the data.

The results in Table 7 indicate that there have been differences in compliance both between industries and between plants. By contrast, the results point to no persistent difference in compliance between pollutants. In other words, any important variation in the relationship between firms' environmental and economic performance may not be found at the level of the various individual water pollutants. One explanation could be that customers do not, in general, perceive the environmental performance of a plant at such a highly detailed level. Another explanation could be that all the pollutants emitted by a plant are treated in the same effluent treatment facility. However, there may still be variation between water pollution and other environmental issues that is not revealed by this data.

²⁰⁸ Hair, J F, Anderson, R E, Tatham, R L & Black, W C. 1995. *Multivariate data analysis with readings*. Fourth edition. London, Prentice-Hall International, Ltd. 745 pages. Pages 421-423.

²⁰⁹ Hair, J F, Anderson, R E, Tatham, R L & Black, W C. 1995. *Multivariate data analysis with readings*. Fourth edition. London, Prentice-Hall International, Ltd. 745 pages. Pages 421-423.

Table 7 Annual median test results for COMPLIAN: significance level (α) of the chi-square statistic. The table summarises the results of 36 separately conducted tests

	CRUDSECT	DETASECT	PLANT #	POLL_ID
1988	0.000***	0.016*	0.019*	0.161
1989	0.000***	0.023*	0.017*	0.056
1990	0.010**	0.092	0.027*	0.324
1991	0.053	0.086	0.033*	0.037*
1992	0.014*	0.000***	0.003**	0.099
1993	0.196	0.005**	0.001***	0.598
1994	0.421	0.000***	0.000***	0.230
1995	0.996	0.010**	0.000***	0.192
1996	0.114	0.008**	0.001***	0.081

$\alpha \leq 0.001$ highly statistically significant (***) All two-tailed tests
 $\alpha \leq 0.01$ statistically significant (**)
 $\alpha \leq 0.05$ almost statistically significant (*)

Outside the median test results, the data point to a year effect that has produced more and more overcompliance over time. This is illustrated in Figure 16 that shows the distribution of COMPLIAN in 1988 and in 1996, at the beginning and the end of the research period. It is readily visible how the mass of the observations has shifted towards the left. This is in spite of the fact that permits have become stricter for many plants over those nine years – the mean value of PERMITTE was 21.5 per cent lower in 1996 than in 1988. Production has also increased at several plants at the same time.

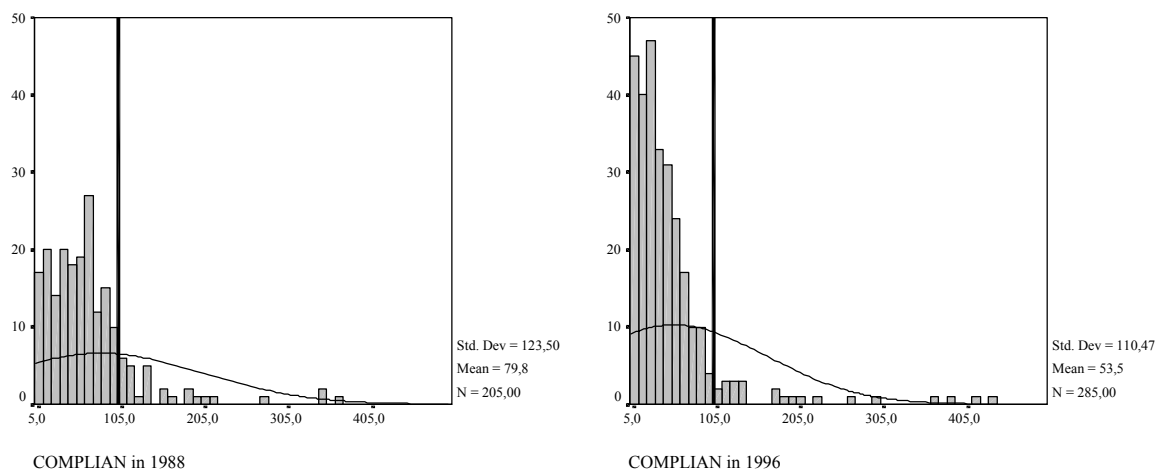


Figure 16 Histogram of the variable COMPLIAN in 1988 and 1996. The horizontal axis is truncated. The vertical line of 100 per cent compliance is inserted for reference

Thus, the hypotheses $H1$ (there is variation in compliance between industries), $H2$ (there is variation in compliance between plants), and $H4$ (there is variation in

compliance between years) received support. The hypothesis *H3* (there is variation in compliance between pollutants) was not supported by the findings.

Since, according to the median test results, there was no significant difference between the pollutants, the compliance-situation level data were aggregated at the plant level for the next analysis stage. This amounted to giving each pollutant an equal weight in calculating the plant-level average annual compliance. Notwithstanding the criticism towards aggregating environmental performance figures across pollutants that was presented earlier in the present study, this was considered acceptable for several reasons. First, the impetus for the aggregation originated from the data. Different pollutants can be treated equally since the data show that compliance has, indeed, been equal across pollutants. Second, the aggregation carries no statement as to the environmental importance of the various pollutants. The pollutants are given an equal weight from the perspective of firm behaviour, not from the perspective of environmental damage. Third, all aggregated values were measured in comparable units to start with, and no summing of pollutants that are measured in tons and others that are measured in grams thus occurred.

The second question posed to the data concerned the relative importance of the sources of variation in compliance. Statistical significance figures, such as those reported in Table 7 tell that the result was likely not obtained by chance; they do not divulge the importance of the effect. (Power, and thus α , is not completely unrelated to the effect size, however.) Of particular interest was the question to what extent compliance is a plant issue and to what extent an industry issue.

Variance components estimation was used to divide the total variation in compliance into industry factors (measured at two levels), plant factors, and year factors, however created. Moreover, as panel data were available, these could be further divided into time-invariant and time-varying components. This analysis followed closely much of Rumelt (1992).²¹⁰ Table 8 shows the variance components attributable to different sources, and Figure 17 illustrates their relative importance.

²¹⁰ Rumelt, R P. 1991. How much does industry matter? *Strategic Management Journal*, volume 12. Pages 167-185.

Table 8

Variance components estimated from plant-level data

Variance Estimates	
Component	Estimate
Var(CRUDSECT)	1,165E-03
Var(DETASECT(CRUDSECT))	1,812E-02
Var(PLANT__#(DETASECT(CRUDSECT)))	6,423E-02
Var(YEAR)	1,031E-02
Var(CRUDSECT * YEAR)	1,207E-03
Var(DETASECT * YEAR(CRUDSECT))	1,752E-03
Var(Error)	6,602E-02

Dependent Variable: LOGCOMP
 Method: Minimum Norm Quadratic Unbiased Estimation
 (Weight = 1 for Random Effects and Residual)

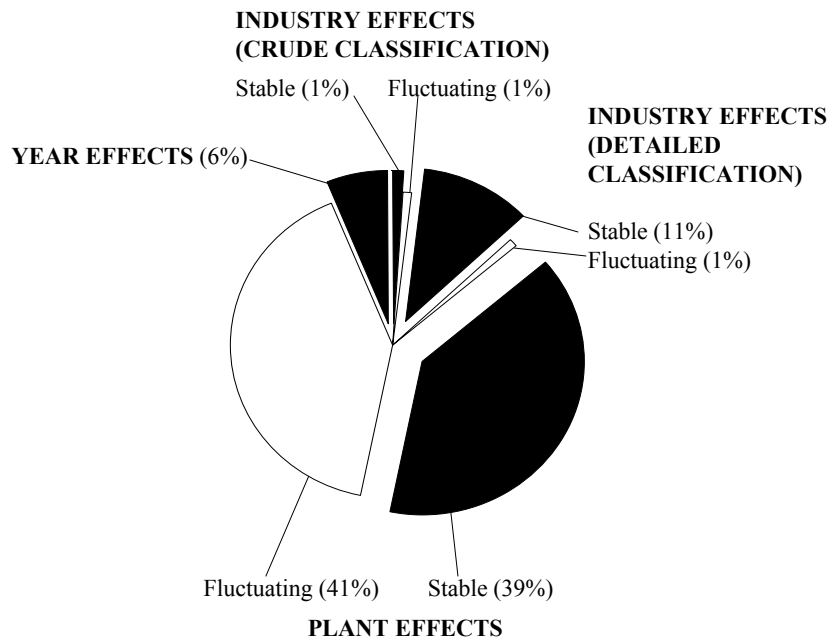


Figure 17 The relative importance of the sources of variation in plant-level compliance

Figure 17 clearly shows that the most important sources of variation in compliance – and thus in perceived win-win situations – are plant-specific. The stable plant effects (39% of the total variation) are about three and a half times as important as the stable industry effects (11%), even when a detailed industry classification is used. If a crude classification in chemical forest industry, chemical industry, metal industry, and food industry is used, the stable plant effects (39%) are almost forty times as important as the stable industry effects (1%). In other words, the variation between plants within an industry is much larger than the variation between industries.

There seem to be stable patterns in the data that account for 57 per cent of the variance in compliance. However, time-varying effects are also present, especially at the plant level. The fluctuating plant effects (41%, reported under error variance in Table 8) represent plant-specific year-to-year variations in compliance. The great fluctuating plant effects suggest certain randomness in compliance. However, this effect also contains the error variance, and the swings in compliance that may be caused by changes in effluent discharge standards during the research period (see the discussion at the end of this chapter).

The year effects, in turn, refer to such annual fluctuations in circumstances affecting compliance that influence all plants and industries equally. The presence of a year effect (6%), and the minor share of fluctuating industry effects at both measurement levels (1% each) may indicate that developments in relevant circumstances have touched all industries almost identically.

One purpose of the variance components estimation was to assist in determining where to focus attention in the case studies to ensure sufficient sampling from the level that produces the most variation. Based on the results, it appears that the most useful level for seeking the mechanisms that cause variation in compliance are individual plants. Therefore, the third and final statistical question was posed directly at the plant level: which plants have had a tendency towards overcompliance, which plants have had a tendency towards non-compliance, and which plants have had a tendency towards ordinary compliance over the research period? The cluster solution is shown in Table 9 and illustrated in Appendix III.

Table 9 Final cluster centers and number of plants in each cluster

	Cluster 1	Cluster 2	Cluster 3
Description	Plants with a tendency towards overcompliance	Plants with a tendency towards non-compliance	Plants with a tendency towards ordinary compliance
Plants	44	15	49
Cluster center			
OVERCOMP	77.19	30.87	28.49
ORDICOMP	19.78	24.38	64.73
NONCOMPL	3.03	44.75	6.78

The cluster centers in Table 9 contain the mean of each variable in each cluster. The interpretation of the cluster results is straightforward since clustering was entirely based on the compliance performance. Of the 108 plants, 44 fall into cluster 1. For these plants, the distinct majority of the compliance situations represent overcompliance and there is very little non-compliance. Roughly the same number of plants (49) fall into cluster 3. For plants in this cluster, ordinary compliance is dominant. However, quite a lot of overcompliance and some non-compliance can also be observed in this cluster. The remaining 15 plants fall into cluster 2. Here, the compliance situations are much more evenly spread between the three types of compliance, but non-compliance nevertheless constitutes the majority of the compliance situations.

5.6 Discussion

In the analysis presented, overcompliance with effluent discharge regulations portrayed an empirically observable example of perceived win-win situations. The key findings were that there is persistent variation in compliance; that the most significant sources of this variation occur at the plant level as opposed to the industry level; and that a year effect has been present. These findings have practical significance for the study of the relationship between firms' environmental and economic performance. They lend strong support to the proposition that the relationship must be studied at a disaggregated level. Moreover, disaggregation to different industries is not sufficient, because at least in manufacturing, plants within an industry may differ from one another much more than industries. However, the findings also suggest that disaggregation to different environmental issues such as water pollution may suffice and that there may be no need to disaggregate the various individual pollutants.

If, as it seems, the relationship between environmental and economic performance varies significantly between plants and firms, environmental issues are truly a question of competitive strategy that firms must approach from their own particular circumstances. And, variation in the relationship over time suggests that it may not need to be taken as given but one may also actively try to influence it.

Three questions immediately arise concerning the reliability and validity of the above empirical analysis. The first question is whether overcompliance is an appropriate indicator of a perceived win-win situation. The overcompliance indicator was already discussed at the outset of the chapter. It was noted that overcompliance is not without problems but probably the best available empirical measure for the purposes of the present study. Especially, because of variation in the strictness of the effluent permits against which overcompliance is measured, overcompliance is a sufficient but not necessary condition for perceived win-win situations.

The second question is whether effluent discharges are a suitable empirical example for the purposes of the present study. The third question is whether the measurements and analyses have been properly conducted. These two questions will be explored below.

Are effluent discharges a suitable example for the empirical illustration of the relationship between firms' environmental and economic performance? As noted, discharges of effluents during the production process provide only a limited picture of the environmental performance of a firm. It would be more ideal to consider all environmental media, and the whole life-cycle of a product or service. Because of both practical and theoretical problems²¹¹, such ideal measurement of environmental performance was not possible. The statistical data should be considered an empirical example of one aspect of environmental performance. If, as hypothesised, the relationship between firms' environmental and economic performance is issue-specific, beginning with the quantitative illustration of only one such issue does not present a major problem.

There are several reasons why effluent discharges should constitute a good empirical example for the purposes of the present study. Any activities in any industries that may result in water pollution must have an environmental permit, and the permit provisions are such that compliance indicators can be calculated. Water pollution has been an important environmental issue and much of environmental protection investments during the research period has gone to addressing this issue. There have been no significant economic instruments or voluntary agreements in operation during the study period that would affect the compliance data.²¹² Regulations in other countries cannot have affected the compliance data, either, because the rules of the multilateral trading system have not allowed trade measures that are based on non-product-related processes and production methods.

However, effluent discharges possibly suffer from not being considered an "output" by many customers.²¹³ They may thus not produce benefits through the demand curve to a similar extent than a product-related environmental issue. Issues such as

²¹¹ The life-cycle approach is not without problems either. For example, Schaltegger (1997) criticises current life-cycle assessment techniques for the lack of site-specific data that could attend to "actual impacts in the real world with geographical and time dimensions". See Schaltegger, S. 1997. Economics of life cycle assessment: Inefficiency of the present approach. *Business Strategy and the Environment*, volume 6. Pages 1-8.

²¹² The effluent permits do specify compensation payments and water protection charges, however.

²¹³ Two kinds of characteristics, inputs and outputs, relate to offerings. Outputs are those characteristics that influence customer choice, either consciously or subconsciously. Inputs are used to produce outputs, but inputs themselves do not directly influence customer choice. This distinction is important, because only the outputs position an offering in the eyes of customers. Firms must manage inputs, such as costs and resources, but for customers, only the outputs matter. Mathur, S S & Kenyon, A. 1997. *Creating value: shaping tomorrow's business*. Oxford, Butterworth-Heinemann. 451 pages.

recycling, biodiversity conservation, and so on, may be more important for some plants in the sample than are effluent discharges. In any case, the result that there were no differences in compliance between different pollutants cannot be directly extended to different environmental issues. This question will be further addressed in the case studies, below, where it will be examined how effluent discharges relate to other aspects of environmental performance.

Concerning the quality of the data, the most serious limitation is the absence of specific effluent discharge values and specific permit limits. Whereas absolute effluent discharge data report the total amount of discharges in a period, specific effluent discharge data report discharges per volume of output. Absolute permit limits regulate pollutant loads in a time period, and specific permit limits per volume of raw material or final product. A simultaneous examination of both kinds of data would be best, as specific figures are better at describing the eco-efficiency of a plant, but absolute figures are better at describing a plant's environmental impact. The compliance calculations in the present study are based on the absolute effluent discharges and permit limits only. This is because although specific permit limits are common in some industries, for most of the compliance situations in the present sample they did not exist.

This limitation in the data has implications that need to be kept in mind in the interpretation of the results. Absolute effluent discharge data are sensitive to fluctuations in output levels. From one perspective, this might not be a problem. Output reduction is, indeed, one of the available means for reducing pollution. For the receiving water body, it is only the absolute effluent discharges and their relation to the carrying capacity that matters. Specific effluent discharges fail to take into account the scale effects of production. From another perspective, however, there may be a problem. Finland experienced a severe recession during the research period. This may mean that some of the overcompliance situations in the data are "artificial" since effluent discharges were reduced only because production was reduced. In those cases where both absolute and specific effluent discharge limits for a plant exist, one is perhaps binding when the other is not. For example, specific limits may become binding if production is less than a certain percentage of capacity. The absence of specific permit limits in the data may therefore produce false overcompliance situations at times when capacity utilisation is low.

Some other aspects of the data also require further discussion. A tightening of the permit limits results in worsened compliance figures if the plant's environmental performance remains the same. Thus, environmental performance that once was overcompliance may become ordinary compliance or even non-compliance later. When technologies and preferences change, the socially optimal level of environmental performance also changes, which may be reflected in the performance level required of a plant. The legal requirements are thus a moving target, and compliance is measured against this moving target at any point in time.

The permit data in the present study only capture requirements that are expressed as effluent discharge limits per time period. The permits specify how the effluent discharge values are to be measured: for example, as annual averages, 3-month moving averages, or monthly averages. The shorter the measurement period the stricter the requirement for the invariability of the effluent flow. The present study, however, records all effluent discharge limits as if they were to be measured as annual averages. High and low effluent peaks are thus averaged over the year. The implication of this is that overcompliance and non-compliance situations that survive till the annual data must have been significant or persistent.

The existence of extreme cases is likely to be restricted in the sample. On the one hand, some plants with serious compliance problems may have been required to switch to a "dry" production process or join the municipal sewage system, in which case they drop out of the data. On the other hand, if a plant successfully implements pollution prevention and no longer discharges effluents or emits a particular substance, the related compliance situations may drop out of the sample, too, or never enter it to start with. The sample may also be biased towards large polluters: many small plants discharge their effluents into the municipal sewage system and are thus not covered by the data, and there may be more missing data points in the effluent discharge database for plants with minor discharges.

As always, the possibility of human error in data collection cannot be completely ruled out. However, measures such as graphical examination of the data were taken at each stage to reduce this possibility to a minimum. The data can thus be treated with reasonable confidence.

To sum up, the objective of the chapter was to anchor the examination of the relationship between firms' environmental and economic performance to comprehensive empirical data on revealed behaviour. The questions posed to the data were few and simple, and the methods employed were selected to be conservative and such that their sophistication would not exceed the level warranted by the quality of the data. The results can be likened to a picture observed from far away: the main features are distinct and reliable enough, but all details are not discernible. This picture shows variation that needs to be explained and points to the sources of that variation. Chapter 6 will now turn to the ensuing question about how this variation is generated.

6 A CASE-STUDY APPROACH

As noted, there is a gap in the previous knowledge concerning the possible non-uniformity of the firm-level relationship between environmental and economic performance. The theoretical module showed that the relationship is, indeed, likely to be non-uniform, and the statistical module showed that the most important source for this non-uniformity is at the plant level. Thus, the naturally following question for the case-study module is: What are the determinants of environmental profit that produce such plant-level non-uniformity in the relationship?

The qualitative case-study approach complements the theoretical and statistical analyses by providing rich data that offer a new perspective to the comprehension of the phenomenon. The qualitative module can be used to help interpret the findings of the quantitative module. Whereas the quantitative module addressed the what-question, the present chapter attempts to answer the why-question. It also has a role in validating and triangulating previous results. When speaking of multi-method studies, Miles and Huberman (1994) state that strong claims on the viability of the findings of the qualitative module can be made if they converge both across cases and with the quantitative module.²¹⁴

Note that instead of environmental private costs and benefits, this chapter tends to speak of environmental costs and revenues. This is because in the context of the issues discussed in the chapter, the word "benefits" easily causes confusion since the same point can be regarded as a reduction in costs or an increase in benefits. However, it would be useful to keep apart the impacts occurring through the cost curve and through the demand curve. With the words cost and revenue no such confusion arises. Each point quite clearly represents an increase or decrease in costs, or an increase or decrease in revenues. This choice of words does not affect what was said in section 2.2: that the concepts in the present study are broader than accounting concepts for expenses and revenues.

6.1 Data and methodology

Although the case selection, data collection and data analysis are here presented separately, in practice they were simultaneous and intertwined processes. This is typical of qualitative research, and must be kept in mind when reading the section.

²¹⁴ Miles, M B & Huberman, A M. 1994. *Qualitative data analysis. An expanded sourcebook*. Second edition. Thousand Oaks, Sage Publications. 338 pages. Page 31.

6.1.1 Selection of cases and informants

Based on the results in chapter 5, a case was determined to be a plant. The purpose of the case studies was to generate theory that is grounded in empirical data, not to test any predefined hypotheses.²¹⁵ This had important implications for the selection of the cases that was based on theoretical sampling.

According to Glaser and Strauss (1967), theoretical sampling is “the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyses his data and decides what data to collect next and where to find them, in order to develop his theory as it emerges”.²¹⁶ The cases are thus not randomly selected but hand-picked according to a sampling strategy. Major sampling strategies are to replicate previous cases, to extend emerging theory, to fill theoretical categories, or to provide polar examples.²¹⁷

The research design involved multiple cases. This is regarded as beneficial for understanding the researched phenomenon, and for developing a good picture of locally grounded causality.²¹⁸ Replication logic is central to sampling in this kind of studies: each case should be selected to produce either literal or theoretical replication, and cases should be sampled for each of these two purposes. Literal replication refers to cases that predict similar results, theoretical replication to cases that produce contrary results but for a predictable reason.²¹⁹

The main sampling dimension in the present study was the dependent variable, compliance. In addition, some independent variables were used as sampling dimensions. The statistical analysis in the previous chapter showed that, together, the stable plant-level factors and stable industry-level factors (detailed classification) accounted for 50 per cent of the variance or 84.7 per cent of the explained variance in compliance or 87.7 per cent of the stable patterns in the data. An initial sampling frame was thus developed based on combinations of these dimensions and compliance. It relied on the sampling strategy of providing polar examples. The logic of this sampling strategy is that the phenomenon of interest is likely to be most easily perceived in the extremes. Thus, plants belonging to the ordinary compliance cluster were not sampled. The sampling frame contained cases that either displayed polar

²¹⁵ See, especially, Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research*. Chicago, Aldine Publishing Company. 271 pages, and Eisenhardt, K M. 1989. Building theories from case study research. *Academy of Management Review*, volume 14, 4. Pages 532-550.

²¹⁶ Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research*. Chicago, Aldine Publishing Company. 271 pages. Page 45.

²¹⁷ Eisenhardt, K M. 1989. Building theories from case study research. *Academy of Management Review*, volume 14, 4. Pages 532-550.

²¹⁸ Miles, M B & Huberman, A M. 1994. *Qualitative data analysis. An expanded sourcebook*. Second edition. Thousand Oaks, Sage Publications. 338 pages. Page 26.

²¹⁹ Yin, R K. 1989. *Case study research. Design and methods*. Revised edition. Newbury Park, Sage Publications. Pages 53-54.

examples of compliance within an industry (detailed classification) or polar examples of compliance between industries. However, flexibility was retained to incorporate new significant sampling dimensions that might arise during the study.

The exact number of cases to be studied could not be predetermined. In theoretical sampling, data collection and analysis is continued until a saturation point is reached where new cases do not introduce any new information.²²⁰ The study ended up containing eleven cases: two from the chemical forest industry, two from the chemical industry, four from the metal industry, and three from the food industry. King et al. (1994) emphasise the importance of sufficient variation in the dependent variable in the sample when the dependent variable has been used as a sampling dimension.²²¹ Six of the plants represented the overcompliance cluster and five the non-compliance cluster. There is no correct answer to the question how many cases are "enough". However, to avoid idiosyncrasy, but to keep the number of replications manageable, Eisenhardt has suggested that the optimal number of cases would be between 4 and 12.²²²

The case in the present study is a plant, but one cannot interview a plant – interviews must be conducted with natural persons. This gives rise to the question about how to select the informant or informants. As a starting point, it was considered important to pick several informants for each case, in order to obtain different perspectives on the issues and to allow within-case triangulation of data. In selecting the informants, variation can be sought on two dimensions: functional responsibilities (horizontal variation) and managerial level (vertical variation). There are also potential informants outside the plants themselves. Table 10 shows the sampling frame for informants, containing the upper limit of variation that was sought for one case.

Table 10 Sampling frame for informants for one case

	General	Environmental	Technical / Production	Marketing	Outside plant
Top management	Plant director				Regulatory authority responsible for the firm
Middle management and / or non-managerial		Environmental manager and / or environmental staff	Technical / production manager and / or technical / production staff	Marketing manager and / or marketing staff	

²²⁰ Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research*. Chicago, Aldine Publishing Company. 271 pages.

²²¹ King, G, Keohane, R O & Verba, S. 1994. *Designing social inquiry. Scientific inference in qualitative research*. Princeton, Princeton University Press. 247 pages. Page 134.

²²² Eisenhardt, K M. 1998. Lecture at Helsinki University of Technology, April 29-30.

For each case, interviewees were sampled from the sampling frame. It was ensured that the general management, environmental, technical / production, and marketing functions were all represented in each case. However, the fact that the four functions were sampled did not necessarily mean that four persons were sampled. Often, one person was responsible for more than one function. For example, the plant director could also be responsible for marketing, or the production manager for environmental issues. In the two smallest plants, all of the four functions were carried out by the owner-manager himself. Sometimes more than one person was responsible for one function: for example, marketing responsibilities could be divided based on the customer segment or geographic market area. Thus, depending on the size and organisation of the case plant, sampling the four functions translated into one to six interviewees. The regulatory authority was interviewed for each case; however, this meant only five interviews since the same official typically supervises several plants.

There was a total of 40 interviews. Table 11 summarises the number of persons interviewed at the plants and in the regulatory agencies, as well as the interview hours.

Table 11 Summary of number of persons interviewed and interview hours

Plant	Number of persons	Interview hours
A	1	1 h 20
B	2	2 h
C	2	2 h 50
D	5	7 h 40
E	1	2 h 10
F	4	5 h 30
G	3	4 h
H	3	4 h
I	6	6 h 15
J	5	6 h 30
K	3	4 h 30
Authorities	5	2 h 20
Total	40	49 h 05

The cases allow comparisons along several dimensions: between overcomplying and non-complying plants; between plants in different industries; between small and large plants; between single-plant and multi-plant companies; between plants with various types of ownership; between plants within the same corporation; and between plants selling intermediate and final products to industrial or consumer clients. The cases provide literal replication for each of these characteristics, even if not for each combination of characteristics. To preserve the anonymity of the participating plants, a detailed summary of their characteristics cannot be presented.

6.1.2 Data collection

The data came from two main sources. First, the water permits of the 108 plants and phone calls with 57 of the plants (collected for the statistical module), and archival data such as environmental reports and newsclippings were used, together with previous literature, to design an interview guide and some initial propositions.

The collection of the water permits and the phone calls were described in chapter 5. The task of collecting and studying the permit limits from more than 300 Water Rights Court permit decisions and the eventual associated decisions from higher courts of appeal was time-consuming. However, the information gained from the permit documents also served to develop a general understanding of the environmental situation of the plants with regard to water pollution. This is because the Water Rights Court decisions contain information on the history, products, processes, effluent discharges, and environmental control technologies of the plants, and on the opinions of the firms, local inhabitants, and environmental authorities concerning the environmental impacts of the plants.

Second, semi-structured interviews in the case plants were used to gradually develop propositions and organise them into a model of factors affecting environmental profit. Throughout data collection and analysis, related literature was used as a springboard for ideas, and to confirm or contrast the findings. This literature is scattered in suitable places in the Results section of the present chapter.

A decision needed to be made on the extent to which the data collection should be planned and structured before entering the field. According to Miles and Huberman (1994), prior instrumentation of data collection helps to avoid data overload and focus data collection on relevant and useful data and increases the reliability of data collection. Moreover, prior instrumentation is the only way to guarantee cross-case comparability. However, there are also drawbacks associated with prior instrumentation. It may cause the researcher to overlook important issues arising from the field if they are not included in the predesigned instrument. It may also force the prior assumptions and categorisations of the researcher on the informants. The desirable amount and nature of prior instrumentation in a study thus depends on the type of study and sample and on the research questions.²²³

In the present study, multiple cases were involved and comparability between them was of utmost importance. At the same time, the focus of the case studies was on exploratory theory building rather than on hypothesis testing, and all the relevant issues were not necessarily known beforehand. The flexibility to accommodate completely new issues and ideas that may emerge during data collection therefore had to be retained. Semi-structured interviews were selected as the data collection method. They may combine the strengths of both a structured interview and an open interview

²²³ Miles, M B & Huberman, A M. 1994. *Qualitative data analysis. An expanded sourcebook*. Second edition. Thousand Oaks, Sage Publications. 338 pages. Pages 35-36.

by facilitating an analysis across the cases while at the same time allowing rich data to be collected. Because of this choice, explicit pilot studies were not necessary.

