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Are environmental aspects value drivers for companies? A review of empirical studies.

von
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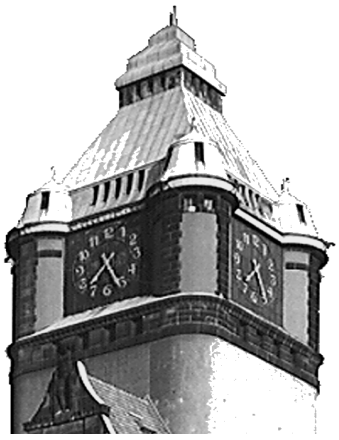

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Content

Figures

Abbreviations

ENA	Environmental aspects
AR	Abnormal Return
CEP	Council on Economic Priorities
CF	Cash Flow
COD	Chemical Oxygen Demand
DIN	Deutsches Institut für Normung e. V.
Ed	Editor
EMAS	Environmental Management and Audit Scheme
EMS	Environmental Management System
EN	European Norm
ISO	International Organization for Standardization
KLD	"Kinder, Lydenberg, Domini and Company"
N.A.	Not available
No.	Number
PE Ratio	Price Earning Ratio
ROA	Return on Assets
ROCE	Return on Capital Employed
ROE	Return on Equity
ROS	Return on Sales
SHV	Shareholder Value
TRI	Toxic Release Inventory
US	United States
USA	United States of America
Vol.	Volume

1. Introduction

This paper examines the relationship between the pursuit of economic and ecological goals on the level of the single company, focusing on the value adding potential of considering environmental aspects (ENA). Its main objective is to establish a broad analysis of empirical research into this topic. Being of passing interest, case studies are not included in the analysis.[1] The methodology applied lies in between a traditional narrative report and a complex meta-analysis. A systematic analysis of the studies' special features is hereby preferred to a narrative description.

2. The basics of the relationship between economic performance and environmental performance

According to the traditional point of view, environment is included in financial accounting as part of the combination of production factors. Environment as a consumption factor belongs to a group of inputs, without which economic production is not possible.[2] However, recognition in financial accounting can only take place when costs or other restrictions are allocated to the use of the consumption factor. For most of the environmental aspects without an existing market price[3], this is not the case. Consequently, environment is considered as a free good[4].[5]

In such a case, the costs of avoidance and/or cleaning up of environmental damages are not voluntarily taken over by the companies but considered as external effects passed on to other market players. Efforts to protect the environment are considered as not profitable i.e. not compatible with the main objective of the company: the maximisation of profit.[6] This will change only when environment, originally a free good, becomes scarce. Scarcity occurs, if a discrepancy between demand and supply exists.[7]

To conclude, traditional recognition of environmental aspects and their relationship to economic aspects are flawed and lead inevitably to market failure.[8]

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[1] Cf FIGGE, F. (2001), p. 9.
[2] Cf GUTENBERG, E. (1952/1972), p. 3., cited by BRODEL, D. (1996), p. 83.
[3] Cf BECKER, C. (1998), p. 2f.
[4] "Free goods are available in any amount without provision costs." HEERTJE, A. (1991), p. 1.
[5] Cf BLEIS, C. (1995), p. 33.
[6] Cf PFRIEM, R. (1995), p. 244., cited by BRODEL, D. (1996), p. 83f.
[7] Cf BRODEL, D. (1996), p. 63.
[8] Cf ENDRES, A. (1985), p. 11ff., cited by BECKER, C. (1998), p. 3.

In a more proactive view, environmental aspects have become a value driver and are considered to have a medium-term or even long-term influence on the future prospects of a company due to the uprising ecological concerns in the society.[9] This is why actions that influence the environment have to be considered as investments with their own opportunities but also threats.[10] The costs[11] and potential opportunities[12] of environmental aspects will therefore influence more and more a company's economic prosperity[13] and cash flows.[14]