At the substantive level, the research questions in the case-study module were the following:

- Why do firms within a detailed industry differ in compliance?
- Why do detailed industries differ in compliance?

At the conceptual level, the same questions read as:

- Why do firms within a detailed industry differ in perceiving win-win situations?
- Why do detailed industries differ in perceiving win-win situations?

However, interview questions are not the same as research questions. To take the step from research questions to interview questions, it was necessary to determine (i) what information is needed to answer the research questions and (ii) what interview questions would bring out such information.

Already before embarking on data collection the researcher needs to have an idea about how the data will ultimately be analysed. Mäkelä (1990) suggests dissecting the analytical operations into small steps as a means of increasing the transparency and credibility of qualitative data analysis.²²⁴ Following his example, the data in the present study can be analysed by

- first, listing each statement that describes the relationship between environmental performance and economic performance
- then, listing all categorisations or distinctions used to support the argument that the relationship is positive, negative, or neutral
- next, classifying the categorisations or distinctions
- finally, reconstructing the system of classifications or distinctions behind the individual statements.

To achieve this, the task of the interview questions was to ensure that the data contain statements about the relationship between environmental performance and economic performance, and arguments to support the assessments made about the nature of the relationship.²²⁵

²²⁴ Mäkelä, K. 1990. Kvalitatiivisen analyysin arviointiperusteet. In: Mäkelä, K (editor). *Kvalitatiivisen aineiston analyysi ja tulkinta*. Helsinki, Gaudeamus. 285 pages. Pages 42-61.

²²⁵ On designing interview questions, see, for example, Kvale, S. 1996. *InterViews. An introduction to qualitative research interviewing*. Thousand Oaks, Sage Publications. 326 pages; or Wärneryd, B (editor). 1986. *Att fråga. Om frågekonstruktion vid intervjuundersökningar och postenkäter*. Stockholm, Statistiska centralbyrån. 264 pages; or Payne, S L. 1951. *The art of asking questions*. Princeton, New Jersey, Princeton University Press. 249 pages.

A semi-structured interview protocol was developed that contained an outline of the themes to be covered in the interviews, a handful of structured questions, and tentative headings for observations. The interview protocol was written in Finnish and will not be reproduced here, but its contents will be shortly outlined.

The interview protocol was divided into three sections. In the first section, open-ended questions ("Tell me about ...") were asked that served both to warm up and to establish some facts about the nature of the business. Depending on the respondent, these questions concerned topics such as the plant's history, production, ownership, structure, size, products, markets, strategies, economic performance, customers, competitors, and relations with environmental authorities. As the last question of this section, the interviewees were asked to describe environmental issues, if any, that related to their business.

In the second section, questions were asked about the impacts of environmental measures on the costs, revenues, and overall economic performance of the plant. The interviewees were asked to consider all measures with an effect on the plant's effluent discharge performance, regardless of whether the primary motivation behind the measure was environmental or not. Questions were asked both about measures that had already been implemented and about measures that would need to be taken if the plant were to improve its environmental performance.

For each question, the interviewees selected an answer among five alternatives,²²⁶ after which a detailed, open-ended discussion followed about why they had answered as they did. The respondents were asked to provide tangible examples to support their argument. They were also asked to consider whether and why their answers would have been different for some other environmental issue than water pollution.

As expected, answers to questions in the second section varied between plants. The third section of the interview protocol was geared towards further investigating the specific circumstances of each plant that may have affected the answers. The interviewees were given a sheet with 10 unfinished sentences and asked to continue discussion from those sentences. The sentences followed the construction "We can / cannot benefit from voluntarily improving our environmental performance with regard to effluent discharges because our technology..." (because our plant...; because our firm...; because in our industry...; because our customers...; because our competitors...; because our permit limits...; because water pollution issues...; because nowadays...; because...)

Similar to the second section, the third section thus included both a structured choice element (can / cannot benefit) as well as open-ended discussion to justify the selection. Note that the choice between can and cannot benefit had to be made from

²²⁶ No impact; moderate impact, positive or negative; significant impact, positive or negative.

scratch with each new sentence: some characteristics of the case could encourage voluntary improvements while others could discourage them at the same time.

Again, the questions were formulated around effluent discharges to fortify the bridge between the statistical and case-study modules of the study. However, water pollution issues were constantly compared to other environmental issues; such comparisons could be used as a vehicle for bringing out any issue-specific factors affecting the link between environmental and economic performance.

Finally, the interviewees were asked to describe their past and present compliance with effluent discharge permit limits. The information given about compliance in 1988-1996 was used to triangulate the statistical and case-study data. The information given about compliance after 1996 was used to give perspective to those interview answers that dealt with present-day issues.

Interviews with the regulatory authorities focused on the plants' permit limits, historical and present compliance, and attitude to environmental protection and relations with environmental authorities.

The case plants were originally approached by telephoning the plant's highest ranking manager, explaining the reason for the interviews and asking for permission to include the plant as a case in the study. All managers that were contacted gave their permission, after which they were asked to supply the names of the other persons to be interviewed, and an interview date or dates were set up.

The plant interviews were all personally conducted by the researcher, face-to-face, on the plant premises, between November 1999 and February 2000. One interview typically lasted between 60 and 90 minutes. Some written material was collected during the interviews, too, and occasionally there was a site visit. A field diary containing memos, impressions, and interpretations was kept during the field research. One of the regulatory authorities was interviewed face-to-face and four by telephone.

To motivate the respondents, the interviews started by explaining the purpose of the study. To ensure that the respondents felt comfortable about answering, it was guaranteed that the participating plants and persons would remain anonymous in the study. Tape-recording was used only if the informant agreed to it, which they all did. It was brought up that the study was financed by an independent research foundation and as such was not commissioned by any particular interest group. It was also emphasised that the starting point for the study was that sometimes environmental performance improvements had a positive effect, sometimes a negative effect, and sometimes no effect on economic performance, wherefore there were no single "correct" answers to the questions posed but anything experienced by a plant would be a correct answer in their specific case. The interviews were conducted using the respondents' terminology and language; research terms such as environmental profit were not used in the interviews.

6.1.3 Data analysis

In principle, qualitative data analysis in multiple case studies consists of two steps. The first step is a within-case analysis where each case is examined as a separate entity: What explains the compliance performance of the plant? What kind of environment-related costs and revenues did the plant face, and why? The second step is a cross-case analysis where a comparison of similarities and differences of the cases helps to find something that goes beyond one case and is more generally true.

In practice, the two steps are intertwined, and the whole analysis process is iterative. The holistic picture is updated with the addition of each case, and the new understanding gained reflected back to the individual cases. New cases are added until the situation is achieved where new cases do not bring additional information. Available literature can also be utilised throughout the process. This is illustrated in Figure 18. Miles and Huberman (1994) summarise the iterative nature of the analysis process: "You construct this evidential trail gradually, getting an initial sense of the main factors, plotting the logical relationships tentatively, testing them against the yield from the next wave of data collection, and modifying and refining them into a new explanatory map, which then gets tested against new cases and instances. This is the classic procedure of analytic induction."²²⁷

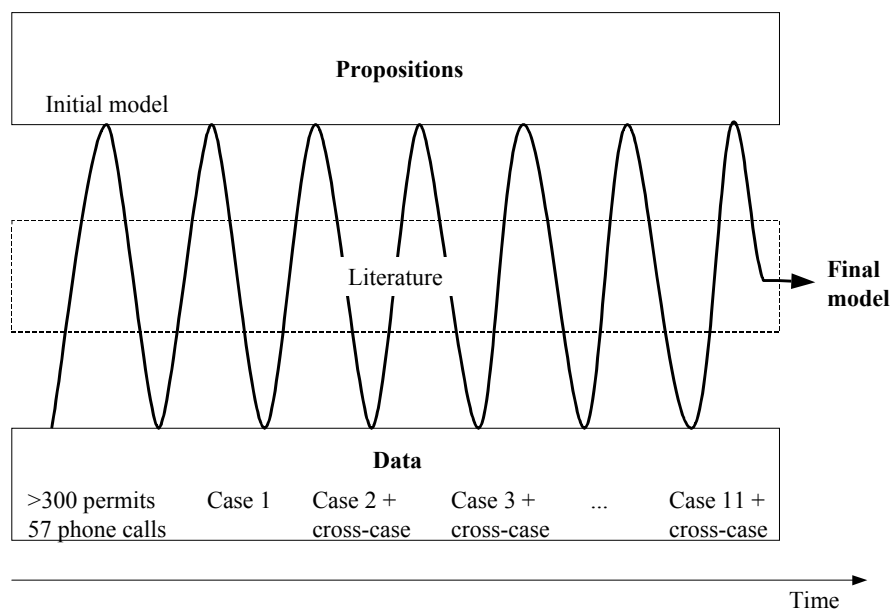


Figure 18 The iterative process of data analysis

²²⁷ Miles, M B & Huberman, A M. 1994. *Qualitative data analysis. An expanded sourcebook*. Second edition. Thousand Oaks, Sage Publications. 338 pages. Page 261.

Recall that a data analysis plan was established already prior to the interviews and the interview protocol was designed with a view to that kind of data analysis. Coding data and developing propositions thus proceeded according to the data analysis plan. Instances relating to the link between a plant's environmental and economic performance were identified and coded as positive, negative, or neutral. The same instances were further coded with one or more codes that described the basis for assessing the relationship to be positive, negative, or neutral.

It is typical of qualitative research that there is a large amount of data and a problem with the analysis is to sort out the essential information from the vast data mass. Following Wolcott (1990), the critical task in qualitative research is not to accumulate data, but to get rid of most of the data one accumulates.²²⁸ This is where the ideas of theoretical sampling and theoretical saturation step in to rationalise the highly time-consuming transcribing and note-taking phase. Glaser and Strauss (1967) write that after theoretical saturation, the researcher begins to see quickly whether a piece of data points to a new aspect. If it does, the incident should be coded and compared, but if not the incident should not be coded "since it only adds bulk to the coded data and nothing to the theory".²²⁹

Accordingly, in the early stages of the analysis, ten interviews from six plants were fully transcribed and coded, but as saturation approached, only new information was picked up from subsequent interview tapes. This analysis stage was assisted by the ATLAS.ti computer programme that has been designed for the qualitative analysis of large bodies of data.²³⁰ It should be noted that although computer programmes such as ATLAS.ti are useful for qualitative analysis, they do not conduct the actual intellectual work; they only facilitate tasks such as coding, annotating, searching, retrieving, comparing, and linking data segments.

Finally, propositions relating the positive, negative, and neutral instances to environmental profit were developed. The propositions were organised into a model that reconstructs the underlying system of factors affecting the relationship between environmental and economic performance, and the avenues through which the factors influence environmental profit. The final model consisted of six main factors, 20 lower-level factors, and a view on how they are linked to each other and to environmental profit. These will be explained and discussed in the Results section of the present chapter.

Once the final model was thus arrived at, it was re-applied to each case to ensure within-case consistency and local explanatory power. To this end, a second round through the whole data mass was taken where each case was coded with the newly established determinants of environmental profit. A fundamental difference between

²²⁸ Wolcott, H F. 1990. *Writing up qualitative research*. Qualitative Research Methods Volume 20. Newbury Park, Sage Publications. 94 pages. Page 35.

²²⁹ Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research*. Chicago, Aldine Publishing Company. 271 pages. Page 111.

²³⁰ See www.atlasti.de for more information on the program.

the two rounds through the data lies in the approach to saturation. In the first round, saturation was sought within the data as a whole, but in the second round, within each case.

It is critical in a case-study analysis to ascertain that the results hold consistently for each case and for each factor. Within each case, the explanation rule must be able to cover all aspects of the phenomenon, and there must be no evidence that contradicts the explanation rule. Across cases, the explanation rule must hold for each individual case, not for some unreal "average" case. Nevertheless, the cases may still vary in their details.²³¹

Thus, the main analysis rule followed was the requirement of absolute explanation. According to Alasuutari (1994), in qualitative research, no exceptions to the explanation rule are allowed. This is in sharp contrast with quantitative research where results apply with a particular probability and usually at best cover the behaviour of a significant majority. The absolute explanation is a feature that makes qualitative research attractive for the present research problem. In a quantitative study, exceptions are disturbances that dampen the results, but in a case study, one can get valuable insights by focusing on the exceptions. When encountering disconfirming evidence, a qualitative researcher is forced to modify the explanation framework or raise abstraction level until all the exceptions can be accommodated.²³² As King et al. (1994) note, such modifications then require the collection of new data to test the new version of the explanation framework through replication.²³³

Table 13, below, illustrates which factors surfaced in which of the eleven cases. However, for confidentiality, the table does not reveal the details of whether and why a particular factor was promoting or hindering win-win situations in each instance.²³⁴ To elaborate on this issue for reporting purposes without breaking the confidentiality, a crude scoring system was applied to the data. In each case, if a factor was conducive to the creation of a win-win situation, it was awarded the score 1. If it hindered the creation of a win-win situation, it was awarded the score -1. If the factor was present in the case, but had a neutral effect on the creation of a win-win situation, it was awarded the score 0. The score 0 was awarded also in situations where the factor in some respects promoted but in some respects discouraged win-win situations and where it was impossible to say which effect predominated. Recall that already the original data analysis plan included coding instances relating to the link between a plant's environmental and economic performance as positive, negative, or neutral.

²³¹ Yin, R K. 1989. *Case study research. Design and methods*. Revised edition. Newbury Park, Sage Publications.

²³² Alasuutari, P. 1994. *Laadullinen tutkimus*. Tampere, Vastapaino. 281 pages. Pages 31-33.

²³³ King, G, Keohane, R O & Verba, S. 1994. *Designing social inquiry. Scientific inference in qualitative research*. Princeton, Princeton University Press. 247 pages. Pages 21-22.

²³⁴ For some details on the empirical manifestations of the determinants of environmental profit, see Appendix IV.

Hence, average scores above zero denote circumstances that have generally been favourable to the creation of win-win situations, and average scores below zero denote circumstances that have generally prevented win-win situations. Note that this scoring system is, indeed, rough and does not capture the richness of the data that was available to the researcher. For example, the scoring system is unable to recognise any weighting between the factors. Note, too, that Figure 19 and Figure 20 include only that part of the interview data that relates to water pollution, since the compliance status to which the scores are compared refers to water pollution only.

Figure 19 addresses the issue of how well the case analysis results are able to explain the compliance behaviour of each individual plant. It contains the average score for the six overcomplying plants and the five non-complying plants in the sample. The figure shows that the results hold consistently: all of the overcomplying plants have scores above zero, and all of the non-complying plants have scores below zero.

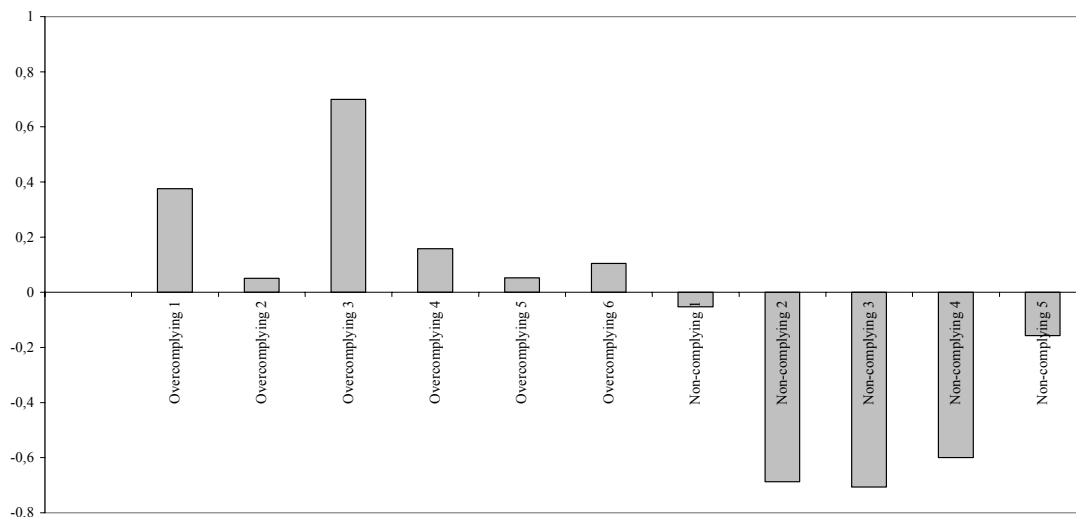


Figure 19 Average total scores for each plant in the sample. Average scores above zero denote circumstances that have generally been favourable to the creation of win-win situations, and average scores below zero denote circumstances that have generally prevented win-win situations. The figure shows that the case analysis results hold for each individual plant in the sample

Figure 20, in turn, examines how well the case analysis results hold for each individual factor. It shows the average scores per lower-level factor for the overcomplying plants as one group and for the non-complying plants as another group. The factors will be discussed in the Results section of the present chapter. The figure shows that the results are very consistent also across factors. The scores for non-complying plants have tended to be below zero, and the scores for overcomplying plants have tended to be above zero. Moreover, the non-complying cases have generally scored lower than the overcomplying cases on each factor, with one exception. The overcomplying cases have scored even lower than the non-complying

cases on management history. This, however, makes sense. As will be explained in the Results section, management history relates to the plant's absolute level of environmental performance and measures taken to achieve it. For the overcomplying plants, few low-cost abatement alternatives may remain on hand since they have already been exhausted in the past.

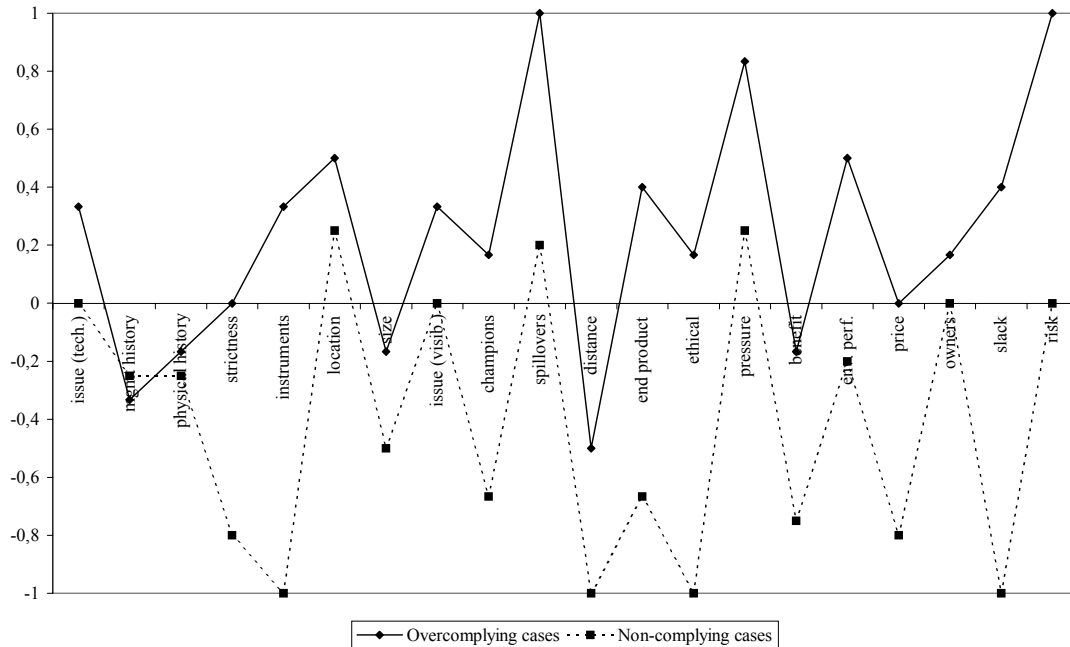


Figure 20 Average scores per lower-level factor for overcomplying and non-complying plants in the sample. The factors are explained in the Results section of the chapter. Average scores above zero denote circumstances that have generally been favourable to the creation of win-win situations, and average scores below zero denote circumstances that have generally prevented win-win situations. The figure shows that the case analysis results hold for each individual factor

Figure 20 also discloses that certain lower-level factors (location, spillovers, and pressure) have tended to promote win-win situations even for the non-complying plants. Similarly, certain lower-level factors (management history, physical history, size, distance, and benefit) have tended to hinder win-win situations even for the overcomplying plants.²³⁵ This might possibly imply something on the prevalence of certain conditions favourable and unfavourable to the creation of win-win situations. However, it must be stressed that the sample being a theoretical sample prevents any generalisation of this finding.

Reporting qualitative data analysis in linear text is difficult since the analysis simply does not proceed in a linear manner. To explain the data analysis, it was already necessary to make reference in this section to the six main factors and the 20 lower-

²³⁵ See also Appendix V which illustrates how it is indeed the overall combination of the determinants of environmental profit that is important.

level factors determining environmental profit. However, it should be emphasised that these factors emerged only as a result of the analysis. They were not established a priori and then operationalised and sought in the data. This is because the purpose of the case studies was to suggest theory, not to test theory. In fact, it would be plain wrong to attempt testing a theory or measuring the magnitude of the relationships in the model with the present data, since data collection was based on theoretical sampling.

Table 12 lists the factors in the initial model, after an examination of some case data but prior to the case interviews, and those in the final model, after the case interviews and full data analysis (see also Figure 18). A comparison of the initial model and the final model shows how considerably the factors changed during the iterative data analysis process. The essence of all factors that were in the initial model is present in the final model. None of the initial factors thus proved to be completely irrelevant. However, the final model contains several factors that were absent from the initial model.

Table 12 Factors in the initial model prior to case interviews, and those in the final model after the case interviews and iterative data analysis. The factors are explained in the Results section of the chapter

Factors in the initial model	Factors in the final model
FIRM	TECHNOLOGY
- Absolute level of environmental performance	- Issue
- Production technology	- Management history
- Economic performance	- Physical history
- Firm size	REGIME
- Cost structure	- Strictness
PRODUCT	- Instruments
- Scope for environmental image differentiation	VISIBILITY
- Scope for environmental content differentiation	- Location
- Price elasticity of demand	- Size
CUSTOMER	- Issue
- Direction of sales and customer segment	- Champions
COMPETITOR	- Spillovers
- Market structure	- Distance
- Benchmark for price	- End product
- Benchmark for environmental performance	WILLINGNESS TO PAY
REGULATION	- Ethical
- Level of environmental performance required	- Pressure
- Types of regulatory instruments used	- Benefit
POLLUTANT	BENCHMARKS
- Sensitivity of issue	- Environmental performance
- Technological solutions	- Price
	DISCOUNT RATE
	- Owners
	- Slack
	- Risk

Glaser and Strauss (1967) note that, typically, lower-level variables emerge fast from the data.²³⁶ Table 13 confirms this: the 20 lower-level factors of the final model were quite clearly identifiable from the interviews and the set of factors was remarkably similar from case to case. The saturation of these factors was thus achieved well before entering the last case plant.

Table 13 The occurrence of lower-level factors in the eleven case plants. A shaded cell denotes that the factor surfaced in the case as affecting the relationship between environmental and economic performance. The factors are explained in the Results section of the chapter

Lower-level factor	Link to env. profit	Case plant										
		A	B	C	D	E	F	G	H	I	J	K
Issue (tech.)	C											
Mgmt history	C											
Physical history	C											
Strictness	C											
Instruments	C											
Location	C,R											
Size	C,R											
Issue (visib.)	C,R											
Champions	C,R											
Spillovers	C,R											
Distance	C,R											
End product	C,R											
Ethical	R											
Pressure	R											
Benefit	R											
Env. perf.	R											
Price	R											
Owners	C,R											
Slack	C,R											
Risk	C,R											

C = factor is linked to environmental profit through costs

R = factor is linked to environmental profit through revenues

Glaser and Strauss (1967) continue to note that the integrating variables tend to appear later during the data analysis process.²³⁷ Indeed, the cross-case comparisons gradually allowed the main factors to emerge. A crucial difference between the initial and the final model is evident in Table 12 in the type of the main factors – six in each model – that integrate the lower-level factors. In the initial model, the main factors lack conceptual insight. Rather than a theory, the initial model resembles a way of organising facts in logical groupings. Glaser and Strauss (1967) warn of the risk of slipping "from the true generation of formal theory to the simple ordering of a mass of

²³⁶ Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research*. Chicago, Aldine Publishing Company. 271 pages. Page 36.

²³⁷ Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research*. Chicago, Aldine Publishing Company. 271 pages. Page 36.

data under a logically worked-out set of categories".²³⁸ In the final model, the main factors are more conceptual, abstract, and analytic.

6.2 Results: determinants of environmental profit

As has been noted several times, the relationship between environmental performance and economic performance is not a black and white issue. The proponents of a positive link admit that offsets against environmental costs cannot always be obtained. The proponents of a negative link admit that such offsets can sometimes be obtained. Heyes and Liston-Heyes (1999) note that there is no dispute over the existence of offsets against environmental costs, the dispute is over the significance of such offsets.²³⁹ The question is thus not whether, but when offsets are available; in other words, what determines environmental profit.

The final outcome of the case studies was a model of factors affecting environmental profit. It consists of six main factors that together determine environmental profit:

- technology - what measures can be taken to improve environmental performance and how much do they cost
- regime - the "rules of the game", the system of economic and command-and-control regulatory instruments under which the firm operates
- visibility - the extent to which the environmental performance improvement is perceived by relevant stakeholders
- willingness to pay - the extent to which customers are willing to pay for the environmental performance improvement
- benchmarks - how the firm's offering compares to the competition after the environmental performance improvement
- discount rate - how the firm weighs long-term vs. short-term costs and revenues

Technology, regime, visibility, and discount rate determine the costs of an environmental performance improvement. Visibility, willingness to pay, benchmarks, and discount rate determine the revenues from an environmental performance improvement. These relationships are shown in Figure 21, together with the 20 lower-level factors that affect the six main determinants of environmental profit. Note the agreement of the revenue-side determinants with Reinhardt's (1998) necessary and

²³⁸ Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research*. Chicago, Aldine Publishing Company. 271 pages. Page 92.

²³⁹ Heyes, A G & Liston-Heyes, C. 1999. Corporate lobbying, regulatory conduct and the Porter hypothesis. *Environmental and Resource Economics*, 13. Pages 209-218.

sufficient conditions for successful environmental differentiation: customer willingness to pay for environmental differentiation, credible information about the environmental and private benefits conferred by the product, and inability of competitors to replicate the environmental differentiation.²⁴⁰

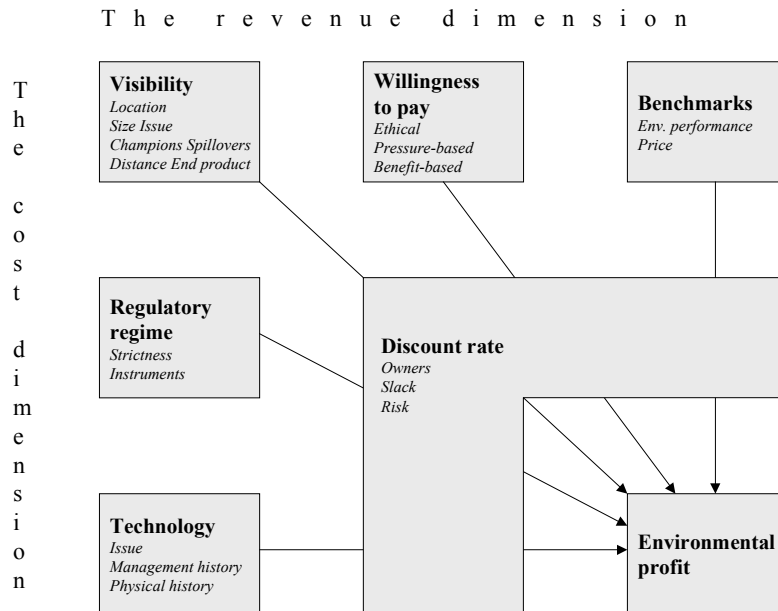


Figure 21 Determinants of environmental profit. The discount rate acts as a lens through which costs and revenues traverse

Each of the six main factors in the model, and the 20 lower-level factors that they in turn depend on, will be elaborated in the following six sections. Selected quotations from the case interviews are incorporated in the discussion for illustration purposes: to show examples of how the factors were either promoting or hindering win-win situations in the case plants. The quotations are freely translated from Finnish, the language in which the interviews were conducted.

6.2.1 Technology

The technology factor captures the direct changes in production costs that a particular environmental performance improvement brings. Stakeholder costs relate to the visibility factor and will be discussed later.

²⁴⁰ Reinhardt, F L. 1998. Environmental product differentiation: implications for corporate strategy. *California Management Review*, volume 40, 4. Pages 43-73.

Technology is here understood broadly: all measures and solutions to improve environmental performance, be they installment of hardware, changes in operating practices, reduction of output, or suchlike. The costs of an environmental performance improvement can be negative (savings) or positive (cost increases).

Factors affecting technology are the environmental issue in question, the plant's management history, and the plant's physical history. The issue matters because the set of available technological solutions is different for different environmental issues. The plant's management and physical history matter because they may place constraints to the feasibility of the available solutions for the plant in question.

Issue. The costs, fixed and variable, of an environmental performance improvement depend on the type of measure that can be implemented. For example, some measures entail economies of scale, disadvantaging small plants. All this varies between issues. If pollution prevention through process innovations is possible, if materials can be recovered and recycled, inputs and waste reduced, cost savings are possible. By contrast, end-of-pipe solutions for pollution control and treatment only add to the costs. This has also been noted by several authors.^{241,242,243} Reinhardt (1999b) argues that if short-run cost savings can be realised through improved environmental performance, they are most likely to arise through reductions in quantities of purchased materials and services.²⁴⁴ Accordingly, cost savings are common in areas such as energy, waste, packaging, and water pollution. As noted by one plant representative, "*investments to save energy are usually quite secure, and the price of energy does not usually go down*". Another plant representative said that "*before we used to invest in effluent treatment, and that cost us money. Now we invest in reducing water consumption and it saves us water, energy, and chemicals*".

Noise, on the other hand, is an example of an issue where costs savings are more difficult to obtain: "*Of all our environmental issues, noise is such that there is no way to extract economic benefits from noise reduction, it just requires a lot of costs. We have had eight environmental projects, and the noise project was the only one where we could identify no economic benefits.*"

The universe of available solutions for an issue, and their costs, changes with technological development. Technological development usually – but not necessarily – means better environmental solutions and lower abatement costs.

²⁴¹ Porter, M E & van der Linde, C. 1995b. Toward a new conception of the environment-competitiveness relationship. *Journal of Economic Perspectives*, volume 9, 4. Pages 97-118.

²⁴² Mahoney, M & Swaine, A. 1994. Executive commentary to Dechant, K & Altman, B. Environmental leadership: From compliance to competitive advantage. *Academy of Management Executive*, volume 8, 3. Pages 7-27.

²⁴³ Klassen, R D & Whybark, D C. 1999. The impact of environmental technologies on manufacturing performance. *Academy of Management Journal*, volume 42, 6. Pages 599-615.

²⁴⁴ Reinhardt, F L. 1999b. *Down to earth: applying business principles to environmental management*. Boston, Harvard Business School Press. 291 pages. Pages 89-90.

Management history. The existing level of environmental performance of a plant affects the costs of environmental improvements. Because of increasing marginal abatement costs, the better the absolute level of environmental performance already is the more expensive are further improvements. Cairncross (1992) argues that the costs of environmental performance increase rapidly as firms become cleaner. Some environmental activities may be costless, but eventually a profit impact will be felt.²⁴⁵ One plant manager said that *"now that we are in compliance 99 per cent of the time, if we want to increase that to 99.9 per cent, the last one per cent is going to be extremely expensive. But if things are going all wrong, if you are in compliance, say, 20 per cent of the time, it may not take more than changing your way of thinking to get it up to 40 per cent"*. Past activities that have been carried out to improve environmental performance thus determine where on its environmental profit curve a plant is situated: whether it has already passed the turning point of private optimum or not.

This also depends on the measures taken to reach the present level of environmental performance. Certain environmental performance improvements are free or even carry a negative cost, some others are inexpensive, but some are costly. It was noted in chapter 4 that, in principle, plants ought to exhaust the least expensive options first, but that this may not happen because of imperfect information on abatement opportunities and their costs. Therefore, costless or inexpensive abatement opportunities can occasionally be found even at high levels of environmental performance. As one plant manager put it: *"There are still a lot of measures out there that we could do for free, that are just between people's ears ... if we could make our people think differently ... if we do not succeed, authorities may require that we invest in some equipment to diminish this problem, but we could achieve the same result just by changing operating practices."*

If a plant has implemented environmental performance improvements in the order of increasing marginal abatement costs, inexpensive opportunities to improve environmental performance may already have been depleted. *"We closed our water cycles already in the 1960's, because the pollutant in the effluent is [our raw material] and it was easily recoverable, thus it made sense to recover it. Now there are no easy measures left to improve our effluents, there is nothing significant left that could be recovered."* Baylis et al. (1998b) note that when the options to minimise pollution without capital expenditure are exhausted, realising net savings from environmental investments becomes more difficult.²⁴⁶

²⁴⁵ Cairncross, F. 1992. UNCED, environmentalism and beyond. *Columbia Journal of World Business*, volume 27, 3&4. Pages 12-17.

²⁴⁶ Baylis, R, Connell, L & Flynn, A. 1998b. Company size, environmental regulation and ecological modernization: further analysis at the level of the firm. *Business Strategy and the Environment*, 7. Pages 285-296.

Reinhardt (1999b) notes that many answers to questions about cost savings depend on the baseline that is chosen for comparison.²⁴⁷ In practice, plants may not even realise that the first, costless environmental performance improvements are indeed win-win situations. The environmental manager of one plant said that *"we have this process where [our raw material] is recovered from emissions, but it cannot be considered savings because it has been like this from the beginning, the recovery has always been a natural part of the process"*. Because the very first environmental performance improvements are so evidently sensible business, plants may not recognise the early part of the rising portion of their environmental profit curve.

Organisational and cultural factors also play a role. For example, the presence of an environmental management system can, in the best case, shift the entire cost curve down by making the search for and implementation of environmental performance improvements systematic and efficient. *"Our environmental management system forces us to be disciplined. We have to be well-organised and research all options carefully, which has helped us to find opportunities for cost savings."*

Christmann (2000) studied the effects of firm resources and capabilities on win-win situations and found that capabilities for process innovation and implementation were complementary assets that were needed to achieve cost reductions from the implementation of environmental initiatives.²⁴⁸ Reinhardt (1999b) argues that sufficient flexibility and appropriate information and incentive systems are needed to realise cost savings.²⁴⁹ Kemp et al. (1992) write that technological opportunities for environmental innovation depend on the size and type of the knowledge base within an organisation, which in turn is shaped by the organisation's past activities.²⁵⁰

Physical history. The physical conditions such as the selected production technology, the existing buildings and equipment, the age of the facilities, and their location, may constrain the feasible set of abatement options for a plant. Colby et al. (1995) note that, for these reasons, the distribution of environmental costs is uneven and may vary by several hundred per cent between competitors.²⁵¹ For example, Lahti-Nuuttila (1997) writes that a plant's location affects the availability of different energy sources

²⁴⁷ Reinhardt, F L. 1999b. *Down to earth: applying business principles to environmental management*. Boston, Harvard Business School Press. 291 pages. Page 81.

²⁴⁸ Christmann, P. 2000. Effects of "best practices" of environmental management on cost advantage: the role of complementary assets. *Academy of Management Journal*, August, forthcoming.

²⁴⁹ Reinhardt, F L. 1999b. *Down to earth: applying business principles to environmental management*. Boston, Harvard Business School Press. 291 pages. Pages 99-100.

²⁵⁰ Kemp, R, Olsthoorn, X, Oosterhuis, F & Verbruggen, H. 1992. Supply and demand factors of cleaner technologies: some empirical evidence. *Environmental and Resource Economics*, 2. Pages 615-634.

²⁵¹ Colby, S, Kingsley, T & Whitehead, B W. 1995. The real green issue. Debunking the myths of environmental management. *The McKinsey Quarterly*, 2. Pages 132-143.

and thus the opportunities to reduce atmospheric emissions.²⁵² One of the plant representatives noted that *"we are so remote from any other industrial plants that it reduces our options to practice industrial ecology"*.

Stevens (1993) argues that the more an industry is typified by large non-recoverable expenditures on plant and equipment the more it is inclined to experience increased costs due to environmental investments. This is especially the case if such investments cannot be timed to fit in the usual investment cycle.²⁵³ Thus, capital- and technology-intensive industries with long investment cycles and high sunk costs may face more adjustment costs than labour-intensive industries. One plant representative noted that *"our machinery is not as capital-intensive as in some other plants, it is easier for us to implement changes because they are a bit smaller in scale, we have small but frequent investments, someone else has seldom occurring large investments"*. By contrast, in another plant *"we always remain prisoners of our technology, once we have selected a technology, we have to live with it. This industry is extremely capital-intensive, you cannot change the basic technology, just renew small parts of it"*.

Whether the production facilities are new or existing may also matter. Dramatic process changes can usually be made with new facilities.²⁵⁴ When retrofitting existing technologies and facilities, only the less innovative and less cost-efficient end-of-pipe solutions may be available. In one plant, *"our buildings are 100 years old, and this forces us to certain solutions, if we could start over from scratch we could implement these measures differently"*. In another plant, *"we have constant problems with lack of space. The buildings were originally built for a production capacity that was half of what we are aiming at now, and to install some environmental equipment here is a problem."*

To sum up, technology affects the costs of investments in environmental performance. Win-win situations are more likely to arise if process changes to prevent pollution are possible; if the plant's environmental performance is not yet very high; if the plant has ignored inexpensive abatement opportunities in the past (failed to pick the "low-hanging fruit"); if the plant has developed a systematic and cost-effective approach to environmental performance, for example, with the help of an environmental management system; if the production technology is not capital-intensive; if the investment cycles are short; if the plant's physical location does not constrain abatement options; and if the production facilities are relatively new or old enough to justify a complete rebuild.

²⁵² Lahti-Nuuttila, K. 1997. *Environmental performance of the Finnish pulp and paper industry*. Paper presented at the 4th conference of the Nordic Business Environmental Management Network. June 5-7, Tuohilampi, Finland. 11 pages.

²⁵³ Stevens, C. 1993. Do environmental policies affect competitiveness? *The OECD Observer*, 183. Pages 22-25.

²⁵⁴ Shrivastava, P. 1995. Environmental technologies and competitive advantage. *Strategic Management Journal*, volume 16. Pages 183-200.

Win-win situations are less likely to arise if only end-of-pipe solutions to control pollution are available; if the plant's environmental performance is already very high; if the plant has already exploited the inexpensive abatement opportunities (picked the "low-hanging fruit"); if the plant's organisational capabilities for implementing a systematic and cost-effective approach to environmental performance are weak; if the production technology is capital-intensive; if the investment cycles are long; if the plant's physical location constrains abatement options; and if the production facilities are relatively old but not old enough to justify a complete rebuild.

6.2.2 *Regime*

The regime factor captures regulatory costs that relate to an environmental performance level. Regime includes all the regulatory instruments that together create the "rules of the game" within which a plant operates: environmental taxes, charges, subsidies, quotas, bans, and the like.

The impact of regime on environmental profit is through avoided costs, in other words, cost prevention. Improving environmental performance reduces the amount of environmental taxes and charges to be paid, as well as fines or other punitive measures from exceeding a quota or violating a ban. It can even postpone or cancel the implementation of new environmental regulatory measures. Factors affecting regime include both regulatory strictness and the types of regulatory instruments used.

Regulatory strictness. For the purposes of the present study, regulatory strictness is best considered in relation to the plant's private optimum for environmental performance. If the regulations specify a level of environmental performance that is much higher than the plant's private optimum without the regulation, the plant will not perceive opportunities for a win-win situation. One plant representative that felt this was the situation noted that "*the requirements are too strict, it is even difficult to find equipment in the market that is good enough for meeting the requirements with somewhat reasonable costs*". If, on the other hand, the regulations specify a level of environmental performance that is much lower than the plant's private optimum without the regulation, win-win situations may be perceived. Reinhardt (1997) notes that firms with technological leadership may be in a good position to create and capture value from environmental performance, because regulators rely on these firms when assessing technological possibilities and appropriate regulatory limits.²⁵⁵

Regulatory instruments. Apart from the actual strictness of regulations, many authors have stressed that the regulatory process and the instruments used significantly

²⁵⁵ Reinhardt, F L. 1997. *Environmental quality and economic advantage: A framework for understanding corporate environmental management*. Harvard Business School Working Paper 97-071. 35 pages. Page 29.

influence the costs of compliance.²⁵⁶ Repetto (1992) has argued that the costs of environmental protection are at least twice as high as they would need to be because cleanup and control responsibilities have not been allocated cost-effectively.²⁵⁷ Brännlund et al. (1998) maintain that the Swedish pulp and paper industry would have achieved the same total emissions target but earned up to six per cent higher profits in 1989 and one per cent higher profits in 1990 if emissions trading had been used instead of non-tradable individual permits.²⁵⁸

Part of the emphasis given to this issue is perhaps due to the adversarial nature perceived in the U.S. environmental regulatory system. Porter and van der Linde (1995a) note that much of the environmental spending goes in the regulatory struggle itself.²⁵⁹ A co-operative, stable, predictable, innovation-enhancing regulatory framework has been called for to reduce the costs of environmental compliance and to increase opportunities for win-win situations.

It is important to recognise the difference between the possibility for win-win situations under a certain regime, and the possibility for win-win situations when shifting from one regime to another. This is another example where the setting of an appropriate baseline for comparison is so crucial.²⁶⁰ For example, there are fewer win-win situations under a regime without environmental economic instruments. One plant manager noted that *"water is cheap, and, therefore, you cannot get anything, you cannot justify any investment by the fact that you would consume less water, because you would really have to consume it very much less before it would make any difference"*.

Under a regime where there are environmental taxes and charges, more environmental performance improvements are win-win situations. The plant manager of another plant said: *"I wish that the waste charges were higher, then we could have bought new equipment here, then it would have been profitable. If the waste charges were 700 or 1000 marks per ton, and if we transport 1000 tons to a landfill each year, then something is bound to happen, but as long as the charges are not there we do not have to calculate that way..."* However, the shift from one type of regime to another is not necessarily (but may be) a win-win situation for a plant. The same plant manager continued: *"... but of course such waste charges cannot be implemented if someone has to pay them and competitors do not have to pay anything, that is the problem"*.

²⁵⁶ See, for example, Porter, M & van der Linde, C. 1995a. Green and competitive: Ending the stalemate. *Harvard Business Review*, September-October. Pages 120-134.

²⁵⁷ Repetto, R. 1992. Environmental taxes and U.S. competitiveness. *Columbia Journal of World Business*, volume 27, 3&4. Pages 128-134.

²⁵⁸ Brännlund, R, Chung, Y, Färe, R & Grosskopf, S. 1998. Emissions trading and profitability: the Swedish pulp and paper industry. *Environmental and Resource Economics*, volume 12, 3. Pages 345-356.

²⁵⁹ Porter, M & van der Linde, C. 1995a. Green and competitive: Ending the stalemate. *Harvard Business Review*, September-October. Pages 120-134.

²⁶⁰ Reinhardt, F L. 1999b. *Down to earth: applying business principles to environmental management*. Boston, Harvard Business School Press. 291 pages. Page 98.

To sum up, the regulatory regime affects the costs of investments in environmental performance. Win-win situations are more likely to arise if the level of environmental performance required of a plant is not higher than the plant's private optimum without the regulation, and if the rules of the game already include economic incentives to improve environmental performance.

Win-win situations are less likely to arise if the level of environmental performance required of a plant is higher than the plant's private optimum without the regulation, and if the rules of the game do not include economic incentives to improve environmental performance.

6.2.3 *Visibility*

The visibility factor captures the extent to which relevant stakeholders perceive the firm's environmental performance and changes in it. Visibility is simply about: Will anyone know? It is worth noting that "knowing" does not necessarily mean that the stakeholders perceive the environmental performance correctly.

Visibility is linked to environmental profit both through costs and revenues. When it comes to costs, relevant stakeholders can be local inhabitants, employees, authorities, the general public, the media, and so on. When it comes to revenues, the relevant stakeholders are the customers.

A problem follows from the central role of perceptions in environmental visibility. From the perspective of a firm, how its environmental performance is perceived is more important than what the environmental performance actually is. But, for the state of the environment, only actual deeds are important, not perceptions. It is possible that in some cases this disparity serves to point firms' environmental activities into directions that do not improve environmental quality.

Visibility in the environmental context was first explicitly explored by Bowen (2000b). She found environmental visibility to be an important predictor of environmental responsiveness in firms, and developed a typology where visibility was considered both a characteristics of an organisation and of an issue, at both the corporate level and the operating unit level.²⁶¹

Visibility resembles the concept of outputs by Mathur and Kenyon (1997).²⁶² Something that is not visible cannot be an output, and characteristics that are not outputs do not enter the customer's mind when making a purchasing decision.

²⁶¹ Bowen, F E. 2000b. Environmental visibility: a trigger of green organisational response? *Business Strategy and the Environment*, volume 9, 2. Pages 92-107.

²⁶² Mathur, S S & Kenyon, A. 1997. *Creating value: shaping tomorrow's business*. Oxford, Butterworth-Heinemann. 451 pages.

Visibility is affected by several factors: location, size, issue, champions, spillovers, distance, and end product.

Location. The location – both in the biogeophysical and socio-economic sense – affects visibility. The biogeophysical location refers to the plant's location with respect to the surrounding natural environment. The carrying capacity of the surrounding environment and how "significant" and "treasured" the environmental resource is affect the visibility of the plant's environmental impacts. For one plant, visibility was enhanced by the fact that *"our receiving water body is such a small creek, even the smallest disturbances are visible all the way to [a large town some 50 kilometres away]"*.

The socio-economic location refers to the plant's location with respect to the surrounding people. Local populations may differ in the amount of environmental damage they tolerate. Arora and Cason (1999) found evidence that community characteristics, such as race and gender, and economic characteristics, such as income levels and unemployment, may influence toxic releases in the United States. They found, however, no evidence that the propensity of communities to engage in political action influenced toxic releases.²⁶³ Afsah et al. (1996) concluded from a number of studies in different countries that "much of the variation in factories' environmental performance is explained by inter-community variation in income, education and bargaining power."²⁶⁴ One of the plant representatives in the present study said: *"We are situated here in the middle of holiday resorts, we have been thinking that when you look at us from there, perhaps one day there will be a requirement that we must stop operating here, and this is one of the reasons why we have been paying attention to our environmental impacts"*. The situation was different for another case plant: *"it is a small village, and all the inhabitants are employed by this plant, there have been no outsiders to put pressure on the plant"*.

Size. Size affects visibility, large plants being generally more visible than small ones.²⁶⁵ Large plants may thus stand to gain more from undertaking environmental performance improvements, for example, by avoiding negative publicity. In addition to size in terms of turnover, production, market share, or employment, size can also be considered in terms of pollution. A plant's size as a polluter can be compared to other

²⁶³ Arora, S & Cason, T N. 1999. Do community characteristics influence environmental outcomes? Evidence from the Toxics Release Inventory. *Southern Economic Journal*, 65. Pages 691-716.

²⁶⁴ Afsah, S, Laplante, B & Wheeler, D. 1996. *Controlling industrial pollution: A new paradigm*. World Bank Policy Research Department Working Paper 1672, October.

²⁶⁵ In addition to visibility, size may matter in the context of issue (technology) and slack. These are discussed under the appropriate headings. See also Bowen, F E. 2000a. *Does size matter? A meta-analysis of the relationship between organisation size and environmental responsiveness*. Paper presented at the International Association for Business and Society (IABS) Annual Meeting, Burlington, Vermont, March 16-19.

polluters of the recipient, or the carrying capacity of the recipient. Environmental impacts that are spatially concentrated, thus exceeding the carrying capacity of nature, are the first targets of regulators, environmental groups and customers.

By contrast, small polluters may gain less from improvements because both their environmental impacts and eventual improvements may go unnoticed. According to one plant representative, *"we cannot get any benefits from reducing our effluents, neither from authorities nor from customers ... the river's condition would not be improved, because our emissions are insignificant compared to the river's flow and to the emissions of all the other emitters"*. For another plant, *"the other emitters in this area are larger than us, this kills our motivation to further improve"*. Garber and Hammitt (1998) found that additional Superfund exposure increased the cost of capital for large chemical industry firms, but perhaps not for smaller firms. They proposed as one potential explanation for this finding that investors were less well informed about the relative Superfund exposure of smaller companies.²⁶⁶

Issue. Environmental issues vary, not only in the availability of technological solutions but also in the visibility of the issues themselves. Some issues are uncertain and proceed slowly (climate change), some are not easily perceived by non-experts (the extinction of an insect species), others can be immediately perceived by anyone (noise, smell, dust). Bowen (2000b) found that the sensory visibility of issues played a role in the amount of local environmental attention a plant received.²⁶⁷ One plant representative noted that *"there have sometimes been complaints when there has been foam on the river, even though it is not harmful or anything, but it is foam and everybody can see it, and they do not know what it is"*. Another plant representative declared that *"it is our objective to improve our environmental performance so that our neighbours can perceive it, but when it comes to liquid effluents, we get no benefits from overcompliance, because it is not apparent to our neighbours"*.

A distinction needs to be made between production externalities and consumption externalities. Production externalities are those that arise during the production of the product, consumption externalities those that arise during the use or disposal of the product. Production externalities may attract only local visibility, especially if the scope of the environmental issue is local. Consumption externalities, on the other hand, travel with the product and may thus be more visible to customers. *"Packaging is more important to our customers than effluents, because the customers receive the packaging, and then they have to get rid of it."*

Champions. A visibility champion may actively promote the visibility of an environmental issue or the environmental impacts of a plant. Whether some issue or plant thus becomes "hot" may not be entirely dependent on the actual seriousness of

²⁶⁶ Garber, S & Hammitt, J K. 1998. Risk premiums for environmental liability: does Superfund increase the cost of capital? *Journal of Environmental Economics and Management*, 36. Pages 267-294.

²⁶⁷ Bowen, F E. 2000b. Environmental visibility: a trigger of green organisational response? *Business Strategy and the Environment*, volume 9, 2. Pages 92-107.

the physical environmental impact. Steger and Winter (1996) found that the most decisive determinant of the "take-off" of an environmental issue was the presence of a group or institution that is devoted to pursuing the issue.²⁶⁸ Kirchhoff (2000) notes that since high environmental performance is usually a credence good, that is, unobservable from the product itself, customers depend on methods such as advertising and labeling to form opinions on environmental performance.²⁶⁹

Almost anyone can become a visibility champion: the plant itself, an information-seeking customer, a competitor, the media, a non-governmental organisation, the regulator, an industry association, or investors. It is also possible that some party actively tries to reduce the environmental visibility of an issue or a plant.

If a plant is to become an effective visibility champion, it has to be able to provide credible environmental information to the relevant stakeholders. For example, if the plant sells to a large number of constantly changing consumers, perhaps around the world, it is difficult to reach the customers with detailed, factual environmental information. Or, as noted by Reinhardt (1998), if the product accounts for a minor fraction of the customer's budget, or is peripheral to the customer's activity, attracting sufficient attention to provide this information is difficult.²⁷⁰

By contrast, if the plant has few and stable customer relationships, maybe with industrial clients or otherwise large customers, providing information is easier. One of the plant representatives expressed this as follows: *"It is a question of providing information ... Not only is there the physical improvement, but even more critical is getting the message there. It requires time and financial resources, because influencing opinions is hard. With our large customers we can influence the decision-maker, because he is a professional buyer and we are face-to-face, but on the retail side we cannot influence individual consumers the same way."*

Even plants with a high level of environmental performance may sometimes lack the motivation to become visibility champions for their own environmental performance. A plant may consider it best not to wake sleeping dogs, out of fear that by promoting the visibility of its good environmental performance in one issue, it may expose other aspects of its environmental performance, other plants in the company or corporation, or its environmental performance in other time periods to increased scrutiny. Welford and Gouldson (1993) point out that before championing their good environmental performance, firms need to ensure that there are no gaps or inaccuracies in the message and that the message is indeed able to confer competitive advantage in the

²⁶⁸ Steger, U & Winter, M. 1996. Early warning of environmentally-driven market changes: a theoretical approach and an empirical investigation. *Greener Management International*, 15. Pages 32-51.

²⁶⁹ Kirchhoff, S. 2000. Green business and blue angels. *Environmental and resource economics*, 15. Pages 403-420.

²⁷⁰ Reinhardt, F L. 1998. Environmental product differentiation: implications for corporate strategy. *California Management Review*, volume 40, 4. Pages 43-73.

markets.²⁷¹ One plant representative said: *"Because of [another plant in the same corporation] we have kept a low profile, so that we do not put it in unfavourable light. And, anyway, it would be unwise to start emphasising environmental issues when no one has asked about them ... then you should perform so well in all issues ... it is not wise to elevate yourself to a high position where it is easy to shoot you down".*

For another plant, the reasons for not championing its environmental performance were less strategic: *"We have done many things but we haven't been telling about them ... Some firms make a lot of noise even when there is no reason, but for us it has been the contrary. We should have taken everything out of [a major environmental improvement that was implemented] but we did not. We have largely been a production unit, there have been no marketing people involved in this, there has been no such communications culture."*

A competitor can act as a visibility champion in two ways. It can publicise its own good environmental performance: *"Competition is tough, we cannot afford to lag behind. If a competitor improves its environmental performance, it will not let it go unadvertised. This won't appeal to the general public, but we have gatekeepers in our distribution channel to whom it does."* Or, a competitor can expose deficiencies in the environmental performance of other producers: *"If we work for [an industrial customer], they require that environmental issues are taken care of, they produce an expensive product to export markets, and they have themselves invested a lot last year in effluent treatment, they say that when the product is sold in the U.S., a competitor may say that look, this is the product of [the industrial customer], and their environmental issues are not taken care of, they cannot afford this at all, they have to perform so that no-one has anything to say against them."*

Media interest in the environmental performance of a plant or in an environmental issue is augmented by recent serious environmental incidents regarding the plant or the issue. Media interest in plants that belong to publicly traded firms is also heightened. The media as a visibility champion were perceived by several plant representatives to promote especially negative visibility: *"Bad news always spread fast in the media and are remembered by people. If we exceed our emission quota, that is news, but if we overcomply by the same amount, that is not news."*

Campaigns by environmental or other non-governmental organisations also increase the visibility of an environmental issue. According to Elkington (1994), for their campaigns, environmentalists have picked "cascade targets", that is, firms or industries whose "distress resonates through an extended supply chain".²⁷² In this way,

²⁷¹ Welford, R & Gouldson, A. 1993. *Environmental management and business strategy*. London, Pitman Publishing. 210 pages. Pages 156-157.

²⁷² Elkington, J. 1994. Towards the sustainable corporation: win-win-win business strategies for sustainable development. *California Management Review*, Winter. Pages 90-100.

customer environmental attention is drawn to an increasing number of industries: targeting paper industry also affects the pulp and chemical industries as well as the forestry sector. One plant manager said that *"the hot issues are chosen and promoted by non-governmental organisations. Once some issue has been taken care of, the fashion is over and attention shifts to the next topic. The old topic is forgotten but remains at an improved level."*

The authorities have several ways of promoting environmental visibility. They can launch campaigns that are explicitly aimed at informing stakeholders of an environmental issue. They can establish voluntary recognition systems, such as eco-labels and environmental management systems, or mandatory labelling systems concerning, for example, energy efficiency. Environmental labelling in various ways can act as a vehicle for turning process-related environmental issues into product-related issues and thus making them more visible for stakeholders. Kennedy et al. (1994) concluded that especially when no other policy instruments are available, there is a distinct role for public environmental information provision.²⁷³

Spillovers. Visibility spillovers occur when a plant or an issue receives attention that originates somewhere else than in the current environmental performance of the plant or the present environmental seriousness of the issue. For example, compared to single-plant companies, multi-plant companies may gain reputational benefits at many sites from environmental performance improvements at one site, which may increase their incentive to improve environmental performance. In other words, reputational economies of scope exist.²⁷⁴ In addition to visibility spillovers between group plants, visibility can spill over from the plant's own history: *"Of course the image of [our firm] is gone, and it is difficult to get it back ... at that time people thought that we were the only ones polluting the river, and then we had a couple of larger accidents where a lot of fish were killed ... It can never be repaired in people's minds even though the results show that we have really improved our performance a lot."*

Visibility can also spill over to or from a parent firm, or through a shared brand. Bowen (2000b) found that visible corporations were likely to pressure individual plants to improve their environmental performance, and that sharing the same name with a visible corporation made a plant more visible.²⁷⁵ One plant representative noted that *"our plant did not face any such pressures, but we had to behave responsibly anyway, because we are part of [the parent corporation] and it operates in other industries as well, and there environmental pressures are important."*

²⁷³ Kennedy, P W, Laplante, B & Maxwell, J. 1994. Pollution policy: the role for publicly provided information. *Journal of Environmental Economics and Management*, 26. Pages 31-43.