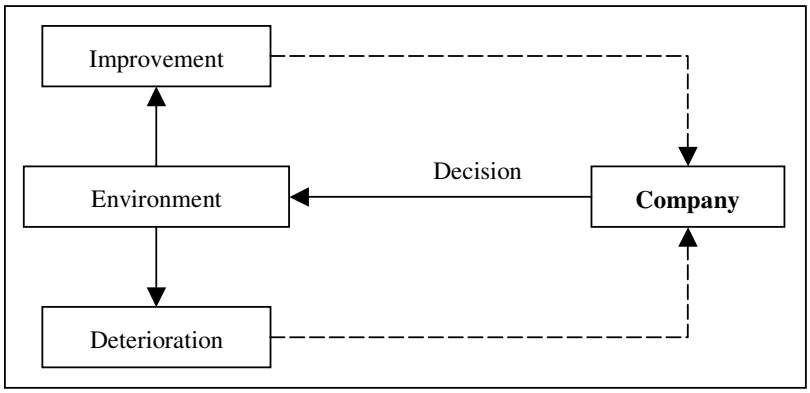

Figure 1: Relationship between a Company and the Environment

It has however to be taken into account that the influence of the environment onto a company runs indirectly, often through other stakeholders, e.g. the society.[15] This states that the ecological concernment is not solely determined by internal factors but also by external ones, i.e. external stakeholders[16].[17] As an example, Henriques und Sadorsky (1996) have proved with the help of empirical data that stakeholders play a decisive role in the decision to establish an environmental plan in the company.[18]

Long-term maximisation of profit is considered as the main objective of a company.[19] This objective consists of three parts: liquidity, success and strategic success potential.[20]

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[9] Cf MILDENBERG, U. in KRALLMANN, H. (1996), p 253f.
[10] Cf BRODEL, D. (1996), p. 162f.
[11] Examples are: energy costs, environmental levy, legal requirements etc.
[12] Examples are: opportunities for specialisation, cost reductions etc.
[13] Cf SCHALTEGGER, S. (2000), p. 30.
[14] Cf REPETTO, R. (1999), p. 33.
[15] Cf KROTZINGER, J. E. (1998), p. 66.
[16] "…a stakeholder is any group or individual who can affect, or is affected by, the achievement of a corporation's purpose. Stakeholder include employees, customers, suppliers, stockholders, banks, environmentalists, government and other groups who can help or hurt the corporation." FREEMAN, R. E. (1984), p. vi., cited by BECKER, C. (1998), p. 58.
[17] For further reading see: GÜNTHER, E. (1994), p. 24ff., BEUERMANN, G. (2003), p. 3ff. und p. 32ff., FIGGE, F. (2000), p. 11ff.
[18] Cf HENRIQUES, I. (1996), p. 381ff.
[19] Cf WÖHE, G. (1990), p. 122.

Liquidity is the reference unit, which is the least determined by environmental aspects. [21] But it is still an important item, for it functions as a KO-criteria for the survival of a company.[22] The term success stands for an operational element, which incorporates in a formal way the difference between all revenues and expenses.[23] The most important item for the long-term perspective is the strategic success potential of the company. Strategic success potential is a sine qua non for future success and liquidity, it therefore guarantees the company's survival. The strategic success potential thereby becomes a strategic control item, monetarily measured as the value of a company.[24] In this paper, the term "value" amounts the capitalised value of the company's potential earnings. The capitalised value of the potential earnings is the discounted value of the future cash flows. The guiding principle of going concern has thereby to be followed.[25] In this paper, the value of a company represents the company's objectives. It is also a crucial element in the relationship between a company's economic and environmental performance, for it has to be determined whether the recognition of environmental aspects can have an incidence on the level to which it can reach its targets.[26] A company will only switch to an environmentally sound way of doing business if it can thereby secure its economic performance.[27]

Copeland reported that the value is the best reference to assess and control a company's performance, since:[28]

- it is the only one, which requires a complete range of information,
- it involves a long-term perspective,
- it is used to control cash flows not only in the balance sheet but also in the income statement,
- it is used to perform a risk-adjusted comparison of cash flows from different periods of time.

In general the value orientation is focused on a lasting value added, i.e. on the return to the shareholders.[29]

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[20] Cf COENENBERG, A. G. (1992), col. 476ff.
[21] Cf GÜNTHER, E. (1994), p. 20.
[22] GÜNTHER, E. (2002), p. 1.
[23] Cf COENENBERG, A. G. (1999), p. 581., cited by STURM, A. (2000), p. 19.
[24] Cf GÜNTHER, E. (2003), p. 1.
[25] Cf VON FLOTOW, P. (2002), p. 31f.
[26] Cf FIGGE, F. (2001), p. 8.
[27] Cf TEMPEL, H. (1999), p. 14., BUNDESUMWELTMINISTERIUM / UMWELTBUNDESAMT (ED) (2000), p. 25., PETERSEN H. (2001), p. 12., FIGGE, F. (2001), p. 9.
[28] Cf COPELAND, T. (1998), p. 54.