²⁷⁴ Reinhardt, F L. 1997. *Environmental quality and economic advantage: A framework for understanding corporate environmental management*. Harvard Business School Working Paper 97-071. 35 pages. Page 30.

²⁷⁵ Bowen, F E. 2000b. Environmental visibility: a trigger of green organisational response? *Business Strategy and the Environment*, volume 9, 2. Pages 92-107.

Spillovers can occur through physical location: the environmental image of all plants situated on one industrial site may go hand in hand. *"We live in a symbiosis with the other plant on this site, the public cannot distinguish who is who. When there was a negative report about [the other plant] on TV they showed our main gate where [the name of our plant] stood in big letters."*

Finally, visibility spillovers are possible along a product's value chain, through links to other firms or industries, or by virtue of belonging to a certain industry or producing a certain product. *"It is very much an issue in this industry, everybody is looking at us, [this kind of plants] are almost like swearwords."* One interesting issue relating to spillovers – or the lack thereof – is how the firms and stakeholders perceive the firm's boundaries. A number of the plant representatives said that having concluded an outsourcing deal whereby an external firm took over the power plant, the plant no longer had any atmospheric emissions.

Distance. Distance affects visibility: the further away the less visible. An obvious example is geographic distance. However, perhaps an even more important dimension that matters especially towards customers is value chain distance. Value chain distance refers to the number of steps between the plant and the point in the value chain where willingness to pay originates. Different motivations for willingness to pay are discussed in the next section.

Two polar examples from one industry illustrate this point. A plant representative from the overcompliance cluster said that *"we are near the consumer, there are no production steps after us, the consumer sees our brands, and we see the consumer as our end user."* Another plant representative from the non-compliance cluster noted that *"our product is invisible in the final product, we are anonymous ... this is a long production chain and we are a small part at the beginning of the chain, the consumer won't know about it and neither will even the step before the consumer. Our product is far from the end user, there are many production steps between us and the final product, and our product constitutes only a small part of the final product that is purchased in a store."* Baylis et al. (1998a) also found that customer-based motivation to improve environmental performance was higher in sectors that are close to end consumer markets than in sectors supplying intermediate products.²⁷⁶

An extreme case is one where a product is sold to a customer who sells it under his own brand. In such a case the producing firm is not at all visible to the end customer. One plant manager described their situation: *"If you look at [the product] where it says [the brand of the customer] on the package, very few people know where it has been produced, all the packages look the same and you cannot tell who has produced it. If it was our plant, there will be [two letters] after a certain number, and there are tens of such codes because the customer purchases the product from several*

²⁷⁶ Baylis, R, Connell, L & Flynn, A. 1998a. Sector variation and ecological modernization: towards an analysis at the level of the firm. *Business Strategy and the Environment*, 7. Pages 150-161.

manufacturers. I have the code list but an ordinary end customer will know nothing about it. Since we do not sell the product directly ourselves but it goes through [the customer], improving environmental performance brings us no market benefits. No-one knows where the product came from, all the information about who produced it and what was the environmental performance stops when the package leaves our factory gate."

To an extent, distance is also a mental question. There may be more or less distance between a plant and the end user, but there may be more or less distance between a plant and its immediate customer as well. *"We have all kinds of customers, big and small, and from all industries, in practice we do not even always know for what purpose our product is purchased."*

End product. The nature of an end product, and its intended use, affects visibility. In a similar manner than certain environmental issues may receive a disproportionately large or small amount of attention, certain products may be special targets while others escape visibility. *"The consumer has never connected [our end product] with harmful environmental impacts in his mind, therefore, he is not receptive to messages about environmental improvements either."* For example, disposable goods used in large quantities may attract the most environmental attention, but the case data do not shed much light on this issue. Bowen (2000b) found that having a large number of customers because of the nature of the product or service produced increased visibility.²⁷⁷

To sum up, visibility affects both the costs and revenues of investments in environmental performance. Win-win situations are more likely to arise if the plant is located in an environmentally precious area and surrounded by people who do not tolerate harmful environmental impacts; if the plant is large; if the issue is easily perceived and its impacts directly felt; if some party acts as a visibility champion (for example, eco-labelling systems exist); if the plant is exposed to visibility spillovers; if the distance from the point where willingness to pay originates is small; and if the end product is such as to attract environmental attention.

Win-win situations are less likely to arise if the plant is located in an environmentally unimportant area, with no local population; if the plant is a small-scale producer and polluter; if the issue is uncertain and difficult to perceive; if no-one acts as a visibility champion; if the plant is not exposed to any visibility spillovers; if the distance between the plant and the origination point of willingness to pay is large; and if the end product does not attract environmental attention.

²⁷⁷ Bowen, F E. 2000b. Environmental visibility: a trigger of green organisational response? *Business Strategy and the Environment*, volume 9, 2. Pages 92-107.

6.2.4 Willingness to pay

Willingness to pay (WTP) captures the weight that customers give to environmental considerations in their purchasing decisions. If visibility, above, is about whether anyone knows about the environmental performance improvement, willingness to pay refers to whether anyone cares about it.

Willingness to pay for environmental performance affects revenues. Customer willingness to pay may manifest itself in the product price if a price premium can be obtained for high environmental performance. Or, customer willingness to pay may manifest itself in the sales volume if high environmental performance is a precondition for increasing market share or holding on to present customers.

Willingness to pay is also reflected in the price elasticity of demand that describes the sensitivity of customers to changes in the product price and thus determines the ability of a firm to pass on environmental costs to customers. With inelastic demand, the drop in the quantity demanded resulting from a price increase remains small. The price elasticity of demand is affected by factors such as the market structure, the availability of substitutes, the presence of switching costs for customers, and the significance of non-price factors in competition.

Customers have three kinds of motivations for their willingness to pay for environmental performance. Willingness to pay can be ethical, pressure-based, or benefit-based. In this context, ethical willingness to pay refers to willingness to pay where the driving force is the desire to improve environmental quality. The driving force for pressure-based willingness to pay is the need to respond to external pressures. The driving force for benefit-based willingness to pay is the desire to obtain the non-environmental benefits incurred by purchasing the environmentally preferable good or service. Willingness to pay arises at a point or points in the value chain based on one or more of these motivations. From there, it trickles down the value chain, backwards or upstream in the life-cycle chain or life-cycle net, until the distance becomes too big and visibility too low.

In general, ethical motivations are to be expected from consumers only: *"We sell business-to-business. It is professional, the volumes are large, and many issues are taken into account, but no ethical or emotional environmental issues. In consumer markets, the purchasing decisions are also based on emotions."* Pressure-based motivations, by contrast, are more rare with consumers – no-one can boycott the consumer, but there may still be regulations that apply to consumers. Benefit-based motivations can arise anywhere in the value chain.

Interestingly, several cases pointed to the possibility that those who are one step removed from the consumers, that is, those who sell to those who sell to consumers, are under the highest pressure to improve their environmental performance but also stand to gain the most from such improvements. The explanation is that consumers do

not have widespread willingness to pay for environmental performance even though they claim they do. Moisander (1996) notes that the relationship between consumers' pro-environmental attitudes and their specific consumption activities is complicated, and, according to several researchers, inconsistent.²⁷⁸ *"Personally, I do not believe that the consumers would pay a penny more for environmental products, because our industry has studied consumer behaviour extensively, and even though the consumers say that they will pay, in a real situation they don't."* But those who sell to consumers have to be prepared for eventual consumer willingness to pay anyway, wherefore they already take environmental action and also demand this from their own suppliers.

Ethical motivations. Sometimes, but not always, customers are willing to pay for environmental performance improvements out of purely ethical reasons. For example, Rauscher (1997) writes that successful use of eco-labels for combating global environmental problems is possible only if consumers act irrationally or derive personal utility from saving the environment; otherwise consumers would choose to free-ride since their own contribution to the problem is so small.²⁷⁹

The existence of ethical-based willingness to pay may vary according to several factors. One of them is the cultural difference between various geographic markets and various customer segments. Some customer segments such as young consumers or women may be particularly environmentally sensitive. Uusitalo (1986) found that willingness to pay for environmental performance in the form of higher prices was clearly higher among women than among men, but there were no differences between other background variables tested. Personal experiences of environmental damage and a concern for the state of the environment also correlated positively with willingness to pay. However, she noted that environmental purchasing behaviour could not be reliably predicted from background variables or attitudinal variables.²⁸⁰ One plant manager noted: *"And if you think about [the end product that our product is part of], who buys it? Children! They do not care; if there would be an environmentally conscious customer segment, like well-educated urban women between 30 and 39 years, that would be a different story."*

Another factor is the nature of the product. Products, and how they are consumed, differ in the scope that they provide for environmental differentiation. Reinhardt (1998) describes two polar examples: StarKist tuna, which is "an unglamorous source of cheap protein that is consumed in the home" failed in competing based on environmental differentiation, whereas Patagonia clothes that sport fashionable labels

²⁷⁸ Moisander, J. 1996. Attitudes and ecologically responsible consumption. Helsinki, Statistics Finland Research Reports 218. 159 pages.

²⁷⁹ Rauscher, M. 1997. *International trade, factor movements, and the environment*. Oxford, Clarendon Press. 335 pages. Page 309.

²⁸⁰ Uusitalo, L. 1986. *Suomalaiset ja ympäristö. Tutkimus taloudellisen käyttäytymisen rationaalisuudesta*. Helsinki, Acta Academiae Oeconomicae Helsingiensis Series A:49. 170 pages.

and are worn in public succeeded.²⁸¹ One study found that environmental considerations were a different purchasing criterion for daily items than for durable goods.²⁸²

A third, important factor is the customer's wealth. The demand for a clean environment is generally considered to be income-elastic and to increase with increasing prosperity.²⁸³ Customers in affluent societies tend to be more environmentally conscious in their purchasing behaviour; within a country, green thinking can often be identified with the top end of the market.²⁸⁴ When economic times are good, customers are more willing to pay to protect the environment.²⁸⁵ "During the recession environmental issues were not on the foreground when factories were closed and people laid off ... now the interest has risen again." Tanskanen (1997) found that, among twenty countries studied, willingness to pay for environmental quality was highest in the industrialised countries and lowest in the countries with economies in transition. However, willingness to pay did not solely depend on the standard of living in the country. For example, willingness to pay correlated positively with knowledge of environmental problems.²⁸⁶

Still another factor affecting ethical willingness to pay is the environmental issue at stake. This point is closely linked to the discussion on the visibility of different issues, above, but is not quite the same thing. Some environmental issues – like forests, cute animals, or threats to human health – are more sensitive and arouse stronger feelings in customers than others. Halme (1996) notes that there was a difference between biodiversity conservation and solid waste management because biodiversity conservation was more of an emotional issue, and it was promoted by environmental organisations who tend to use methods appealing to emotions. By contrast, solid waste management was not such an emotional issue and it was promoted by authorities who do not tend to use methods appealing to emotions.²⁸⁷

²⁸¹ Reinhardt, F L. 1998. Environmental product differentiation: implications for corporate strategy. *California Management Review*, volume 40, 4. Pages 43-73.

²⁸² GfM. 1992. Zweite Repräsentativ-Befragung "Abfälle" im Auftrag des Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Hergiswil. Ref. offprint from Dyllick, T, Belz, F, Hugenschmidt, H, Koller, F, Laubscher, R, Paulus, J, Sahlberg, M & Schneidewind, U. *Ökologischer Wandel in Schweizer Branchen*. Bern, Haupt.

²⁸³ For a discussion on the difference between the income elasticity of demand and the income elasticity of willingness to pay, see Flores, N E & Carson, R T. 1997. The relationship between the income elasticities of demand and willingness to pay. *Journal of Environmental Economics and Management*, 33. Pages 287-295.

²⁸⁴ Cairncross, F. 1995. *Green, Inc. A guide to business and the environment*. London, Earthscan Publications Ltd.

²⁸⁵ Cairncross, F. 1992. UNCED, environmentalism and beyond. *Columbia Journal of World Business*, volume 27, 3&4. Pages 12-17.

²⁸⁶ Tanskanen, E. 1997. *Suomalaiset ja ympäristö kansainvälisestä näkökulmasta*. Helsinki, Statistics Finland Research Reports 225, 153 pages.

²⁸⁷ Halme, M. 1996. Shifting environmental management paradigms in two Finnish paper facilities: A broader view of institutional theory. *Business Strategy and the Environment*, volume 5. Pages 94-105.

With internationally traded products, customers may be more concerned about consumption externalities arising near them and affecting them directly than about production externalities arising in the producer country. On the other hand, it may be easier to protect the environment in another country: fewer economic impacts are directly felt and fewer changes are required in customers' own behaviour.

Pressure-based motivations. Industrial or retail customers may be willing to pay for environmental performance because they themselves are under pressure to use suppliers with high environmental performance. Pressure-based willingness to pay is the channel through which environmental demands trickle down the value chain. *"We obtained one order only because we had the ISO 14001 system and the others did not, even though our offer was not the least expensive one. That single order alone covered all the expenses of the ISO 14001 for that year. The customer was an international company and they wanted a supplier with the ISO 14001 system because they needed to show that they were using environmentally friendly suppliers."*

Such pressure may originate from the customer's own customers. Or, it may originate from the legal requirements the customer faces: *"Packaging is what interests our customers, because they face packaging laws in their own country, and they have to report to their authorities how much packaging they receive and they have to dispose of it"*. The pressure may also originate from private initiatives that the customer participates in, such as Responsible Care in the chemical industry, or voluntary obligations that it has undertaken, such as the ISO 14001 environmental management system. *"If our customer is industrial, perhaps he is committed to an environmental management system. If he is a public body, perhaps he is bound by public procurement requirements. For these kinds of customers the requirements have been explicitly defined. But if our client is the consumer, no-one pressures him, and what is important is subjective and varies from consumer to consumer."*

Benefit-based motivations. Benefit-based motivations for willingness to pay may arise both with consumers and with industrial customers. They appear if the improved environmental performance, which is a public good, is bundled with a private good in the product. For example, it may bring health or other benefits to the customer, or decrease the customer's costs. The customer may be willing to pay for the private good even if he is not willing to pay for the public good.²⁸⁸ Belz (1995) found that health benefits were on the foreground for customers buying products from organic farming; for many customers, the contribution of organic farming to environmental quality was of secondary importance.²⁸⁹

²⁸⁸ Reinhardt, F L. 1998. Environmental product differentiation: implications for corporate strategy. *California Management Review*, volume 40, 4. Pages 43-73.

²⁸⁹ Belz, F. 1995. *Ökologie und Wettbewerbsfähigkeit in der Schweizer Lebensmittelbranche*. Schriftenreihe Wirtschaft und Ökologie, Band 3. Bern, Haupt. 324 pages. Page 223.

One of the case plants had developed a product that benefits the environment and also saves customers' costs: *"The product is more expensive than the previous alternatives, but it has succeeded in the markets. In the consumer market it commands a premium of 100 per cent. However, the product was not developed for environmental reasons, and it is not marketed with environmental arguments."* The representative of another case plant saw no opportunity to bundle health-related private goods with the plant's product: *"The end products are unhealthy as such, if I am honest, so those who are really conscious consume them very little or not at all, and if you think about the main user groups of the products, they are not very conscious anyway."*

By contrast, willingness to pay is reduced if the environmental good is negatively bundled with a private good in the product: if the appearance, convenience, or functional quality of the product is weakened (or perceived to be weakened) or if there are trade-offs with other quality attributes. Both positive and negative bundling with private goods requires that the environmental issue is or can be made product-related.

To sum up, willingness to pay affects the revenues from investments in environmental performance. Win-win situations are more likely to arise if there are no substitutes; if there are switching costs; if the customer is a wealthy consumer from an environmentally conscious geographic market or customer segment; if the product provides scope for environmental differentiation; if the issue appeals to emotions; if the customer is under market or regulatory pressure to use environmentally friendly suppliers; or if the improved environmental performance lowers the customer's costs or increases customer value.

Win-win situations are less likely to arise if there are substitutes but no switching costs; if the customer is poor and belongs to a geographic market or customer segment that is not environmentally conscious; if the product does not provide scope for environmental differentiation; if the issue does not appeal to emotions; if the customer is under no market or regulatory pressure to use environmentally friendly suppliers; or if the improved environmental performance increases the customer's costs or decreases customer value.

6.2.5 *Benchmarks*

Incorporating benchmarks on the revenue side of the model is necessary because in a purchasing situation customers assess each offering by comparing it to available alternatives. Two benchmarks are relevant in this context: the prices of competing offerings, and the environmental performance of competing offerings. Section 3.1.3 also showed how in an oligopoly the optimal level of environmental performance depends on the level selected by the other firms.

The non-environmental attributes of the offering, such as appearance, functional quality, or taste, also matter in a purchasing situation. Situations where changes in environmental performance change – improve or worsen – some of these other product or service attributes were discussed above under benefit-based motivations for willingness to pay. The relative importance of the different benchmarks is also not discussed separately under this heading since it is essentially the same point as willingness to pay.

Environmental performance benchmark. The extent of environmental differentiation, which is a relative concept, is judged in the eyes of customers in relation to the environmental performance of competitors. *"We have to be able to demonstrate constant improvement to maintain our good image, we must be able to show improvement in our environmental figures ... if we stabilise at some level, when the others slowly make progress, we will be left behind, the comparison is always to our competitors."* Competing products can either be similar products produced by other firms (intra-product substitution), or substitutes that are different products but fulfil the same need as the original product (inter-product substitution).

The desirable environmental performance level of the competitors is a thorny question. On the one hand, if environmental performance is emphasised by too many competitors, its differentiating value erodes: *"In the beginning environmental friendliness was something extra and you were perhaps rewarded for it. Soon it will have become a natural part of everyone's activities and you will be punished for failing to accomplish it."* An industry-wide environmental programme reduces the cost barriers to environmental protection faced by the individual firms. However, while such a programme may improve the environmental legitimacy of the industry as a whole, no single firm can gain a differentiation advantage – except against inter-product substitution – if all firms implement a similar programme.²⁹⁰ Reinhardt (1998) notes that one precondition for building a strategy on environmental differentiation is that the competitors cannot easily imitate the improved environmental performance.²⁹¹

On the other hand, there may also be problems if none of the competitors emphasise environmental performance. First-mover advantages are not inevitable but depend on the competitors following the path.²⁹² And, customers may be reluctant to commit themselves to the new alternative product if there is only one supplier. The representative of one plant that had developed an environmentally friendlier product alternative noted that *"when [our industrial retail customer] buys from several manufacturers, if they were to switch to [the new environmentally friendlier product], they would have only two or three possible suppliers to negotiate with, now that they*

²⁹⁰ Downing, R M. 1994. Executive commentary to Dechant, K & Altman, B. Environmental leadership: From compliance to competitive advantage. *Academy of Management Executive*, volume 8, 3. Pages 7-27.

²⁹¹ Reinhardt, F L. 1998. Environmental product differentiation: implications for corporate strategy. *California Management Review*, volume 40, 4. Pages 43-73.

²⁹² European Community. 1992. *Industrial competitiveness and environmental protection*. EC Commission Communication SEC(92)1986.

have this ordinary product they have hundreds of manufacturers to select from, they can buy anywhere and play the suppliers against each other."

Price benchmark. Two situations can be distinguished when discussing the price benchmark. There may be price differentials due to differences in environmental performance between competitors. Or, there may be price differentials despite the similarity of environmental performance between competitors. Of course, there may also be price differentials that do not relate to environmental performance at all.

Producers coming from different jurisdictions may be subject to different environmental process standards. If compliance with these standards results in cost increases, loss of cost competitiveness in international trade has been claimed. However, even if two producers implement the same level of environmental performance, they do not necessarily incur the same costs in this exercise. This is especially true in the case of inter-product substitution, but cost asymmetries are even possible with producers of similar products.²⁹³ One plant manager noted that *"we can benefit from improving our environmental performance, and from lobbying for stricter regulations, because in this way we can force more costs on our competitors."*

Reinhardt (1999b) summarises the situation with regard to both benchmarks as follows. If there is customer willingness to pay for improved environmental performance, a firm can choose the strategy of environmental differentiation. In this case it would not wish for the competitors to imitate its good environmental performance. If, by contrast, there is no customer willingness to pay and a firm is subject to a regulatory requirement to improve its environmental performance, it would want all its competitors to face similar requirements so that they would have to match the good environmental performance and incur the related costs. If a firm considers that it can fulfil a requirement at a lower cost than its competitors, it may even actively lobby for stricter regulations or voluntary industry-wide initiatives to raise its rivals' costs.²⁹⁴

To sum up, benchmarks affect the revenues from investments in environmental performance. Win-win situations are more likely to arise if competitors cannot imitate the good environmental performance, at least not with low costs, and if the prices of competing products are relatively high.

Win-win situations are less likely to arise if competitors can imitate the good environmental performance, perhaps with smaller costs, and if the prices of competing products are relatively low.

²⁹³ Reinhardt, F L. 1999a. Market failure and the environmental policies of firms: economic rationales for "beyond compliance" behaviour. *Journal of Industrial Ecology*, volume 3, 1. Pages 9-21.

²⁹⁴ Reinhardt, F L. 1999b. *Down to earth: applying business principles to environmental management*. Boston, Harvard Business School Press. 291 pages. Pages 45-77.

6.2.6 Discount rate

Discounting is the process of aggregating the flow of costs and revenues over time. Environmental profit equals the discounted net stream of all costs and revenues, however indirect, that relate to environmental performance. Therefore, a discount rate enters the model. The discount rate factor captures the weight that the plant gives to short-term vs. long-term costs and revenues. The higher the discount rate the less weight is given to future costs and revenues and, usually, the less win-win situations there are.²⁹⁵ Kirchhoff (2000), too, notes that one should expect to see overcompliance where the discount rate is low.²⁹⁶

In the present study, the term discount rate is used as an abstract concept, to refer to the idea of discounting. It does not refer to a concrete value as, for example, in finance. Consequently, the model should not be understood so that each plant would actually have a certain percentage discount rate in mind that it applies to environment-related costs and revenues. To start with, the environment-related costs and revenues are usually not even quantifiable. Similarly, there may be no explicit discount rate calculations, but, either consciously or subconsciously, each plant must and does weigh short-term and long-term effects in its decision-making. Three factors influence the discount rate as understood for the purposes of the present study: owners, slack, and risk.

Owners. Different owners may be satisfied with different short-term returns on their investment. In this respect, one can contrast family-owned, state-owned, or publicly owned firms. For example, it has been suggested that the stock market as the critical financial institution may encourage short-termism by overestimating the discount factor.²⁹⁷ Whereas the owner-manager of one small enterprise said: "*I haven't really followed the financial side so much, I just do my work and see then if I have money in the back pocket*", the plant manager of a plant belonging to a multinational publicly traded corporation claimed that "*in this corporation you have to be crazy to suggest an investment with a payback time over five years, men have been replaced for lesser reasons*".

This is also the place where some ethical considerations may enter the model. As explained in the introduction, the approach taken in the present study is that firms aim

²⁹⁵ Discount rate matters if there is an asymmetry in the distribution of costs and benefits over time. Typically, environmental costs need to be incurred before the environmental private benefits are realised. In this case a low discounting rate increases win-win situations because even long-term benefits are included in the calculations. Of course, if the circumstances were reversed so that environmental private benefits were to be obtained immediately but the costs were spread over a long period, a low discount rate would decrease win-win situations. Such instances may, however, be rare.

²⁹⁶ Kirchhoff, S. 2000. Green business and blue angels. *Environmental and resource economics*, 15. Pages 403-420.

²⁹⁷ Mathur, S S & Kenyon, A. 1997. *Creating value: shaping tomorrow's business*. Oxford, Butterworth-Heinemann. 451 pages. Pages 270-278.

to maximise expected profit. However, even if the organisations themselves are not ethical agents, the people working in them may still have ethical motivations. Ruud (1995) argues that individual employees have to follow the norm of profit maximisation even if it is not identical to their own preferences.²⁹⁸ One interviewee said: *"You can promote [environmental issues] with your heart and then try to make up some arguments, it has to be camouflaged in something else, you cannot use ethical arguments to receive the investment funds from above."* Petts et al. (1999) found that the operational climate in many small and medium-sized enterprises differed from the positive attitude of individuals to environmental issues.²⁹⁹ If a manager is in a position to exert considerable influence over the firm, such as the owner-manager quoted above, his personal values may become the organisation's values.

Slack. Bowen (1999) has examined the role of organisational slack, in terms of time or money, in implementing environmental initiatives.³⁰⁰ Slack refers to the availability of excess resources. Hence, slack constitutes the feedback mechanism from economic to environmental performance. For example, it is often argued that small firms do not possess the financial, technological or human resources to examine all options to improve environmental performance, wherefore they must focus on meeting regulatory mandates instead of searching for innovative and profitable proactive solutions for the future.^{301,302}

Firms at the margin of survival may not be able to afford to incur environmental costs, even if short-term cost increases could be expected to bring long-term revenues. One plant representative noted that *"we have had quite a few lay-offs recently, when there are enough other problems, when the survival of the whole operation is at stake, environmental issues are pushed to the background"*. Another said that *"if we are not talking about big money, perhaps we could accept somewhat longer payback times for environmental investments, I mean, if there is extra money available, but if the times are hard or if we are talking about big sums, there is no special treatment for environmental investments."*

However, a lack of excess resources may not be entirely negative: *"In a way it was a good thing that we had this financial crisis ... since we had no possibility to invest in*

²⁹⁸ Ruud, A. 1995. *Corporate environmental decision-making: a rational choice?* Centre for Development and the Environment, University of Oslo, Working Paper 1995.2. 20 pages. Page 5.

²⁹⁹ Petts, J, Herd, A, Gerrard, S & Horne, C. 1999. The climate and culture of environmental compliance within SMEs. *Business Strategy and the Environment*, 8. Pages 14-30.

³⁰⁰ Bowen, F E. 1999. Does organisational slack stimulate the implementation of environmental initiatives? In: Wood, D & Windsor, D (editors). *Proceedings of the Tenth Annual Meeting of the International Association of Business and Society*. Pages 529-534.

³⁰¹ Bonifant, B C, Arnold, M B & Long, F J. 1995. Gaining competitive advantage through environmental investments. *Business Horizons*, July-August. Pages 37-47.

³⁰² Miller, R A. 1994. Executive commentary to Dechant, K & Altman, B. Environmental leadership: From compliance to competitive advantage. *Academy of Management Executive*, volume 8, 3. Pages 7-27.

a biological effluent treatment plant, we had to focus on the production process instead, and there we discovered savings that show directly on the bottom line".

Even if the marginal environmental profit of some investment in environmental performance is positive, investing the same resources somewhere else could yield an even more positive result. Thus, in an opportunity cost sense, a win-win situation may still not be attractive for a plant if more lucrative alternative uses for the resources are available and the resources are scarce. *"If you look at the payback time of [an environmental investment], it is long, there are lots of investment opportunities out there with a payback time of less than a year, and this is certainly not going to be less than a year, I would say it is in the order of five years ... we have prioritised investments that increase capacity or improve product quality."*

Here, again, slack enters the picture. Because investment resources are limited, a positive net present value, corresponding to positive environmental profit in the case of environmental investments, is usually not a sufficient condition for implementing an investment. In principle, after deciding on the "must" investments, all other investment opportunities with a positive net present value are ranked in the order of descending net present value, and as many investments are implemented as the remaining investment budget allows, starting from number one.³⁰³ If, despite representing win-win situations, environmental investments are in general less lucrative than some other investments, they will not occupy the first places in this line. This is not to say, however, that all environmental investments are categorically doomed to the end of the line. The more excess resources the plant has the further along the line it gets before the investment budget is exhausted, and the more environmental investments fit in the implementation schedule.

Risk. Reinhardt (1999a, 1999b) emphasises risk management as an important reason for overcompliance but also notes that risk considerations are difficult to separate from value considerations.³⁰⁴ In the present study, general risk management issues

³⁰³ Markandya, A & Pearce, D. 1988. *Environmental considerations and the choice of the discount rate in developing countries*. World Bank Environment Department Working Paper No. 3. Washington, D.C., The World Bank. 79 pages.

³⁰⁴ Reinhardt, F L. 1999a. Market failure and the environmental policies of firms: economic rationales for "beyond compliance" behaviour. *Journal of Industrial Ecology*, volume 3, 1. Pages 9-21, and Reinhardt, F L. 1999b. *Down to earth: applying business principles to environmental management*. Boston, Harvard Business School Press. 291 pages. Pages 45-77. Pages 11 and 175.

have been integrated with value creation issues throughout.³⁰⁵ However, risk emerged as a separate, important element affecting plants' time perspective in decision-making, and thus their discount rate. Plants anticipating important changes in the behaviour of customers, competitors, and regulators were already preparing adjustment to such changes, because *"the one who shoots first, wins."*

Customer preferences for the environment can fluctuate both ways with time.³⁰⁶ However, more often than not, it is anticipated that customers' willingness to pay for environmental performance will increase in the future. *"We have to follow the developments, and preferably in the first row, not begin to change only after we have already lost something, this is why it already affects the way we work ... in the future environmental issues will be important for our customers, but this is not the case today."*

To an extent, this is a self-fulfilling prophecy. As noted, to get ready for supposed future customer requirements, industrial customers are expressing such requirements towards their own suppliers already today. The same holds for predictions that competitors' environmental performance will improve in the future and thus alter the benchmarks against which a plant is judged. When all competitors improve their environmental performance to keep up with the others, the environmental performance of the whole industry improves.

In addition to the market risks of changing customer and competitor behaviour, changes in the rules of the game may also pose a risk. Reinhardt (1998) notes that business strategy needs to take into account the behaviour of regulators "not just now but over the lives of the assets the firm is dedicating to the business".³⁰⁷ Generally, environmental regulation is expected to increase over time. *"The requirements will*

³⁰⁵ As discussed in chapter 5, one type of risk arises from the fact that managers may have incomplete control over emission levels, wherefore they may need to target an emission level lower than the permitted level in order not to violate the emission standard with a certain probability. Technically, this issue was taken into account by not declaring any level of compliance below 100 as overcompliance. Substantively, however, this issue serves to illustrate how risk management has been integrated with value treatment in the model. When facing this kind of risk, managers need to consider the probability of occasionally violating the standard and the magnitude of penalties from violation: formal penalties from regulators or informal sanctions from surrounding communities or the markets. Thereafter, managers need to decide whether to emit less than permitted on the average, or whether to face the possibility of non-compliance. A decision to emit less than permitted corresponds to a perceived win-win situation. This decision may be affected by several of the determinants of the model, such as the costs of emitting less than permitted (technology), the severity of regulatory consequences of violating the standard (regime), or the alertness of local populations or the markets to occasional non-compliance (visibility).

³⁰⁶ For example Azzone and Bertelè (1994) discuss how an ecological cataclysm or an economic recession can affect the evolution of environmental expectations. Azzone, G & Bertelè, U. 1994. Exploiting green strategies for competitive advantage. *Long Range Planning*, volume 27, no. 6. Pages 69-81.

³⁰⁷ Reinhardt, F L. 1998. Environmental product differentiation: implications for corporate strategy. *California Management Review*, volume 40, 4. Pages 43-73.

become stricter in the future, that is why we have to be awake all the time. A new hot environmental topic may appear any time, but it may be different from the previous ones."

However, the riskiness of a plant's external world may also serve to shorten the time perspective of decision-making. One plant manager noted that *"the world around us has changed a lot ... uncertainty has increased and time frames have shortened ... now we are exposed to global competition ... before we could make large investments with long payback times since we knew that the world around us was quite stable ... now we cannot foresee changes so well, if we were now to invest in an effluent treatment plant, we could not think that we have ten years to pay it back like we could think before."*

To sum up, the discount rate affects the present value of both the costs and revenues of investments in environmental performance. Win-win situations are more likely to arise if weight is given also to long-term considerations because owners do not require high short-term returns on investment; excess resources are available; customer willingness to pay is anticipated to increase in the future; competitors' environmental performance is anticipated to improve in the future; and environmental regulations are anticipated to tighten in the future.

Win-win situations are less likely to arise if no weight is given to long-term considerations because owners require high short-term returns on investment; no excess resources are available; customer willingness to pay is not anticipated to increase in the future; competitors' environmental performance is not anticipated to improve in the future; and environmental regulations are not anticipated to tighten in the future.

6.2.7 Summary

Table 14 summarises the six main factors and the 20 lower-level factors by way of detailing how each factor can promote the creation of win-win situations. It is combinations of this net of factors that together determine the environmental profit of an environmental improvement.

Reflecting back to the theoretical module in chapter 4, note that the determinants of environmental profit could produce shifts in the MAC curve or the MPB curve. This corresponds to the division of the determinants into cost-side and revenue-side factors in the case module. The results can be formally expressed as $MAC = f(e, T, R, V, D)$ and $MPB = f(e, V, W, B, D)$, and thus $e^{p*} = f(T, R, V, W, B, D)$, where e stands for environmental performance, T is technology, R is regime, V is visibility, W is willingness to pay, B is benchmarks, and D is discount rate. These equations capture both the non-constant properties and the non-uniform properties of the relationship between environmental and economic performance.

Table 14 Summary of factors that increase the potential for win-win situations

Main factor	Lower-level factor	Win-win situations are more likely if
Technology	Issue	- process changes to prevent pollution are possible
	Management history	- the plant's environmental performance is not yet very high - the plant has ignored inexpensive abatement opportunities in the past (failed to pick the "low-hanging fruit") - the plant has developed a systematic and cost-effective approach to environmental performance, for example, with the help of an environmental management system
	Physical history	- the production technology is not capital-intensive - investment cycles are short - the plant's physical location does not constrain abatement options - the production facilities are relatively new or old enough to justify a complete rebuild
Regime	Strictness	- the level of environmental performance required of a plant is not higher than the plant's private optimum without the regulation
	Instruments	- the rules of the game already include economic incentives to improve environmental performance
Visibility	Location	- the plant is located in an environmentally precious area and surrounded by people who do not tolerate harmful environmental impacts
	Size	- the plant is large
	Issue	- the issue is easily perceived and its impacts directly felt
	Champions	- some party acts as a visibility champion (for example, eco-labelling systems exist)
	Spillovers	- the plant is exposed to visibility spillovers
	Distance	- the distance from the point where willingness to pay originates is small
Willingness to pay	End product	- the end product is such as to attract environmental attention
	Ethical	- the customer is a wealthy consumer from an environmentally conscious geographic market or customer segment - the product provides scope for environmental differentiation - the issue appeals to emotions
	Pressure-based	- the customer is under market or regulatory pressure to use environmentally friendly suppliers
	Benefit-based	- the improved environmental performance lowers the customer's costs or increases customer value
Bench-marks	Environmental performance	- competitors cannot imitate the good environmental performance, at least not with low costs
	Price	- the prices of competing products are relatively high
Discount rate	Owners	- weight is given also to long-term considerations because owners do not require high short-term returns on investment
	Slack	- excess resources are available
	Risk	- customer willingness to pay is anticipated to increase in the future - the competitors' environmental performance is anticipated to improve in the future - environmental regulations are anticipated to tighten in the future

Two interesting issues that are not apparent from the results are the prevalence of the different determinants of environmental profit and their relative importance. As has already been noted, it is impossible for the present study to answer these questions since the study is based on theoretical sampling. However, it is possible to present

some impressions gained during the research, recognising that the impressions would need to be subjected to a separate test. Perhaps the three factors that came across the most strongly from the interviews were distance (visibility), pressure (willingness to pay) and risk (discount rate), of the latter especially the perception that customers will pay increased attention to environmental issues in the future. What is notable is that all three relate very closely to customer behaviour.

The resulting model as a whole is new, even though references to literature supporting the findings were spread throughout the chapter. Not only does the literature provide support to the model; the model also offers a home and a systematic context for some previous stand-alone observations. Many of such observations were taken not from studies about the relationship between environmental and economic performance but from studies about other, related issues. Of the individual determinants, the most novel or surprising findings were perhaps the role of a number of factors relating to visibility (location, champions, spillovers, and distance), the discount rate as a lens through which costs and revenues traverse, and the role of pressure-based willingness to pay.

6.3 Discussion

This final section discusses the risks to the quality of the analysis presented above. Some of these risks are specific to the present study but most are typical of case studies.

A common argument against case studies is that their results are not generalisable due to a small sample size. Indeed, statistical generalisation is not possible in the present case. It would not be possible even if the sample size were much larger, because the sample is a theoretical, not random sample. In the statistical sense, the sample is not representative of any population, wherefore the results cannot be generalised to a population of plants through statistical inference. This was never the intention, either.

In qualitative studies, analytical generalisation to theoretical propositions instead of statistical generalisation to populations comes into question. A theoretical framework that describes the conditions under which a phenomenon is or is not likely to be found acts as the vehicle for generalising to new cases.³⁰⁸ Generalisation takes place through raising the abstraction level, not through finding average or typical relationships.³⁰⁹ Lukka and Kasanen (1993) emphasise that case-study results are likely to be frameworks, models, or constructs that act as vehicles for the conceptual capture of a phenomenon. Results that manifest profound understanding of a problem have relevance also outside the primary data sample. For example, the competitive strategy framework by Porter does not assert anything substantive about the competitive

³⁰⁸ Yin, R. K. 1989. *Case study research. Design and methods*. Revised edition. Newbury Park, Sage Publications.

³⁰⁹ Alasuutari, P. 1994. *Laadullinen tutkimus*. Tampere, Vastapaino. 281 pages. Page 41.

situation of any group of firms. Yet, it can be used to analyse the competitive situation of any firm.³¹⁰ The same logic applies to the results of the present study.

Because no statistical generalisation is attempted, sample size requirements for quantitative studies do not apply as such. The adequacy of the sample does not depend on its size but on the theoretical sampling process: whether the sample provides sufficient variation and whether there is sufficient certainty that saturation has been achieved and data collection has not been stopped prematurely. Lukka and Kasanen (1993) note that the generalisability of the results depend on the depth of the insight, not on the size of the sample.³¹¹ In the present case, theoretical sampling included deliberately searching for disconfirming cases that would falsify the evolving explanation rule. Alasuutari (1994) notes that a meta-observation can manifest itself in the form of several variants in the raw data.³¹² Accordingly, saturation was declared when adding new cases did not yield any new factors even though they could still yield new empirical variants of the way a factor exhibited itself.

Qualitative studies easily suffer from a gap between the data and the conclusions, which gives rise to a credibility problem. In the present study, this risk was further aggravated by the confidentiality requirement. However, the sensitivity of the topic gives a strong reason to believe that the data quality would have seriously suffered if confidentiality had not been guaranteed. There was thus a trade-off between being able to report the cases thoroughly, and having something interesting to report on in the first place. Although primary case data could not be presented in detail, an attempt was made to describe all the analytical steps in an explicit and transparent manner.

Case interviewers are often suspected of a lack of objectivity, manifested by consciously or subconsciously leading questions. In the worst case, the interviewer can force his or her prior assumptions on the respondents. To avoid this, it is often recommended that the interviewer know as little as possible on the topic or the cases before entering the field. However, as noted by Dey (1993), "there is a difference between an open mind and empty head": prior assumptions and ideas do not need to present a problem if the researcher is fully aware of them.³¹³ In the present study, consciously leading questions were shunned. For example, probes were sometimes used to lead the respondents towards a topic, but never towards particular answers about the topic. The threat of subconsciously leading questions may have been reduced by the fact that there was genuinely no preconceived idea about the most desirable answers to the interview questions.

³¹⁰ Lukka, K & Kasanen, E. 1993. Yleistettävyyden ongelma liiketaloustieteessä. *The Finnish Journal of Business Economics*, volume 41, 4. Pages 348-381.

³¹¹ Lukka, K & Kasanen, E. 1993. Yleistettävyyden ongelma liiketaloustieteessä. *The Finnish Journal of Business Economics*, volume 41, 4. Page 375.

³¹² Alasuutari, P. 1994. *Laadullinen tutkimus*. Tampere, Vastapaino. 281 pages. Page 161.

³¹³ Dey, I. 1993. *Qualitative data analysis. A user-friendly guide for social scientists*. London, Routledge. 285 pages. Pages 63-64.

As in any study, however, scope for researcher impact cannot be fully denied. The fact that there was one interviewer only did not affect the quality of note-taking since all face-to-face interviews were tape-recorded, but it is in principle possible that another researcher would have analysed the data differently. In particular, it is worth noting that the researcher knew before the interviews whether a plant represented the non-compliance cluster or the overcompliance cluster. This information was necessarily revealed because one of the criteria in theoretical sampling was just this property. This required careful attention to avoid introducing any bias in data collection and analysis. However, the seriousness of this problem is reduced by the fact that the compliance information only related to effluent discharges during 1988-1996. The case studies also covered many other environmental dimensions besides effluent discharges, and focused on present environmental performance. Of these, there was no prior information.

Another typical problem is encountered with unreliable interview responses. The respondents may not know the answers to the interview questions, or they may not be willing to reveal the answers. Strategic responding is a considerable possibility in a study like the present one: the interviewees may be tempted to exaggerate their environmental performance to look good, or their environmental costs to avoid further requirements being placed on them.

Several measures were taken to avoid strategic responding and to ensure the reliability of the data in the present study. Retrospective questions were avoided because of the memory problems and ex post rationalising associated with them. The interview situation and the interview questions were designed so as to establish confidence and to minimise the respondents' need for strategic responding. As already explained, full confidentiality was guaranteed and the independence of the study from any interest group was brought up. Strategic responding was made difficult by designing the questions so that "correct" answers were non-existent and making this clear to the respondents. Consistency checks were applied throughout: the interview data were triangulated (i) between several respondents within a plant, (ii) between respondents within the plant and the regulatory authority responsible for the plant, and (iii) with the statistical data in chapter 5. In this context, it is also worth quoting Glaser and Strauss (1967): "even if some of our evidence is not entirely accurate this will not be too troublesome, for in generating theory it is not the fact upon which we stand, but the conceptual category (or a conceptual property of the category) that was generated from it."³¹⁴

According to Eisenhardt (1989), theory building from case-study research is especially applicable when "little is known about a phenomenon, current perspectives seem inadequate because they have little empirical substantiation, or they conflict with each other or common sense." In such a situation, theory building from case

³¹⁴ Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research*. Chicago, Aldine Publishing Company. 271 pages. Page 23.

studies can help provide fresh perspectives on a topic.³¹⁵ In view of that, the objective of this chapter was to develop a new model that contributes towards theory building on the firm-level relationship between environmental performance and economic performance. This objective was accomplished. The resulting model is novel, grounded in empirical data, and clear and parsimonious with its six main factors. The model does not attempt to capture the entire complexity of the real world, only the most essential features necessary for understanding the phenomenon. One might consider it a limitation of the developed model that it portrays the issue as perceived by firms, not necessarily as it objectively speaking is. However, since firms are not run based on how the world is – they are run based on how they perceive the world to be – this may not be a limitation after all.

³¹⁵ Eisenhardt, K M. 1989. Building theories from case study research. *Academy of Management Review*, volume 14, 4. Pages 532-550. Page 548.

7 CONCLUSIONS

7.1 Summary and key findings

The main research question of the present study was *what determines environmental profit?* Environmental profit is a new concept that refers to the isolated net economic impact of environmental performance on a firm. It captures the stream of environment-related private costs and benefits that accrue to a firm over time and discounts them to the present. Environmental profit thus represents the firm-level relationship between environmental performance and economic performance.

The debate on the firm-level relationship between environmental and economic performance is often framed as if it were an either-or issue. Some argue that improved environmental performance hurts economic performance; others maintain that improved environmental performance promotes economic performance. The present study shows that the correct question is not whether, but when improved environmental performance results in improved economic performance and thus in so-called win-win situations.

The review of the previous knowledge of the firm-level relationship between environmental and economic performance (chapter 3) revealed both an internal conflict within theoretical literature and an external conflict between theory and empirical evidence. A new approach that is able to integrate both positive and negative arguments about the relationship as well as accommodate the varying empirical evidence was, consequently, necessary. In particular, the three gaps identified in the previous theoretical knowledge that the present study focuses on are the following:

- The relationship may not be constant across environmental performance levels, which means that it needs to be considered a function of environmental performance.
- The relationship may not be uniform across cases, which means that the determinants of environmental profit need to be identified.
- The relationship may not be static across time, which means that changes in the determinants of environmental profit over time need to be discussed.

The results of the previous empirical studies on the firm-level relationship between environmental and economic performance range from a positive relationship to a negative relationship, no relationship, and an inverted U-shaped relationship. Several data and methodological problems were identified that partly explain the diversity of these findings. On the empirical side, the present study improves upon some of the previous studies, for instance, by circumventing the problem of confounders, allowing

for reciprocal causality, relying on comprehensive panel data of observed behaviour in an inclusive sample, and relaxing assumptions of a linear and uniform relationship.

The study employs a portfolio design that includes three modules. The purpose of the first, theoretical module (chapter 4) was the theoretical identification of win-win situations. The module extends the traditional neoclassical framework by integrating in it the possibility for private market benefits from environmental performance. The resulting framework shows that the relationship, represented by an environmental profit curve, is indeed not constant, but an inverted U-shaped function of environmental performance (see Figure 10). Thus, win-win situations are theoretically plausible, but not all situations are win-win situations. They exist as long as a firm is situated in the rising portion of its environmental profit curve. However, after the turning point of the environmental profit curve, environmental performance improvements are no longer profitable for the firm.

Moreover, the results of the theoretical module confirm that the relationship is not uniform across cases and static across time. The shape and location of the environmental profit curve, and, hence, win-win possibilities, are case-specific. They are affected by the determinants of environmental profit: factors that influence the costs of environmental performance and the benefits available from environmental performance. Such factors may cause environmental profit to differ between two cases. Also, some of the determinants of environmental profit change with time and some others can be actively changed, and environmental profit may differ for the same case between two time periods. Therefore, it is possible for a plant's optimal path of environmental performance over time to be one of constant improvement, even if at any one time the environmental profit curve does exhibit the inverted U-shape.

The purpose of the second, statistical module (chapter 5) was the empirical identification of win-win situations. It is impossible to observe environmental profit or win-win situations from statistical data. However, it is possible to observe overcompliance with environmental regulations, which corresponds to a perceived win-win situation. A new database was assembled that combines data on actual and permitted effluent discharges into a compliance indicator for all regulated Finnish manufacturing plants in the chemical forest industry, chemical industry, metal industry and food industry during 1988-1996. The database contains a total of 2195 compliance situations for 108 plants. An examination of the data showed that, empirically, perceived win-win situations do exist: overcompliance has been widespread, and it has increased over the research period in spite of the fact that the permits have become stricter.

However, there is significant variation in compliance. If there are plants that always overcomply, there are also plants that never overcomply. This non-uniformity in overcompliance and perceived win-win situations was examined for systematic patterns suggested by the theoretical module. The results confirmed the existence of

non-uniformity in compliance between years, industries, and plants, but not between individual water pollutants, and identified stable patterns in this non-uniformity.

Next, as there was evidence of non-uniformity of the relationship, the empirical question of identifying the determinants of environmental profit entered. As an opening step towards identifying the determinants of environmental profit, the main sources of such non-uniformity were examined. An analysis of the relative importance of the sources of non-uniformity showed that firm-level effects (approximated by plant effects) predominate all other effects (see Figure 17). Firm-level effects were about three and a half times as important as industry-level effects in explaining the variation in perceived win-win situations, even when a detailed industry classification was used. If a crude industry classification was used, firm-level effects were almost forty times as important as industry-level effects. Hence, the appropriate level for continuing the identification of the determinants of environmental profit is that of individual firms, and the plants with a tendency towards overcompliance and those with a tendency towards non-compliance were identified from the sample for further analysis.

The purpose of the third, case-study module (chapter 6) was the empirical understanding of win-win situations. In order to elaborate on the factors affecting the costs of environmental performance and the benefits available from environmental performance, 40 semi-structured interviews were conducted in eleven plants that represented polar examples of compliance behaviour. As a result of the case-study module, six main determinants of environmental profit were discovered (see Figure 21). These are

- technology - what measures can be taken to improve environmental performance and how much do they cost
- regime - the "rules of the game", the system of economic and command-and-control regulatory instruments under which the firm operates
- visibility - the extent to which the environmental performance improvement is perceived by relevant stakeholders
- willingness to pay - the extent to which customers are willing to pay for the environmental performance improvement
- benchmarks - how the firm's offering compares to the competition after the environmental performance improvement
- discount rate - how the firm weighs long-term vs. short-term costs and revenues

Altogether 20 lower-level factors affecting environmental profit were identified under the six headings. Each of these factors can either promote or hinder win-win situations (see Table 14). Together, they build a net that establishes whether a particular

environmental performance improvement in a particular firm results in a win-win situation or not.

Overall, the expected contribution of the present study was achieved: to improve understanding of the firm-level relationship between environmental and economic performance, with a particular focus on the factors affecting this relationship. The findings shed light on both theoretical and empirical aspects of the relationship and help resolve a conflict in previous literature. They show that the firm-level relationship between environmental and economic performance takes the form of an inverted U-shaped function of environmental performance, and varies according to the six main firm-level determinants of environmental profit.

King et al. (1994) write that all research projects in the social sciences should ideally satisfy two criteria. They should address topics that are "important in the real world", and they should make a specific contribution to the body of academic literature.³¹⁶ Accordingly, the rest of the chapter shortly outlines both the theoretical and practical significance of the findings.

7.2 Theoretical significance of the findings

7.2.1 Contribution to theoretical understanding

From a theoretical standpoint, the key findings of the three research modules can be recapitulated as follows:

- The theoretical module found that the firm-level relationship between environmental performance and economic performance must be regarded as a case-specific, dynamic, inverted U-shaped function of environmental performance.
- The statistical module found that the most important sources of the case-to-case variation in the firm-level relationship between environmental performance and economic performance (determinants of environmental profit) are to be discovered at the level of individual plants or firms.
- The case-study module found that the six main determinants of environmental profit are technology, regime, visibility, willingness to pay, benchmarks, and discount rate.

The findings are geared towards improving theoretical understanding about an underdeveloped substantive research area, not towards creating new general, formal

³¹⁶ King, G, Keohane, R O & Verba, S. 1994. *Designing social inquiry. Scientific inference in qualitative research*. Princeton, Princeton University Press. 247 pages. Page 15.

theory.³¹⁷ They extend previous theoretical understanding of the firm-level relationship between environmental and economic performance in a few important respects:

- The findings accommodate arguments of both the negative and positive views on this relationship, thus helping to alleviate a long-standing controversy in literature.
- The findings are explicitly applicable to the impacts of environmental performance rather than environmental regulations on economic performance, which has been relatively rare in previous literature.
- The findings relax assumptions of a constant, linear, and uniform causal relationship from environmental to economic performance. They increase knowledge of how the relationship varies as a function of environmental performance, how environmental and economic performance are reciprocally related, and what mechanisms produce variation in the relationship across cases.

7.2.2 *Implications for further research*

The fact that there is no constant, uniform relationship waiting to be discovered between firms' environmental and economic performance has important implications for further research. First, the relationship needs to be regarded as a function of environmental performance. Any assessment of the economic impacts of environmental performance on firms must therefore establish the range of environmental performance over which the results are valid.

Second, variation in the relationship between cases and over time must be acknowledged. Consequently, attention has to be paid to the factors that produce such variation. This needs to be done at a sufficiently disaggregated level. For example, had the present study been conducted at the crude industry level, only one per cent of the factors causing variation in overcompliance and perceived win-win situations could have been identified.

The present study represents one step in a chain of steps that brings us closer to understanding the firm-level relationship between environmental performance and economic performance. As such, it opens two kinds of avenues for future work. One is to continue improving and refining the model or parts thereof. Based on the nature of the results, it is evident that environmental questions are not an independent island among business issues but they are tightly linked to various areas in business decision-making. This means that the relevant topic area to be covered is so vast that the present study cannot have exhausted it. For example, each of the six main

³¹⁷ Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research*. Chicago, Aldine Publishing Company. 271 pages.

determinants of environmental profit would deserve a separate in-depth examination. This might result in more precise characterisations of some of the lower-level factors.

Another future research avenue could be to formally test the model or parts thereof, feeding the results back to further development of the model. The relative importance of the various determinants could also be examined. This research avenue would probably employ quantitative methods.

Finally, the present study has only addressed the direction of the relationship between environmental and economic performance. Questions of magnitude, that is, the size of environmental profit compared to overall profit, are left for future research.

7.3 Practical significance of the findings

7.3.1 Implications for environmental strategy

The results disclose a multitude of factors that impinge on the relationship between firms' environmental and economic performance. Different firms are unlikely to face all these factors in a similar manner. As a matter of fact, the results confirm that there is much more variation between firms within an industry than between industries. This means that selecting the appropriate level of environmental performance is, indeed, an issue of competitive strategy that each firm must approach from its own particular situation.

A profit-maximising firm may or may not benefit from a proactive environmental strategy. Managers should therefore identify the circumstances under which they are operating, in the light of the model introduced in the present study, and design an appropriate environmental strategy that is in concordance with the opportunities presented by their situation. Managers need not, though, be powerless victims of their circumstances; they may also actively attempt to shape the conditions surrounding their firm (see section 7.3.3). In addition to evaluating their own situation, firms should also consider how the model applies to their competitors, or to other participants in their value chain, such as suppliers and customers, in order to understand their situation and assess their possible reactions.

For evaluating the particular situation of a firm, several questions directly arise from the results. These include questions about the firm (Are you exposed to reputational spillovers? Do you have excess resources available? How do environmental investments fit in your investment cycle?), its customers (Where in your value chain does environmental willingness to pay originate? What is your distance from that point? Are your customers under market or regulatory environmental pressure?), its competitors (Are there switching costs between your product and substitutes? Can competitors imitate your good environmental performance? At what cost?), its products (Does your product attract environmental attention? Can private goods be

bundled with environmental goods in the product?), the environmental issue (Is the environmental issue product-related? Can it be made product-related? Are there visibility champions?), and applicable regulations (Are economic instruments of environmental protection in place? Are they to be expected in the future?). The examples above represent only a fraction of the relevant questions to be asked.

7.3.2 Implications for environmental policy

From an environmental policy-making perspective, the main message of the results is that some, but not all, situations are win-win situations. By identifying conditions on which the win-win outcomes depend, the findings can help assess how widespread win-win situations are and where they can be expected.

Different options arise for environmental policy-making depending on the outcomes. Where win-win situations are available, environmental policy can support voluntary approaches. However, like managers, authorities need not take the conditions affecting environmental profit as given. Where win-win situations are not directly available, environmental policy-making can attempt to influence the conditions so that they are more favourable to the creation of win-win situations. From the findings, several entry points for authorities can be identified (see section 7.3.3).

It may not be possible to turn each and every situation into a win-win situation. Some trade-offs between firms' environmental and economic performance are likely to persist. But, this does not necessarily mean that society should renounce its environmental objective. The question becomes one of a political nature: to weigh the gains from improved environmental performance against the losses from reduced economic performance, and to choose which is more important to achieve from a sustainable development perspective in the particular case.

7.3.3 Six ways to promote win-win situations

Without knowledge of the factors affecting the relationship between environmental and economic performance, firms and policy-makers can do no more than react to impacts once they have materialised. However, with knowledge of such factors, it is possible not only to predict the impacts in advance, but to an extent also to manipulate them. Conditions that alleviate the negative links or strengthen the positive links between firms' environmental and economic performance may be consciously created and reinforced. This should help to reduce the potential for conflicting interests by bringing the privately optimal level of environmental performance closer to the socially optimal level of environmental performance.

Six main ways to promote win-win situations can be inferred from the results. Ways and means available to achieve this include, but are not limited to those listed below:

- *Improve technology.* Firms can examine rigorously their abatement opportunities with existing technologies, as well as develop new environmental technologies. Authorities can spread information about abatement opportunities, facilitate the dissemination of technology, and create an environment that is conducive to technological innovation.
- *Pay attention to the features of the regulatory system.* Authorities can create a regulatory system that is stable and predictable with appropriate transition periods, and where the use of economic instruments of environmental protection is carefully and gradually increased. Firms can cooperate with authorities by providing inputs to the process of designing the regulations.
- *Increase visibility.* Firms can advertise their environmental performance efforts, disclose environmental information through environmental reporting, and participate in voluntary schemes that increase transparency such as the European Union Eco-Management and Audit Scheme. Authorities can organise information campaigns, establish voluntary agreements or other voluntary systems like eco-labels or environmental management system certificates, or mandatory labelling systems that increase transparency about environmental performance, establish community right-to-know requirements, create environmental awards or other ways of publicizing good environmental performance, or publicize bad environmental performance. Consumers and local inhabitants can demand information about the environmental performance of firms and their products.
- *Increase willingness to pay.* Both firms and authorities can increase environmental consciousness by educating customers on environmental issues. In addition, firms can bundle environmental performance with lower customer costs or added customer value in the product. Authorities can create environmental pressures on customers through, for instance, public procurement rules.
- *Watch the benchmarks.* If there is willingness to pay for environmental performance, firms can attempt to protect themselves against imitation. If there is no willingness to pay for environmental performance, authorities can move in tandem with competitor countries in tightening environmental regulations, for example, through multilateral environmental agreements. Firms that are able to comply cost-efficiently can lobby for stricter regulations to raise rivals' costs.
- *Decrease discount rate.* Investors can prolong their time perspective. Managers and policy-makers can guard the economic health of firms.

REFERENCES

- Acton, J P & Dixon, L S. 1992. *Superfund and transaction costs: the experiences of insurers and very large industrial firms*. Working paper, Rand Institute for Civil Justice, Santa Monica, California.
- Afsah, S, Laplante, B & Wheeler, D. 1996. *Controlling industrial pollution: A new paradigm*. World Bank Policy Research Department Working Paper 1672, October.
- Akashi, K & Yabe, M. 1994. *A note on the optimal level of pollution: Integrated approach to abatement and output reduction*. Research paper No. 12. National Research Institute of Agricultural Economics, Tokyo.
- Alasuutari, P. 1994. *Laadullinen tutkimus*. Tampere, Vastapaino. 281 pages.
- Amacher, G S, Fina, M, Koskela, E & Ollikainen, M. 2000. *Environmental quality competition and eco-labeling*. Mimeo.
- Arora, S & Cason, T. 1995. An experiment in voluntary environmental regulation: Participation in EPA's 33/50 program. *Journal of Environmental Economics and Management*, volume 28. Pages 271-286.
- Arora, S & Cason, T. 1996. Why do firms volunteer to exceed environmental regulations? Understanding participation in EPA's 33/50 program. *Land Economics*, volume 72, 4. Pages 413-432.
- Arora, S & Cason, T N. 1999. Do community characteristics influence environmental outcomes? Evidence from the Toxics Release Inventory. *Southern Economic Journal*, 65. Pages 691-716.
- Arora, S & Gangopadhyay, S. 1995. Toward a theoretical model of voluntary overcompliance. *Journal of Economic Behavior and Organization*, volume 28, 3. Pages 289-309.
- Ashford, N A, Ayers, C & Stone, R F. 1985. Using regulation to change the market for innovation. *Harvard Environmental Law Review*, 9. Pages 419-466.
- Aupperle, K E, Carroll, A B & Hatfield, J D. 1985. An empirical examination of the relationship between corporate social responsibility and profitability. *Academy of Management Journal*, volume 28, 2. Pages 446-463.
- Azzone, G & Bertelè, U. 1994. Exploiting green strategies for competitive advantage. *Long Range Planning*, volume 27, no. 6. Pages 69-81.
- Babbie, E. 1990. *Survey research methods*. Second edition. Belmont, Wadsworth Publishing Company.
- Barrett, S. 1992. Strategy and the environment. *Columbia Journal of World Business*, volume 27, 3&4. Pages 202-208.
- Baumol, W & Oates, W. 1988. *The theory of environmental policy*. Second edition. New York, Cambridge University Press.

- Baylis, R, Connell, L & Flynn, A. 1998a. Sector variation and ecological modernization: towards an analysis at the level of the firm. *Business Strategy and the Environment*, 7. Pages 150-161.
- Baylis, R, Connell, L & Flynn, A. 1998b. Company size, environmental regulation and ecological modernization: further analysis at the level of the firm. *Business Strategy and the Environment*, 7. Pages 285-296.
- Belkaoui, A. 1976. The impact of the disclosure of the environmental effects of organizational behavior on the market. *Financial Management*, volume 5, 4. Pages 26-31.
- Belz, F. 1995. Ökologie und Wettbewerbsfähigkeit in der Schweizer Lebensmittelbranche. Schriftenreihe Wirtschaft und Ökologie, Band 3. Bern, Haupt. 324 pages.
- Biondi, V, Frey, M & Iraldo, F. 1996. *EMAS: first evaluation of a policy instrument*. Paper presented at the conference "The economics of law and voluntary approaches in environmental policy", sponsored by Fondazione ENI Enrico Mattei and Cerna, Venice, Italy, November 18-19.
- Blacconiere, W G & Patten, D M. 1994. Environmental disclosures, regulatory costs, and changes in firm value. *Journal of Accounting & Economics*, volume 18. Pages 357-377.
- Bonifant, B C, Arnold, M B & Long, F J. 1995. Gaining competitive advantage through environmental investments. *Business Horizons*, July-August. Pages 37-47.
- Bowen, F E. 1999. Does organisational slack stimulate the implementation of environmental initiatives? In: Wood, D & Windsor, D (editors). *Proceedings of the Tenth Annual Meeting of the International Association of Business and Society*. Pages 529-534.
- Bowen, F E. 2000a. *Does size matter? A meta-analysis of the relationship between organisation size and environmental responsiveness*. Paper presented at the International Association for Business and Society (IABS) Annual Meeting, Burlington, Vermont, March 16-19.
- Bowen, F E. 2000b. Environmental visibility: a trigger of green organisational response? *Business Strategy and the Environment*, volume 9, 2. Pages 92-107.
- Bowman, E & Haire, M. 1975. A strategic posture toward corporate social responsibility. *California Management Review*, volume 18, 2. Pages 49-58.
- Bragdon, J & Marlin, J. 1972. Is pollution profitable? *Risk Management*, volume 19, 4. Pages 9-18.
- Brännlund, R, Chung, Y, Färe, R & Grosskopf, S. 1998. Emissions trading and profitability: the Swedish pulp and paper industry. *Environmental and Resource Economics*, volume 12, 3. Pages 345-356.
- Brännlund, R, Färe, R & Grosskopf, S. 1995. Environmental regulation and profitability: An application to Swedish pulp and paper mills. *Environmental and Resource Economics*, volume 6. Pages 23-36.
- Brännlund, R & Löfgren, K-G. 1996. Emission standards and stochastic waste load. *Land Economics*, volume 72, 2. Pages 218-230.

- Cairncross, F. 1992. UNCED, environmentalism and beyond. *Columbia Journal of World Business*, volume 27, 3&4. Pages 12-17.
- Cairncross, F. 1995. *Green, Inc. A guide to business and the environment*. London, Earthscan Publications Ltd.
- Callan, S & Thomas, J. 1996. *Environmental economics and management: theory, policy and applications*. Irwin.
- Chen, K & Metcalf, R. 1980. The relationship between pollution control record and financial indicators revisited. *The Accounting Review*, volume 55, 1. Pages 168-177.
- Chiang, A. 1984. *Fundamental methods of mathematical economics*. Third edition. Singapore, McGraw-Hill.
- Christmann, P. 2000. Effects of "best practices" of environmental management on cost advantage: The role of complementary assets. *Academy of Management Journal*, August, forthcoming.
- Cochran, P L & Wood, R A. 1984. Corporate social responsibility and financial performance. *Academy of Management Journal*, volume 27, 1. Pages 42-56.
- Colby, S, Kingsley, T & Whitehead, B W. 1995. The real green issue. Debunking the myths of environmental management. *The McKinsey Quarterly*, 2. Pages 132-143.
- Cooper, H M. 1989. *Integrating research. A guide for literature reviews*. Second edition. Newbury Park, Sage Publications.
- Corbett, C J & van Wassenhove, L N. 1993. The green fee: internalizing and operationalizing environmental issues. *California Management Review*, Fall. Pages 116-135.
- Cordeiro, J J & Sarkis, J. 1997. Environmental proactivism and firm performance: evidence from security analyst earnings forecasts. *Business Strategy and the Environment*, volume 6. Pages 104-114.
- Cormier, D, Magnan, M & Morard, B. 1993. The impact of corporate pollution on market valuation: some empirical evidence. *Ecological Economics*, 8. Pages 135-155.
- COWI. 1997. *Study on voluntary agreements concluded between industry and public authorities in the field of the environment*. Final report and annexes. Prepared for the European Commission Directorate General III.01 - Industry.
- Crampes, C & Hollander, A. 1995. Duopoly and quality standards. *European Economic Review*, 39. Pages 71-82.
- Cropper, M L & Oates, W E. 1992. Environmental economics: A survey. *Journal of Economic Literature*, volume 30, June. Pages 675-740.
- Daft, R L. 1985. Why I recommended that your manuscript be rejected and what you can do about it. In: Frost, P & Cummings, L L (editors). *Publishing in the organizational sciences*. Homewood, Ill., Richard D Irwin, Inc.
- Dasgupta, S, Hettige, H & Wheeler, D. 2000. What improves environmental compliance? Evidence from Mexican industry. *Journal of Environmental Economics and Management*, 39. Pages 39-66.

- Davidson, W & Worrell, D. 1990. A comparison and test of the use of accounting and stock market data in relating corporate social responsibility and financial performance. *Akron Business and Economic Review*, volume 21, 3. Pages 7-19.
- Dean, J. 1992. Trade and the environment: a survey of the literature. In: Low, P (editor). *International trade and the environment. World Bank Discussion Papers 159*. Washington, D.C., the World Bank. 365 pages. Pages 15-28.
- Dechant, K & Altman, B. 1994. Environmental leadership: from compliance to competitive advantage. *Academy of Management Executive*, volume 8, 3. Pages 7-20.
- Dey, I. 1993. *Qualitative data analysis. A user-friendly guide for social scientists*. London, Routledge. 285 pages.
- Diltz, J D. 1995. The private cost of socially responsible investing. *Applied Financial Economics*, volume 5, 5. Pages 69-77.
- Downing, P B & White, L J. 1986. Innovation in pollution control. *Journal of Environmental Economics and Management*, 13. Pages 18-29.
- Downing, R M. 1994. Executive commentary to Dechant, K & Altman, B. Environmental leadership: From compliance to competitive advantage. *Academy of Management Executive*, volume 8, 3. Pages 7-27.
- Dyllick, T, Belz, F, Hugenschmidt, H, Koller, F, Laubscher, R, Paulus, J, Sahlberg, M & Schneidewind, U. *Ökologischer Wandel in Schweizer Branchen*. Bern, Haupt (offprint).
- Eisenhardt, K M. 1989. Building theories from case study research. *Academy of Management Review*, volume 14, 4. Pages 532-550.
- Eisenhardt, K M. 1998. Lecture at Helsinki University of Technology, April 29-30.
- Ekins, P & Speck, S. 1999. Competitiveness and exemptions from environmental taxes in Europe. *Environmental and Resource Economics*, 13. Pages 369-396.
- Elkington, J. 1994. Towards the sustainable corporation: win-win-win business strategies for sustainable development. *California Management Review*, Winter. Pages 90-100.
- Esty, D. 1996. *Environmental regulation and competitiveness*. Paper presented at the Asia Conference on Trade and the Environment, organised by the National University of Singapore and the Global Environment and Trade Study, June 27-28, Singapore.
- European Community. 1992. *Industrial competitiveness and environmental protection*. EC Commission Communication SEC(92)1986.
- EVA. 1997. *Yritysjohtajien menestyksen eväät. Raportti yritysjohdon asenteista 1997*. Helsinki, Elinkeinoelämän valtuuskunta. 71 pages.
- Fama, E F, Fisher, L, Jensen, M C & Roll, R. 1969. The adjustment of stock prices to new information. *International Economic Review*, volume 10, 1. Pages 1-21.
- Feldman, S, Soyka, P & Ameer, P. 1996. *Does improving a firm's environmental management system and environmental performance result in a higher stock price?* ICF Kaiser International, Inc.

- Flores, N E & Carson, R T. 1997. The relationship between the income elasticities of demand and willingness to pay. *Journal of Environmental Economics and Management*, 33. Pages 287-295.
- Fogler, H & Nutt, F. 1975. A note on social responsibility and stock valuation. *Academy of Management Journal*, volume 18, 1. Pages 155-160.
- Fredriksson, P G. 1997. *Why don't environmental regulations influence trade patterns?* Paper presented at the European Association of Environmental and Resource Economists (EAERE) conference, Tilburg University, June 26-28.
- Freedman, M & Jaggi, B. 1982. Pollution disclosures, pollution performance and economic performance. *Omega*, volume 10, 2. Pages 167-176.
- Färe, R, Grosskopf, S, Lovell, C & Yaisawarng, S. 1993. Derivation of shadow prices for undesirable outputs: A distance function approach. *Review of Economics and Statistics*, volume 75. Pages 374-380.
- Gabel, H L & Sinclair-Desgagné, B. 1993. Managerial incentives and environmental compliance. *Journal of Environmental Economics and Management*, 24. Pages 229-240.
- Garber, S & Hammitt, J K. 1998. Risk premiums for environmental liability: does Superfund increase the cost of capital? *Journal of Environmental Economics and Management*, 36. Pages 267-294.
- Garrod, B & Chadwick, P. 1996. Environmental management and business strategy: Towards a new strategic paradigm. *Futures*, volume 28, 1. Pages 37-50.
- GfM. 1992. Zweite Repräsentativ-Befragung "Abfälle" im Auftrag des Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Hergiswil.
- Glaser, B G & Strauss, A L. 1967. *The discovery of grounded theory. Strategies for qualitative research.* Chicago, Aldine Publishing Company. 271 pages.
- Guimaraes, T & Liska, K. 1995. Exploring the business benefits of environmental stewardship. *Business Strategy and the Environment*, volume 4, 1. Pages 9-22.
- Hair, J F, Anderson, R E, Tatham, R L & Black, W C. 1995. *Multivariate data analysis with readings.* Fourth edition. London, Prentice-Hall International, Ltd. 745 pages.
- Halme, M. 1996. Shifting environmental management paradigms in two Finnish paper facilities: A broader view of institutional theory. *Business Strategy and the Environment*, 5. Pages 94-105.
- Hamilton, J T. 1995. Pollution as news: media and stock market reactions to the Toxics Release Inventory data. *Journal of Environmental Economics and Management*, 28. Pages 98-113.
- Hart, S. 1995. A natural-resource-based view of the firm. *Academy of Management Review*, volume 20, 4. Pages 986-1014.
- Hart, S L & Ahuja, G. 1996. Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. *Business Strategy and the Environment*, volume 5. Pages 30-37.

- Helminen, R-R. 1998. Eco-efficiency in the Finnish and Swedish pulp and paper industry. *Acta Polytechnica Scandinavica* 90. Espoo. 183 pages.
- Henriques, I & Sadorsky, P. 1996. The determinants of an environmentally responsive firm: an empirical approach. *Journal of Environmental Economics and Management*, volume 30. Pages 381-395.
- Hetemäki, L. 1996. *Essays on the impact of pollution control on a firm: A distance function approach*. Finnish Forest Research Institute, Research Papers 609.
- Heyes, A G & Liston-Heyes, C. 1999. Corporate lobbying, regulatory conduct and the Porter hypothesis. *Environmental and Resource Economics*, 13. Pages 209-218.
- Hsiao, C. 1986. *Analysis of panel data*. Econometric Society Monographs No. 11. Cambridge University Press. 246 pages.
- Ingram, R W. 1978. An investigation of the information content of (certain) social responsibility disclosures. *Journal of Accounting Research*, volume 16, 2. Pages 270-285.
- Ingram, R W & Frazier, K B. 1980. Environmental performance and corporate disclosure. *Journal of Accounting Research*. Pages 614-622.
- Jaffe, A B, Peterson, S R, Portney, P R & Stavins, R N. 1995. Environmental regulation and the competitiveness of U.S. manufacturing: What does the evidence tell us? *Journal of Economic Literature*, volume 33, pages 132-163.
- Johnson, S. 1995. *An analysis of the relationship between corporate environmental and economic performance at the level of the firm*. Doctoral dissertation, University of California, Irvine.
- Jorgenson, D & Wilcoxon, P. 1990. Environmental regulation and U.S. economic growth. *RAND Journal of Economics*, volume 21, no. 2. Pages 314-340.
- Kemp, R, Olsthoorn, X, Oosterhuis, F & Verbruggen, H. 1992. Supply and demand factors of cleaner technologies: some empirical evidence. *Environmental and Resource Economics*, 2. Pages 615-634.
- Kennedy, P W, Laplante, B & Maxwell, J. 1994. Pollution policy: the role for publicly provided information. *Journal of Environmental Economics and Management*, 26. Pages 31-43.
- Khanna, M & Damon, L A. 1999. EPA's voluntary 33/50 program: impact on toxic releases and economic performance of firms. *Journal of Environmental Economics and Management*, 37. Pages 1-25.
- King, G, Keohane, R O & Verba, S. 1994. *Designing social inquiry. Scientific inference in qualitative research*. Princeton, Princeton University Press. 247 pages.
- Kirchhoff, S. 2000. Green business and blue angels. *Environmental and resource economics*, 15. Pages 403-420.
- Klassen, R D & McLaughlin, C P. 1996. The impact of environmental management on firm performance. *Management Science*, volume 42, 8. Pages 1199-1214.

- Klassen, R D & Whybark, D C. 1999. The impact of environmental technologies on manufacturing performance. *Academy of Management Journal*, volume 42, 6. Pages 599-615.
- Konar, S & Cohen, M A. 1997. Information as regulation: the effect of community right to know laws on toxic emissions. *Journal of Environmental Economics and Management*, 32. Pages 109-124.
- Kuusiniemi, K. 1993. Environmental law. In: Pöyhönen, J (editor). *An introduction to Finnish law*. Helsinki, Finnish Lawyers' Publishing.
- Kvale, S. 1996. *InterViews. An introduction to qualitative research interviewing*. Thousand Oaks, Sage Publications. 326 pages.
- Lahti-Nuuttila, K. 1997. *Environmental performance of the Finnish pulp and paper industry*. Paper presented at the 4th conference of the Nordic Business Environmental Management Network. June 5-7, Tuohilampi, Finland. 11 pages.
- Lancaster, K J. 1979. *Variety, equity and efficiency*. New York, Columbia University Press.
- Lang, J. 1996. *Corporate environmentalism and regulatory interventions*. Doctoral dissertation, Boston University Graduate School of Management.
- Lankoski, L & Lankoski, J. 1999. Economic globalisation and the environment. *The Finnish Environment 336*. Helsinki, Ministry of the Environment. 66 pages.
- Lanoie, P, Laplante, B & Roy, M. 1998. Can capital markets create incentives for pollution control? *Ecological Economics*, 26. Pages 31-41.
- Laplante, B & Lanoie, P. 1994. The market response to environmental incidents in Canada: a theoretical and empirical analysis. *Southern Economic Journal*, volume 60, 3. Pages 657-672.
- Lehtonen, T. 1990. *Tilastotieteen jatkokurssi*. Helsingin kauppakorkeakoulun kuvalaitos. 196 pages.
- Liski, M. 1997. *On the regulation of pollution and polluters' long-term compliance strategies*. Acta Universitatis Oeconomicae Helsingiensis A-129. 152 pages.
- Lombardini-Riipinen, C. 2000. *Taxation, environmental quality choice and welfare in a vertically differentiated duopoly*. Paper presented at the European Association of Environmental and Resource Economists (EAERE) conference, University of Crete, June 30 - July 2.
- Long, B L. 1995. Global competition: the environmental dimension. *Business Economics*, April. Pages 45-50.
- Lovio, R. 1995. *Yritykset ja ympäristö: ongelmien ratkaisusta uusiin ongelmiin*. In: Massa, I & Rahkonen, O (editors). Riskiyhteiskunnan talous. Helsinki, Gaudeamus. Pages 143-159.
- Lukka, K & Kasanen, E. 1993. Yleistettävyyden ongelma liiketaloustieteessä. *The Finnish Journal of Business Economics*, volume 41, 4. Pages 348-381.
- Madu, C N, Kuei, C & Winokur, D. 1995. Environmental quality planning. A strategic total quality management (STQM) approach. *Futures*, volume 27, 8. Pages 839-856.

- Mahoney, M & Swaine, A. 1994. Executive commentary to Dechant, K & Altman, B. Environmental leadership: From compliance to competitive advantage. *Academy of Management Executive*, volume 8, 3. Pages 7-27.
- Markandya, A & Pearce, D. 1988. *Environmental considerations and the choice of the discount rate in developing countries*. World Bank Environment Department Working Paper No. 3. Washington, D.C., The World Bank. 79 pages.
- Mathur, S S & Kenyon, A. 1997. *Creating value: shaping tomorrow's business*. Oxford, Butterworth-Heinemann. 451 pages.
- McGahan, A M & Porter, M E. 1997. How much does industry matter, really? *Strategic Management Journal*, volume 18. Pages 15-30.
- McGuire, J, Sundgren, A & Schneeweis, T. 1988. Corporate social responsibility and firm financial performance. *Academy of Management Journal*, volume 31, 4. Pages 854-872.
- McGuire, M. 1982. Regulation, factor rewards and international trade. *Journal of Public Economics*, 17. Pages 335-354.
- Miles, M B & Huberman, A M. 1994. *Qualitative data analysis. An expanded sourcebook*. Second edition. Thousand Oaks, Sage Publications. 338 pages.
- Miller, R A. 1994. Executive commentary to Dechant, K & Altman, B. Environmental leadership: From compliance to competitive advantage. *Academy of Management Executive*, volume 8, 3. Pages 7-27.
- Milliman, S R & Prince, R. 1989. Firm incentives to promote technological change in pollution control. *Journal of Environmental Economics and Management*, 17. Pages 247-265.
- Moisander, J. 1996. Attitudes and ecologically responsible consumption. Helsinki, Statistics Finland Research Reports 218. 159 pages.
- Motta, M. 1993. Endogenous quality choice: price vs. quantity competition. *The Journal of Industrial Economics*, volume 41, 2. Pages 113-131.
- Muoghalu, M I, Robison, H D & Glascock, J L. 1990. Hazardous waste lawsuits, stockholder returns, and deterrence. *Southern Economic Journal*, volume 57, 2. Pages 357-370.
- Mäkelä, K. 1990. Kvalitatiivisen analyysin arviointiperusteet. In: Mäkelä, K (editor). *Kvalitatiivisen aineiston analyysi ja tulkinta*. Helsinki, Gaudeamus. 285 pages. Pages 42-61.
- Mäkelä, P. 1986. *Ympäristönsuojelun taloudelliset vaikutukset*. Working paper based on OECD work. Helsinki, Taloudellinen suunnittelukeskus. 31 pages.
- Nehrt, C. 1996. Timing and intensity effects of environmental investments. *Strategic Management Journal*, volume 17. Pages 535-547.
- Nehrt, C. 1998. Maintainability of first mover advantages when environmental regulations differ between countries. *Academy of Management Review*, volume 23, 1. Pages 77-97.
- Neilimo, K & Näsi, J. 1980. *Nomoteettinen tutkimusote ja suomalainen yrityksen taloustiede*. Series A2: Research Reports 12. Tampere, University of Tampere.

Niskanen, J & Halme, M. 1997. *Stock market response to environmental investments of forest industry firms: Finnish evidence*. Series A2: Research Reports 69. Tampere, University of Tampere. 46 pages.

OECD. 1993. *Environmental policies and industrial competitiveness*. Paris.

OECD. 1998. *The environmental effects of international portfolio flows*. ENV/EPOC/GEEI(98)32. Paris, OECD. 41 pages.

Ollikainen, M. 1995. Ympäristönsuojelun taloudellinen ohjaus ja ympäristöpolitiikka. In: Massa, I & Rahkonen, O (editors). *Riskiyhteiskunnan talous*. Helsinki, Gaudeamus. Pages 289-318.

Palmer, K, Oates, W E & Portney, P R. 1995. Tightening environmental standards: the benefit-cost or the no-cost paradigm? *Journal of Economic Perspectives*, volume 9, 4. Pages 119-132.

Panayotou, T & Zinnes, C. 1994. Free-lunch economics for industrial ecologists. In: Socolow, R, Andrews, C, Berkhout, F & Thomas, V (editors). *Industrial ecology and global change*. Cambridge University Press. Pages 383-397.

Payne, S L. 1951. *The art of asking questions*. Princeton, New Jersey, Princeton University Press. 249 pages.

Petts, J, Herd, A, Gerrard, S & Horne, C. 1999. The climate and culture of environmental compliance within SMEs. *Business Strategy and the Environment*, 8. Pages 14-30.

Porter, M E. 1990. *The competitive advantage of nations*. New York, the Free Press.

Porter, M. 1991. America's green strategy. *Scientific American*, volume 264, 4. Page 96.

Porter, M & van der Linde, C. 1995a. Green and competitive: Ending the stalemate. *Harvard Business Review*, September-October. Pages 120-134.

Porter, M & van der Linde, C. 1995b. Toward a new conception of the environment - competitiveness relationship. *Journal of Economic Perspectives*, volume 9, 4. Pages 97-118.

Randall, A. 1987. Total economic value as a basis for policy. *Transactions of the American Fisheries Society*, 116. Pages 325-335.

Rauscher, M. 1994. On ecological dumping. *Oxford Economic Papers*, 46. Pages 822-840.

Rauscher, M. 1997. *International trade, factor movements, and the environment*. Oxford, Clarendon Press. 335 pages.

Reinhardt, F L. 1997. *Environmental quality and economic advantage: A framework for understanding corporate environmental management*. Harvard Business School Working Paper 97-071. 35 pages.

Reinhardt, F L. 1998. Environmental product differentiation: implications for corporate strategy. *California Management Review*, volume 40, 4. Pages 43-73.

Reinhardt, F L. 1999a. Market failure and the environmental policies of firms: economic rationales for "beyond compliance" behaviour. *Journal of Industrial Ecology*, volume 3, 1. Pages 9-21.

- Reinhardt, F L. 1999b. *Down to earth: applying business principles to environmental management*. Boston, Harvard Business School Press. 291 pages.
- Reinikainen, T. 1993. *Suomen suurimmat pistekuormittajat vuosina 1990 ja 1991*. Ympäristökatsaus, March, special issue.
- Repetto, R. 1992. Environmental taxes and U.S. competitiveness. *Columbia Journal of World Business*, volume 27, 3&4. Pages 128-134.
- Repetto, R. 1995. *Jobs, competitiveness and environmental regulation: What are the real issues?* Washington, D.C., World Resources Institute. 43 pages.
- Rockness, J W. 1985. An assessment of the relationship between US corporate environmental performance and disclosure. *Journal of Business Finance and Accounting*, volume 12, 3. Pages 339-354.
- Rumelt, R P. 1991. How much does industry matter? *Strategic Management Journal*, volume 12. Pages 167-185.
- Russo, M & Fouts, P. 1997. A resource-based perspective on corporate environmental performance and profitability. *Academy of Management Journal*, volume 40, 3. Pages 534-559.
- Ruud, A. 1995. *Corporate environmental decision-making: a rational choice?* Centre for Development and the Environment, University of Oslo, Working Paper 1995.2. 20 pages.
- Räsänen, K, Meriläinen, S & Lovio, R. 1994. Pioneering descriptions of corporate greening: notes and doubts on the emerging discussion. *Business Strategy and the Environment*, 3. Pages 9-16.
- Salop, S C & Scheffman, D T. 1983. Raising rivals' costs. *AEA Papers and Proceedings*, volume 73, 2. Pages 267-271.
- Sayer, A. 1992. *Method in social science. A realist approach*. London, Routledge. 313 pages.
- Schaltegger, S. 1997. Economics of life cycle assessment: Inefficiency of the present approach. *Business Strategy and the Environment*, volume 6. Pages 1-8.
- Schaltegger, S & Figge, F. 1998. *Environmental shareholder value*. WWZ (University of Basel) Study 54. 39 pages.
- Schmidheiny, S. 1992. *Changing course. A global business perspective on development and the environment*. Cambridge, MIT Press. 374 pages.
- Schmidheiny, S. 1992. The business logic of sustainable development. *Columbia Journal of World Business*, volume 27, 3&4. Pages 18-23.
- Segerson, K & Miceli, T J. 1998. Voluntary environmental agreements: Good or bad news for environmental protection? *Journal of Environmental Economics and Management*, 36. Pages 109-130.
- Shane, P & Spicer, B. 1983. Market response to environmental information produced outside the firm. *The Accounting Review*, volume 58, 3. Pages 521-538.

- Shrivastava, P. 1995. Environmental technologies and competitive advantage. *Strategic Management Journal*, volume 16. Pages 183-200.
- Siebert, H. 1985. Spatial aspects of environmental economics. In: Kneese, A V & Sweeney, J L, editors. *Handbook of natural resource and energy economics*, volume I. New York, North-Holland. Pages 125-164.
- Siebert, H, Eichberger, J, Gronych, R & Pethig, R. 1980. *Trade and environment. A theoretical enquiry*. Amsterdam, Elsevier Scientific Publishing Company.
- Simpson, R D & Bradford, R L III, 1996. Taxing variable cost: environmental regulation as industrial policy. *Journal of Environmental Economics and Management*, 30. Pages 282-300.
- Sjöblom, M. 1994. *Yrityksen ympäristöystävällisyys ja liiketaloudelliset tunnusluvut*. Master's thesis, Helsinki School of Economics and Business Administration.
- Spicer, B. 1978a. Investors, corporate social performance and information disclosure: An empirical study. *The Accounting Review*, volume 53, 1. Pages 94-111.
- Spicer, B. 1978b. Market risk, accounting data and companies' pollution control records. *Journal of Business Finance and Accounting*. Pages 67-83.
- Spicer, B. 1980. The relationship between pollution control records and financial indicators revisited: Further comment. *The Accounting Review*, volume 55, 1. Pages 178-185.
- Sprenger, R-U. 1996. Environmental policies and competitiveness. In: Lim, J-S (editor), *Trade and environment. International issues and policy options*. Seoul, Korea Environmental Technology Research Institute. Pages 223-266.
- SPSS Inc. 1997. *SPSS Advanced Statistics 7.5*. 579 pages.
- SPSS Inc. 1998. *SPSS Base 8.0 Applications guide*. 372 pages.
- Statistics Finland. 1995. *Standard Industrial Classification*. Annex 3: Summary. 124 pages.
- Steger, U & Winter, M. 1996. Early warning of environmentally-driven market changes: a theoretical approach and an empirical investigation. *Greener Management International*, 15. Pages 32-51.
- Stevens, C. 1993. Do environmental policies affect competitiveness? *The OECD Observer*, 183. Pages 22-25.
- Tanskanen, E. 1997. *Suomalaiset ja ympäristö kansainvälisestä näkökulmasta*. Helsinki, Statistics Finland Research Reports 225, 153 pages.
- Ullman, A A. 1985. Data in search of a theory: a critical examination of the relationships among social performance, social disclosure, and economic performance of U.S. firms. *Academy of Management Review*, volume 10, 3. Pages 540-557.
- UNCTAD 1996. *The relationship of environmental protection to international competitiveness, job creation and development*. Background paper No. 21 for the Commission on Sustainable Development, Fourth Session, 18 April - 3 May, New York.

U.S. Congress, Office of Technology Assessment. 1994. *Industry, technology, and the environment: Competitive challenges and business opportunities*. OTA-ITE-586. Washington, D.C., U.S. Government Printing Office.

Uusitalo, L. 1986. *Suomalaiset ja ympäristö. Tutkimus taloudellisen käyttäytymisen rationaalisuudesta*. Helsinki, Acta Academiae Oeconomicae Helsingiensis Series A:49. 170 pages.

van der Linde, C. 1993. The micro-economic implications of environmental regulation: a preliminary framework. In: *Environmental policies and industrial competitiveness*. Paris, Organisation for Economic Cooperation and Development. Pages 69-77.

van Ewijk, C and van Wijnbergen, S. 1995. Can abatement overcome the conflict between environment and economic growth? *De Economist*, volume 143, 2. Pages 197-216.

Varian, H R. 1992. *Microeconomic analysis*. Third edition. New York, W. W. Norton & Company. 506 pages.

von Wright, G. 1971. *Explanation and understanding*. London, Routledge & Kegan Paul Ltd. 230 pages.

Walley, N & Whitehead, B. 1994. It's not easy being green. *Harvard Business Review*, May-June. Pages 46-52.

Welford, R & Gouldson, A. 1993. *Environmental management and business strategy*. London, Pitman Publishing. 210 pages. Pages 156-157.

Wetherill, G B. 1981. *Intermediate statistical methods*. London, Chapman and Hall. 390 pages.

Wiseman, J. 1982. An evaluation of environmental disclosures made in corporate annual reports. *Accounting, Organizations and Society*, volume 7, 1. Pages 53-63.

Wolcott, H F. 1990. *Writing up qualitative research*. Qualitative Research Methods Volume 20. Newbury Park, Sage Publications. 94 pages.

Wärneryd, B (editor). 1986. *Att fråga. Om frågekonstruktion vid intervjuundersökningar och postenkäter*. Stockholm, Statistiska centralbyrån. 264 pages.

Xepapadeas, A & de Zeeuw, A. 1999. Environmental policy and competitiveness: the Porter hypothesis and the composition of capital. *Journal of Environmental Economics and Management*, 37. Pages 165-182.

Yin, R K. 1989. *Case study research. Design and methods*. Revised edition. Newbury Park, Sage Publications.

APPENDIX I

Environmental profit under various competitive assumptions

Table I-1 Summary of environmental profit under various competitive assumptions

	Market structure		
	Perfect competition	Monopolistic competition	Oligopoly (duopoly)
Discussed in section	3.1.1	4.2	3.1.3
Environmental performance affects the firm's profit through	costs	costs and demand (note: if customer willingness to pay for environmental performance is zero, $MPB(e) = 0$ for all e and the case coincides with perfect competition)	costs, demand, and intensity of price competition
See figure	I-1	I-2	I-3
Location of the turning point of the environmental profit curve	$e > 0$ if the MAC curve takes negative values in the beginning, otherwise $e = 0$	$e > 0$	$e > 0$ at least for firm H

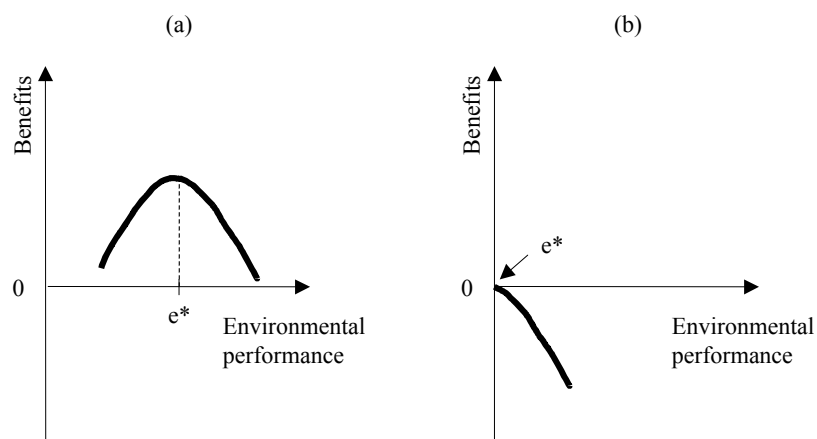


Figure I-1 Environmental profit curve under perfect competition when the MAC curve takes negative values in the beginning (panel a) and when it does not (panel b)

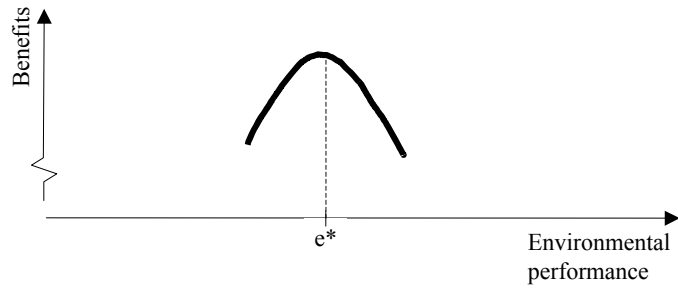


Figure I-2 *Environmental profit curve under monopolistic competition*

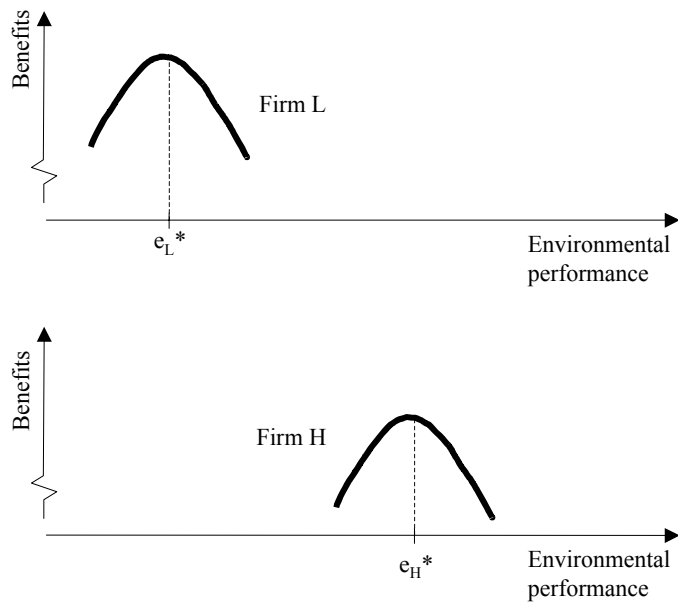


Figure I-3 *Environmental profit curves under a duopoly. Optimal levels of environmental performance differ between the two firms*

APPENDIX II

Description of the statistical data

Table II-1 shows the breakdown of the 2195 compliance situations in the data by industry and year.

Table II-1 Breakdown of observations by industry and year

YEAR * CRUDECT Crosstabulation

Count		CRUDECT				Total
		Chemical forest industry	Chemical industry	Metal industry	Food industry	
YEAR	88	79	48	53	25	205
	89	81	49	64	29	223
	90	82	49	64	33	228
	91	83	47	62	28	220
	92	92	53	64	32	241
	93	93	54	63	37	247
	94	112	50	63	33	258
	95	121	53	71	43	288
	96	120	55	68	42	285
Total		863	458	572	302	2195

Descriptive statistics for the continuous variables EMITTED, PERMITTE and COMPLIAN are shown in Table II-2.

Table II-2 Descriptive statistics for the continuous variables

	EMITTED (kg/a)	PERMITTE (kg/a)	COMPLIAN (%)
N	2195	2195	2195
Dispersion			
Mean	960293.7	1933662.6	59.5
Median	11086.9	30000.0	38.9
Minimum	0.0	0.4	0.0
Maximum	78798000.0	90000000.0	4904.1
Distribution			
Std. Dev.	3986310.4	7277602.7	140.6
Skewness	10.0	7.2	21.4
Std. Error	0.1	0.1	0.1
Kurtosis	148.9	63.3	665.8
Std. Error	0.1	0.1	0.1

Figures II-1 to II-5 show various boxplots of compliance observations. The shadowed box represents the interquartile range, containing the middle 50 per cent of the observations. The median value of the observations is indicated by a line across the box. The whiskers extend from the box to the highest and lowest values that are not statistical outliers. Outliers (1.5-3 box lengths from end of box) and extreme values (more than 3 box lengths from end of box) are not shown because their high values would impose a different scale on the value axis and render the figures illegible. The horizontal line of 100 per cent compliance is inserted in each figure for reference.

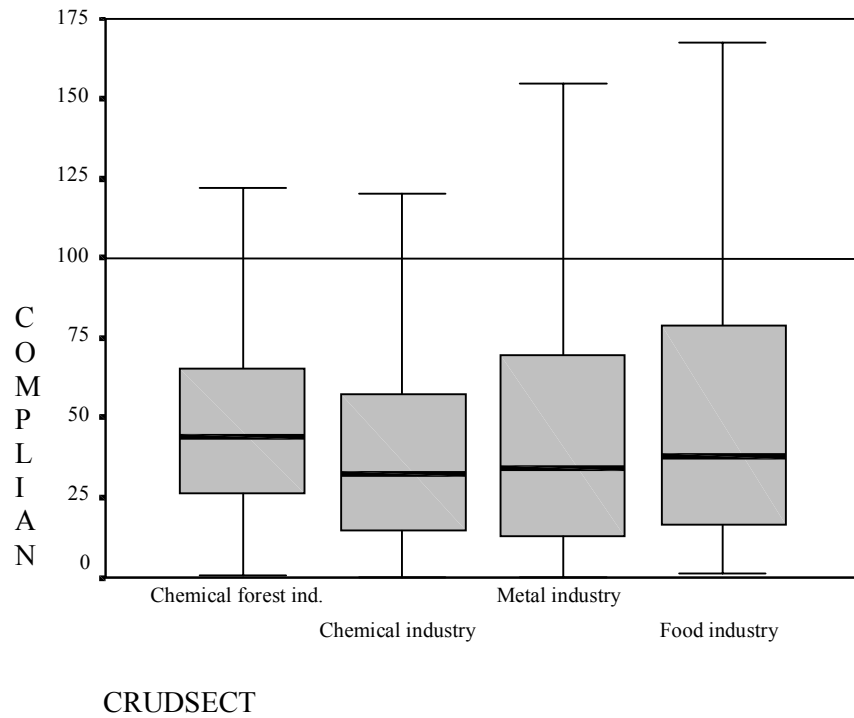


Figure II-1 Boxplot of compliance observations across different industries; crude classification

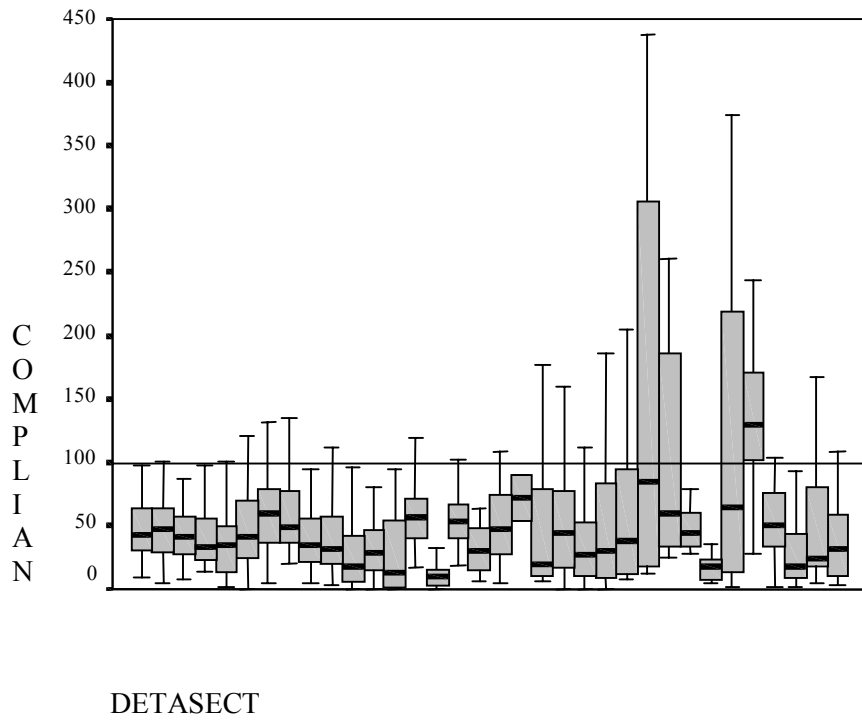


Figure II-2 *Boxplot of compliance observations across different industries; detailed classification*

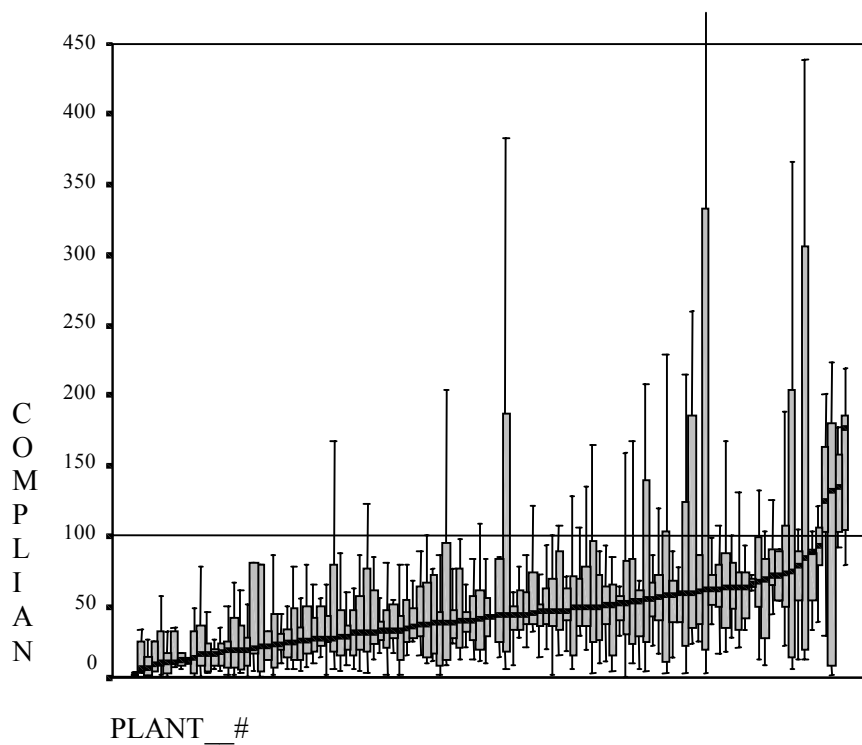


Figure II-3 *Boxplot of compliance observations across different plants*

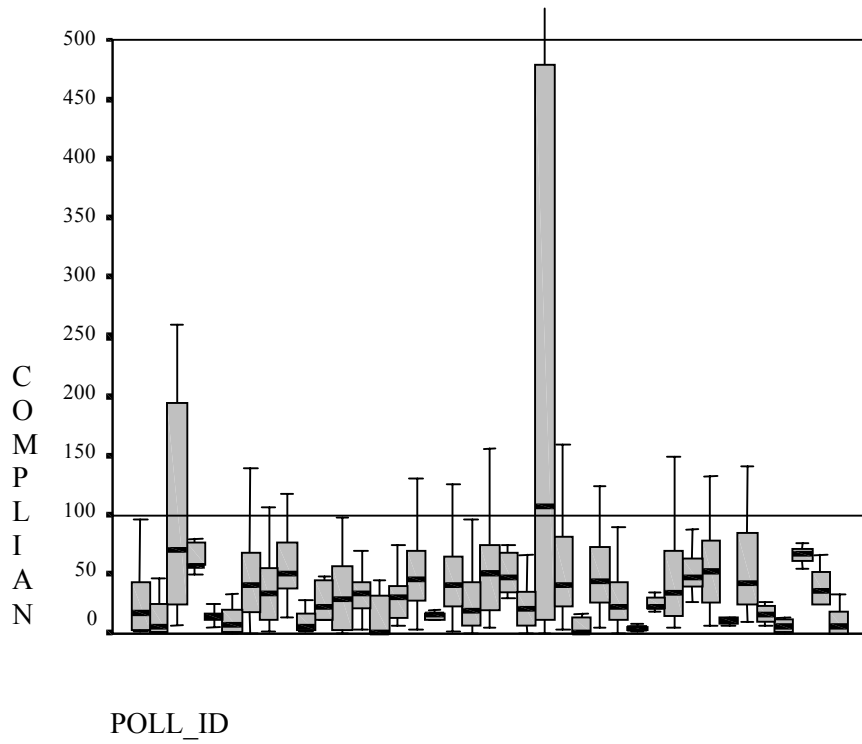


Figure II-4 Boxplot of compliance observations across different pollutants

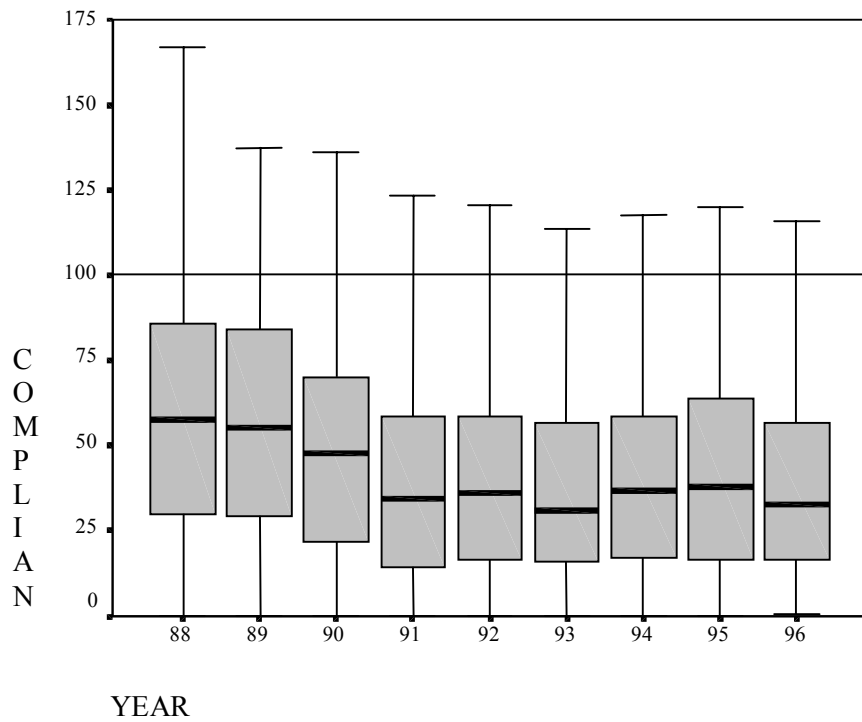


Figure II-5 Boxplot of compliance observations across different years

APPENDIX III
Plant clustering based on compliance performance

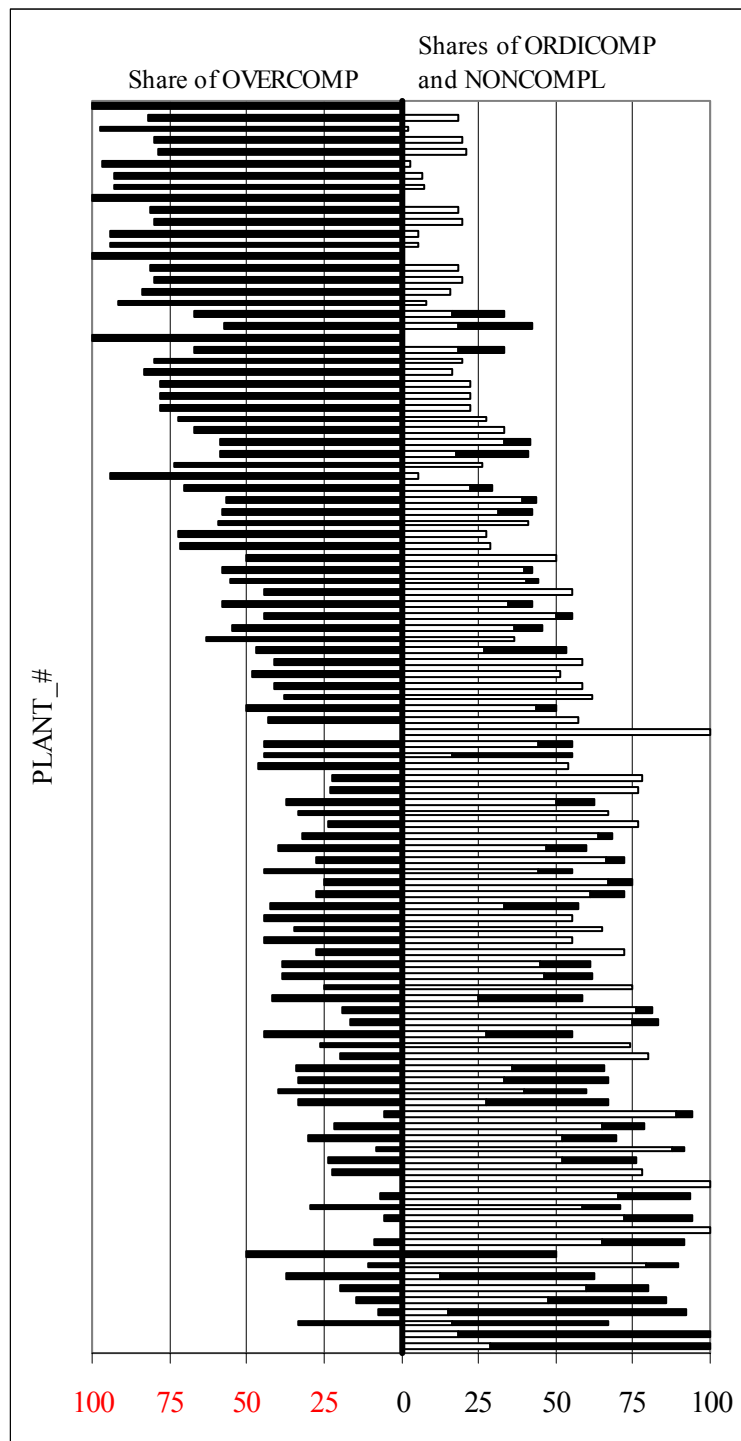


Figure III-1 The share of overcompliance situations, ordinary compliance situations and non-compliance situations in 1988-1996 in the 108 plants in the sample. Overcompliance situations are represented by the black bars left to the category axis. Ordinary compliance situations and non-compliance situations are represented by the white and black bars, respectively, right to the category axis

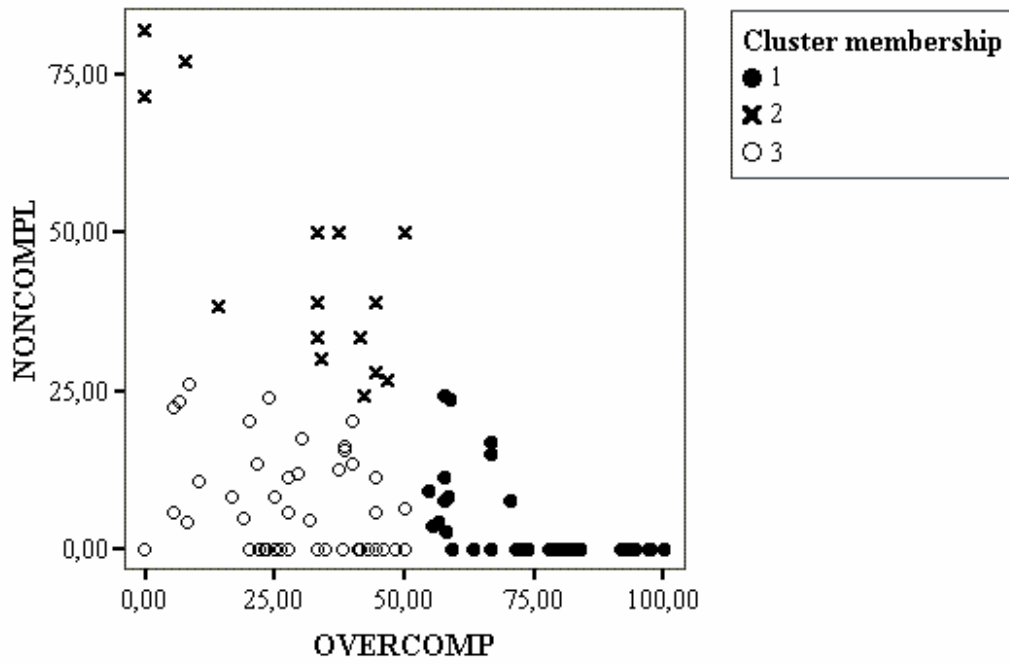


Figure III-2 Clustering of the plants based on their compliance performance over the research period. To improve readability, the ORDICOMP dimension which can be calculated from the two other dimensions is not drawn in the figure

APPENDIX IV

Empirical manifestations of the determinants of environmental profit

The appendix shows how the abstract concepts of the six main determinants of environmental profit materialised in each of the eleven case plants. It serves to demonstrate the application of the requirement of absolute explanation: each determinant of environmental profit manifested itself in each case plant, even if through different empirical variants. For example, all plants stated that issues concerning customer willingness to pay for environmental performance affect the profitability of environmental performance improvements. For some plants it was the presence and for some plants the absence of customer willingness to pay that mattered, but for all plants the factor "willingness to pay" existed as a determinant of environmental profit. Note again that the six determinants of environmental profit were not preset but arose independently in each case.

Because of confidentiality reasons, the amount of detail in the lists below is restricted. The lists contain a crystallisation of the key features of each case, not an exhaustive description. For each determinant of environmental profit, the cases where the determinant materialised as favourable conditions for win-win situations are presented first. The cases where the determinant materialised as unfavourable conditions for win-win situations are presented last. The cases where the conditions were in some respects favourable and in some other respects unfavourable for win-win situations are presented between these two extremes. Thus, the eleven cases are presented in a different order for each determinant, and it is not possible to identify the full combination of circumstances for any particular plant.

Technology

Technology-related reasons quoted by case plants why they could or could not achieve cost savings from environmental performance improvements, or why cost increases from environmental performance improvements were or were not significant:

1. In one plant, cost savings were possible because several of the issues touching the plant provided opportunities for reductions in material and energy use. A key issue made it possible to replace a fundamental raw material with a less expensive alternative. A well-functioning environmental management system was in place, making the search for environmental improvements cost-effective. The plant owned the physical facility that was needed for a profitable solution of a key issue. The plant had access to proprietary technological solutions. The production facilities were old but there was a way to achieve savings through remedying their environmental weakness. The investment cycle was relatively short and the production process was not as capital intensive as for some other plants in the industry. Sourcing arrangements were such that some solutions could be implemented relatively flexibly, but some others could not.
2. In one plant, several of the issues provided scope for cost savings. An environmental management system helped to find cost-efficient solutions for environmental issues. Due to outsourcing arrangements, it was easy to switch a key component to an environmentally friendlier alternative.
3. In one plant, there had been an accident after which new production facilities had to be built, which enabled the design of both cost-efficient and environmentally friendly solutions from scratch. Environmental expertise was available from the parent corporation. It was not possible to recover materials from the waste streams, but it was possible to obtain savings from packaging. A new solution was about to become commercially available that would enable the removal of one environmentally harmful

production step, thus also reducing costs. In another group plant, very short investment cycles and the application of an environmental management system facilitated environmental investments, but the lack of space restricted feasible solutions and physical location restricted energy source alternatives.

4. In one plant, a suitable technological solution for the issues faced by the plant became commercially available. The timing of the investment coincided with the building of new production facilities. The new technological solution performed well, was more reliable, reduced risks, and saved personnel time, which was important as the plant was micro-sized.
5. In one plant, the environmental technology was old enough to have been fully depreciated, and now provided savings in operating costs. However, the production facilities were very old, which restricted the implementation of environmental solutions.
6. In one plant, investments were typically large and expensive, and it took a long time to get the process back in control after changes in the production line. However, small environmental improvements could be implemented along with modernisation investments.
7. In one plant, the physical features of the old production facilities restricted the available solutions concerning environmental issues. However, savings had been achieved through improvements in general housekeeping introduced by the new management.
8. In one plant, technological development was slow, investment cycles were long, and the production technology was capital intensive. The main raw material was both the largest cost item and the largest pollutant, wherefore recovery opportunities had been exhausted long ago. However, the environmental issues facing the plant were not particularly difficult to deal with, and certain cost savings and environmental improvements could be simultaneously achieved in close cooperation with the suppliers of the main raw material.
9. In one plant, the production technology was highly capital intensive and initial technological choices largely determined environmental performance. The production facilities were of medium age. The production process was complex and the environmental issues facing the plant were such that finding and implementing solutions was not straightforward. By-products had been recovered since the beginning; remaining opportunities for recovery did not offer significant economic potential.
10. In one plant, no opportunities to achieve cost savings from environmental performance improvements were foreseeable. Expensive technologies were needed to address the issues faced by the plant. The plant suffered from diseconomies of scale in environmental protection. The initial environmental solution was quite old and restricted present opportunities for environmental performance improvements. No environmental management system or other systematic approach to environmental performance was in place.
11. In one plant, the issues faced were such that no opportunities to achieve cost savings from environmental performance improvements were foreseeable.

Regime

Regime-related reasons quoted by case plants why they could or could not achieve cost savings from environmental performance improvements, or why cost increases from environmental performance improvements were or were not significant:

1. In the case of one plant, there were several environmental taxes, charges and payments affecting the plant, wherefore savings could be achieved by avoiding or reducing them.
2. In one plant, it was felt that the regime within which the plant operated had the power to affect any profitability calculations by causing shifts in relative prices for inputs.
3. In one plant, it was felt that regulatory costs could be managed by voluntarily performing well in environmental issues.
4. For one plant, the form and content of the environmental regulations did not pose any cost problems but neither did they provide opportunities for savings.
5. In one plant, it was felt that since production costs were already higher than in some competitor countries for other reasons, there was no scope for further cost increases through strict environmental requirements.
6. For one plant, environmental permits had always been strict because of the limited carrying capacity of the surrounding environment.
7. In the case of one plant, it was felt that environmental instruments based on concentration values disadvantaged small plants.
8. In one plant, cost savings from environmental performance improvements were negligible as the price of a key input did not reflect its full environmental costs.
9. One plant considered environmental regulations to be too strict and their requirements to be irrelevant.
10. In the case of one plant, the lack of economic instruments of environmental protection reduced the profitability of environmental investments and reduced opportunities to achieve savings through avoiding regulatory charges.
11. In one plant, an environmental tax on the plant's product that was in place in some countries increased costs without bringing opportunities for savings since it could not be avoided through environmental performance improvements.

Visibility

Visibility-related reasons quoted by case plants why they could or could not reduce stakeholder costs or increase customer revenue³¹⁸ through environmental performance improvements:

1. One plant was situated in the middle of a city, by a significant water body. Several of the environmental issues relating to the plant's production were easy to perceive by the local inhabitants. A key environmental issue was readily learned from the characteristics of the end product by customers. The plant advertised its environmental performance and had established eco-product lines. There were no further production steps between the plant and the end customer. The product was a consumer product with a well-known brand name. However, the name of the company and the name of the product brand were not the same. The end product typically attracted environmental attention, and the industry in

³¹⁸ In the context of visibility, willingness to pay, and benchmarks, increasing customer revenue refers to a with-without comparison, not to a before-after comparison. Hence, maintaining customer revenue, or restricting its loss, may also be counted as "increasing customer revenue" in certain situations.

general was regarded as a polluting industry. However, within its industry sector, the plant was relatively small and thus escaped most intense attention. There were both non-governmental organisation activity and environmental labels relating to the industry and its products. Some of the plant's customers were professional buyers, with whom information sharing on environmental issues was much easier than with consumers.

2. One plant belonged to an industrial sector that was regarded as particularly harmful by the general public. In the past the plant had been part of a corporation that was considered a significant polluter. The plant had relatively large environmental impacts, and was situated on an industrial site with several other major polluters. The main environmental issue relating to the plant's products was a consumption externality and as such very easily perceived by the general public. However, other than this issue, it was difficult for a customer to perceive the environmental issues relating to the end product. There were numerous end product applications for the plant's product; some of them were quite distant from the original product but others were not. Some of the end product applications attracted a lot of environmental attention.
3. One plant was situated exceptionally near housing and many of the environmental issues that the plant was facing were such that they could be easily perceived by the local inhabitants. The plant was under heightened environmental attention because of the bad historical image of its location, the perceived harmful environmental impacts of the parent corporation whose name was identifiable in the plant's name, and the perceived environmental harmfulness of the industry and its products. The plant had various end customer types: some with a very close connection to the plant's operations but others with practically no connection. The plant's product related to the environment, wherefore the plant could not have the image of a polluter.
4. One plant was located in an area where summer cottages were very important. The residents of the summer cottages were keen to preserve the quality of the local environment and complained easily about the activities of the plant.
5. One plant, a single-plant company with a remote location, was a small polluter. Its "product" was only a small processing step in manufacturing the end products of other companies. However, the environmental issues relating to the industry were perceived harmful by the general public, and the whole industry attracted environmental attention. Competitors could also bring up environmental issues in business-to-business negotiations. It was thus important to avoid negative visibility, even if much could not be gained from positive visibility.
6. In one plant, the environmental issues were only of local interest. The remote location of the plant reduced the environmental impacts felt by stakeholders. (For comparison, the socioeconomic composition of the city where another group plant was located had changed and environmental impacts that were previously accepted by the local population had become less acceptable.) The end product did not attract environmental attention, and neither the product nor the plant were targeted by non-governmental organisations. However, improving the environmental friendliness of the packaging of the end product was well received by customers. But, the parent corporation was publicly traded and operated in environmentally sensitive areas, wherefore this plant could not afford to tarnish its image.
7. One plant was situated near inhabitation, in an area with much recreational use. The plant, however, was a minor polluter. In general, the industry was considered polluting by the general public, but this particular branch of the industry was relatively clean and did not attract much environmental attention. Some of the materials used were, however, perceived particularly harmful. An average customer had difficulty in understanding in

detail the environmental issues facing the plant. Many of the products of the plant were almost invisible to an ordinary consumer. The plant kept a low profile on environmental issues so as not to draw attention to another group plant whose environmental performance was perhaps less good.

8. In one plant, the relevant environmental issues were easily perceivable, but generated only local interest. The industry in general was perceived polluting by the general public and non-governmental organisations were active concerning the environmental performance of the industry. However, this particular plant was relatively small within the industry and had outsourced the most environmentally harmful production steps. There were several vertical production steps between the plant and the end customer; in practice, the product of the plant was hardly noticeable in the end product and the plant remained anonymous to customers.
9. For historical reasons, one plant was located in a beautiful area in the middle of a holiday resort. The plant was so dominant in the community that its activities were closely followed. However, this part of the production chain was less polluting than some others, and besides product packaging, customers hardly perceived the environmental issues relating to the plant's activities. This, nevertheless, varied between customers: some industrial end customers were very close to the plant and its activities but some other end customers were quite distant and for them the plant remained practically unknown.
10. The environmental impacts of one single-plant company were so small compared to the pollutant load of other emission sources that even if the plant ceased all emissions, no discernible impact on the surrounding environment would be felt. The whole industry branch, however, was emotionally considered a "poison branch" by the general public. The plant's "product" was only a small production step in a long chain of steps required for the end product.
11. The environmental impacts of one plant were local and minor. Customers were situated far away and hardly visited the plant. The plant could not make a noticeable improvement in the surrounding environment – which was already polluted and of relatively low recreational value – because its environmental impacts were so small compared to those of other emission sources. But, because of past environmental problems, the plant was constantly under local scrutiny, and it was part of a large publicly traded corporation whose image was not to be harmed. The product of the plant was perceived by customers to be a marginal part of the end product, and neither the end product nor this part of it attracted environmental attention.

Willingness to pay

Willingness to pay -related reasons quoted by case plants why they could or could not increase customer revenue through environmental performance improvements:

1. One plant had several customers who were interested in the plant's environmental performance. Some had purchasers with a high personal interest in the environment. Some sold their product to environmentally conscious markets and therefore demanded high environmental performance from their suppliers. Some customers faced mandatory labelling requirements if a certain environmentally harmful substance was used in the production process and thus required that the substance not be used, even if this meant weakening some other quality aspects. Some customers, however, were not in a position where they had to demonstrate high environmental performance, and did not require this from their suppliers, either. The physical product could not be improved through better environmental performance, but continuity and reliability, which were very important in the business, were more secure when environmental risks were minimised.

2. The customers of one plant were clearly environmentally conscious, in some markets even to the extreme. However, the consciousness did not materialise as a price premium but rather as the protection of the market share. There were a number of environmental labels, environmental management certificates, and environment-related public procurement requirements affecting the customers, as well as market pressure from the customers' customers. Depending on the intended use of the product, other product attributes were or were not weakened by the environmental improvements. However, the other product attributes were never enhanced by environmental performance improvements.
3. In one plant, customers were hardly interested in the plant's environmental performance. Larger customers, however, were interested in whether the plant had an environmental management system certificate. The question of the final disposal of the product was of some interest to customers, too. Environmental performance improvements did not make other attributes of the product any better.
4. In one plant, different customer segments exhibited very different environmental consciousness: private consumers were conscious but not particularly knowledgeable and relied on the product's image. Industrial customers were both conscious and knowledgeable about the plant's environmental performance. They themselves had certified environmental management systems whose requirements trickled down to suppliers. A third customer group, "professional consumers", was under certain regulatory pressures to take environmental issues into consideration. Besides these pressures, however, the price was the most important parameter for these customers as they were not doing well economically. It had been possible to develop a product type that was environmentally preferable and at the same time more efficient and thus less expensive for the customer to use. These products commanded a significant price premium.
5. For one plant, the ordinary, significant mass of customers was not particularly interested in the plant's environmental performance. Consumers relied mostly on the product image, and they did not perceive environmental issues to relate to the image of this kind of a product. Industrial customers and delivery channels were beginning to enquire about environmental management system certificates, though. The actual product itself could not be affected by environmental performance improvements.
6. In one plant, customers were not that interested in the environmental performance of such a minor polluter. There was significant variation between geographic markets in this respect, however. And, industrial customers were interested in whether the plant had an environmental management system certificate so that they could prove their own environmental friendliness to their own customers.
7. In one plant, the customers were in general not environmentally conscious. However, some interest in environmental issues was beginning to show, especially in certain geographic markets. Environmental management systems were emerging with customers, as well as packaging requirements, which were reflected in supplier demands. In one environmental issue, it was possible to bundle improvement with lower use costs for customers.
8. In one plant, the environmental consciousness of customers varied between markets, and the plant mainly served the market that was the least environmentally conscious. There was no way to augment other characteristics of the product through environmental performance improvements. In general, thus, customers were "surprisingly uninterested" about the plant's environmental performance. Some customers, though, faced packaging requirements in their own country and hence were interested in packaging-related issues.

9. One plant could not think of any customer that would pay a price premium for improved environmental performance. Environmental issues almost never came up in discussions with customers. Some large companies might enquire about environmental performance, but more as a formality, and the content of the answer was not that important.
10. In one plant, the customers were not environmentally conscious when it came to the products of the plant. Many of the end products were such that environmentally conscious customers would not be their significant users anyway. Neither were there any environmental labels relating to the products, and environmental certificates were not widespread among the customers. All in all, environmental issues were not significant in the markets: customers did not react when the plant was breaking environmental laws and they did not react when the plant made environmental improvements. For some customer segments the economic situation was so tight that only price mattered in a purchasing situation.
11. An important share of the sales of one plant was destined to a geographic market where there was little purchasing power and where environmental issues were of little interest. By contrast, customers had expressed a preference for less modern production facilities and a cheaper product.

Benchmarks

Benchmark-related reasons quoted by case plants why they could or could not increase customer revenue through environmental performance improvements:

1. One plant had been a first-mover and was now the market leader in terms of environmental performance. High environmental performance was thus a competitive weapon for the plant since it was ahead of competition. However, there were signs that competitors were following suit and it was expected that high environmental performance would soon become a must instead of a competitive weapon. It was possible for the plant to raise rivals' costs by forcing stricter environmental permit requirements on them. The environmentally friendly product lines of the plant were less expensive than competing products because their production costs were smaller.
2. The domestic competitors of one plant were completely different from the plant in terms of their production methods and image. The plant could not afford to be an environmental laggard since the competitors' environmental image was so much better than its own.
3. One plant was ahead of competition environmentally and felt that it was beneficial to keep it that way.
4. In the case of one plant, all competitors paid attention to environmental performance. Good environmental performance had become a natural part of the activities of each producer: a plant would not get a prize for it but would get punished for neglecting it.
5. In one plant, lagging behind competition in terms of environmental performance would produce a negative market reaction. Price competitiveness also needed to be guarded since global free trade reigned in the industry. Through proactive measures, the plant could raise costs for certain rivals. Substitutes with different environmental properties were available for the plant's products.
6. In the case of one plant, a substitute for the plant's product existed that was both less expensive and more environmentally friendly. There was competition from other

jurisdictions with different environmental performance requirements and thus different production costs.

7. In one plant, the product and the production process did not, practically speaking, differ from those of competitors. The product was a bulk product with a world market price. In environmental terms, the relevant comparison was rather to substitutes than to other producers of the same product.
8. One plant had practically no competition in its main market. It was also in a particular situation where the product prices were largely guaranteed. The plant's customers thus had almost no comparison points for the price or for environmental performance. The little competition that there was did not utilise environmental performance as a competitive weapon.
9. In the case of one plant, no competitors had tried to differentiate themselves through environmental performance.
10. In the case of one plant, there were lots of small identical producers and price competition was extremely tough. There were no particular environmental measures, such as environmental management system certificates, in the industry.
11. In the case of one plant, there were no domestic competitors. None of the foreign producers had used environmental issues in competition, and it was perceived that environmental management system certificates could not be used to achieve competitive advantage against competition since imitation would quickly erode their differentiating power. By contrast, price competition was tough, and much of the plant's production capacity had been reduced after price wars with foreign producers.

Discount rate

Discount rate -related reasons quoted by case plants why they would or would not take a long-term perspective to the costs and benefits of environmental performance improvements:

1. One plant was doing well economically, its market share was growing, and it had access to the large R&D resources of the parent corporation. The plant estimated that both environmental permit limits and eco-label criteria would become stricter in the future, and that competitors were constantly improving their environmental performance.
2. In one plant, stringent short-term return requirements were not followed.
3. In one plant, profitability was moderate, but had been reduced. It was perceived that the environmental demands of the regulators and markets were becoming stricter.
4. In one plant, it was expected that environmental permits would become stricter and that customers would start to pay more and more attention to environmental issues. The parent corporation required that environmental issues be treated as important. It was easy to devote attention to environmental issues as the plant was doing well financially.
5. In one plant that was part of an international publicly traded corporation, the first priority for the owners was profitability. Demand for the product was stable. Especially in the past, when the major environmental investments were implemented, the industry was protected, and the plant was doing very well economically. Now the situation had slightly changed, and as a result, the environmental profile had been somewhat lowered. However, it was believed that environmental issues would matter more in the markets in the future, and preparing for the long-term success of the plant thus had to take into

consideration also environmental performance. Similarly, when environmental investments became necessary, it was considered best to invest in good equipment once and for all since it was perceived that permit limits would only get stricter in the future.

6. One plant was not doing well economically. Moreover, there was competition between the group plants for investment funds, and the plant was not well positioned in this competition: it was not a priority plant, its production capacity had been significantly reduced, and the other group plants faced more serious environmental problems than this plant. However, it was perceived that compliance with the present environmental requirements was not sufficient since customer expectations and permit requirements were becoming stricter.
7. In one plant, profit margins in the industry were tight, investment funds were relatively scarce, and payback times exceeding five years were not considered acceptable. The plant was not doing well economically; it had suffered market share loss and there had been layoffs. However, both the plant management and top management of the parent corporation saw that environmental issues would be an important competitive weapon of the future, wherefore they could not be neglected.
8. In one plant, the first priority for the owners was profitability. Short payback times were required of investments, and it was felt that the parent corporation might cease operations at the site if a large non-profitable environmental investment is suggested. The plant was not doing well economically: there had been major changes in its operating environment, product prices had been cut by half, there had been layoffs and the plant had on occasions been at the verge of closure.
9. One plant had undergone significant crises and was not a strategic plant for the parent corporation. Hence, funds for large investments or investments that were not directly profitable were not to be expected. Investments in environmental performance instead of some other, more profitable investments could be made only if extra funds were available.
10. One plant felt that environmental issues would become more important in the future, even if they so far had played no role in the markets.
11. In the case of one plant, there were many small producers in the industry, all of which were doing badly economically. Demand for the product was falling, and there were no resources for investments or R&D. It was perceived that the whole industry in its present form was doomed.

APPENDIX V

Determinant profiles of the case plants

Figures V-1 and V-2 contain the profiles of the eleven case plants in terms of the six main determinants of environmental profit. Each radar chart displays three concentric circles. The innermost circle refers to circumstances that are unfavourable to the creation of win-win situations, the middle circle to circumstances that are neutral to the creation of win-win situations, and the outermost circle to circumstances that are favourable to the creation of win-win situations. The assessment of the situation of each plant is based on the case data relating to water pollution only, since compliance information refers to water pollution only.

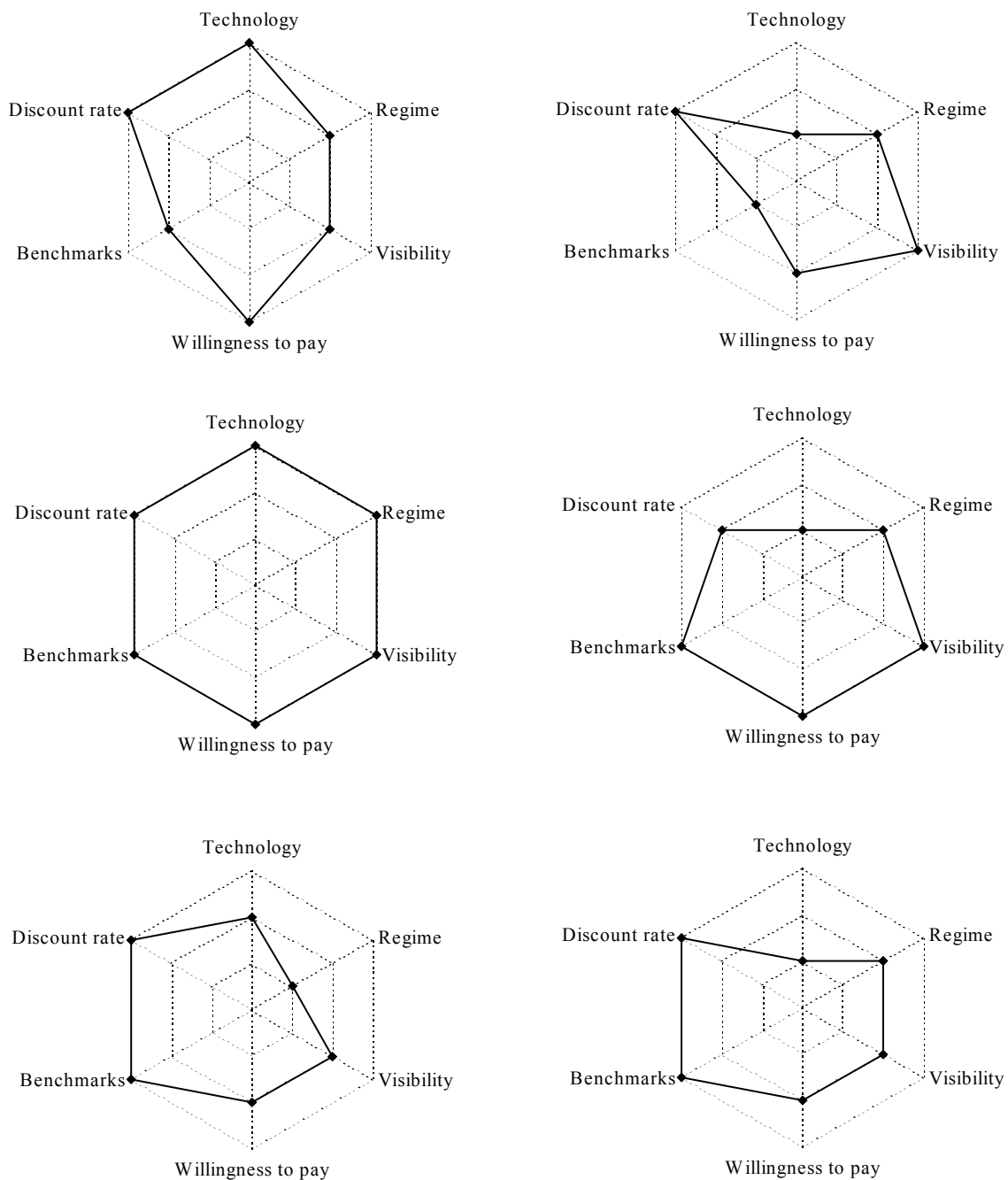


Figure V-1 Determinant profiles of the case plants in the overcompliance cluster

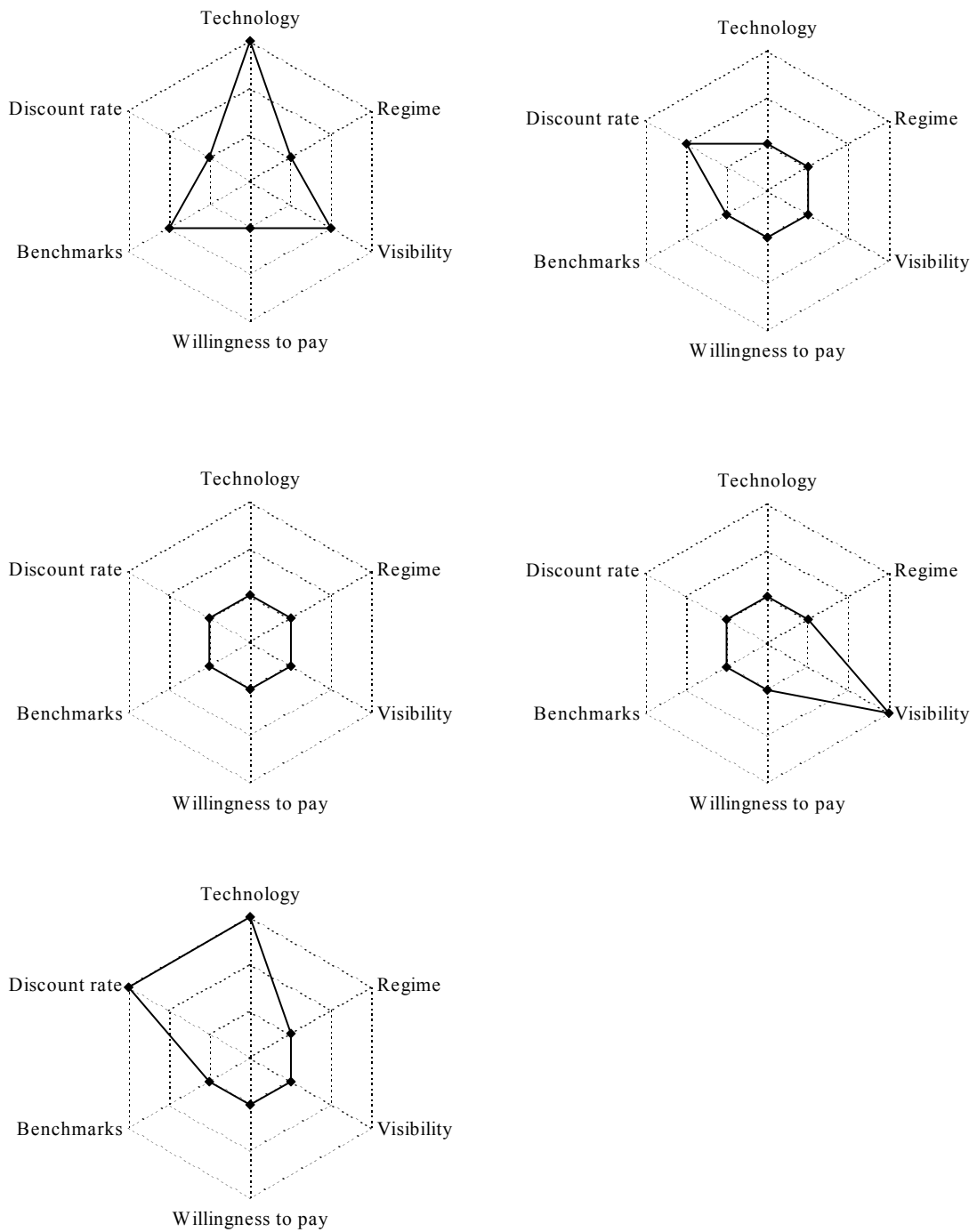


Figure V-2 Determinant profiles of the case plants in the non-compliance cluster

The radar charts show how it is not a single determinant but the delicate balance of the six determinants that separates the plants in the overcompliance cluster from the plants in the non-compliance cluster.