A company should ideally succeed in increasing its value with the help of environmental management. A possible objective function could strive for the maximisation of the value by simultaneous minimisation of the environmental damage. Since this objective cannot always be reached, a company may proceed as follows:[30]

1.) Respect the existing legal requirements,
2.) Carry out value-adding projects for the protection of the environment,
3.) Carry out non value-adding projects for the protection of the environment, providing the minimisation of a decrease in value.[31]

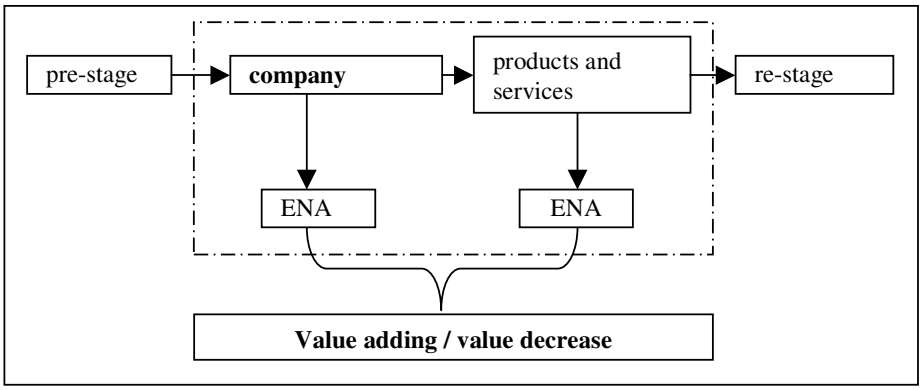

Figure 2: The system of value

3. The relationship between economic and environmental performance

The notion of performance stands either for the result of a systematic activity or for this activity itself.[32] In this paper, performance is the synonym of the result of a systematic economic or ecological activity.[33]

3.1 Economic Performance

Economic performance is the result of company's activities regarding its targets: liquidity, success and strategic success potential. Therefore one can differentiate between a strategic level (strategic success potential) and an operational one (success and liquidity).[34]

Several methods may be used to measure the economic performance of a company, the most appropriate of which has to be chosen according to the respective targets figures. A short overview of existing methods will be presented in the following:

[29] Cf SCHIERENBECK, H. (2001), p. 3.
[30] Cf BELLMAN, K. IN KRALLMANN, H. (1996), p. 133.
[31] Cf WALLEY, N. (1994), p. 47.
[32] Cf GLEICH, R. (2001), p. 36.
[33] Cf STURM, A. (2000), p. 6.
[34] Cf STURM, A. (2000), p. 23.

Firstly, there are accounting based measures to assess the economic performance such as profit, return on assets etc.[35] Such measures are predominantly used to determine the company's operational performance. When using such a measure and the underlying method, one has to be aware of its shortcomings. The use of different valuation methods for example may alter the observed profit. This shift may have a remarkable incidence on the companies' comparability.[36] Furthermore, accounting for a company's risks from accounting based measures only remains a difficult task. All accounting based measures do only provide ex-post information.

Secondly, economic performance may also be drafted from stock market based measures, e.g. Stock Price and Price Earning Ratio. It hereby has to be assumed that, in the case of a perfect capital market, the stock value of a company corresponds to its actual value.[37] In reality, it has to be considered that expectations of shareholders, speculative capital transactions and movements of the stock prices of alternative investments have a strong incidence on stock prices.[38] In terms of empirical research the recognition and valuation of the analysed variable (e.g. environmental performance) by the stock market itself is also an important requirement for capital based measures. It is the authors' opinion that a company's stock price can only reflect the influence of environmental performance the capital market players have knowledge of and can evaluate.

Value oriented methods like the shareholder value (SHV) may also be used to measure performance. In this method, emphasis is laid on the strategic economic performance and its target figure: strategic success potential.[39]

In the opinion of the authors value-oriented methods have some important advantages over other ones. They are meaningful, future-oriented, particularly with regard to economics, and their valuation may reflect environmental aspects.

[35] For further reading see: COENENBERG, A. G. (1997), p. 563ff.
[36] Cf CHAKRAVARTHY, B. P. (1986), p. 442f., cited by SCHÜLE, F. M. (1992), p. 104f.
[37] Cf KROTZINGER, J. E. (1998), p. 114., GÜNTHER, T. (1997), p. 250.
[38] Cf BECKER, C. (1998), p. 104.
[39] Cf GÜNTHER, T. (1997), p. 70f.

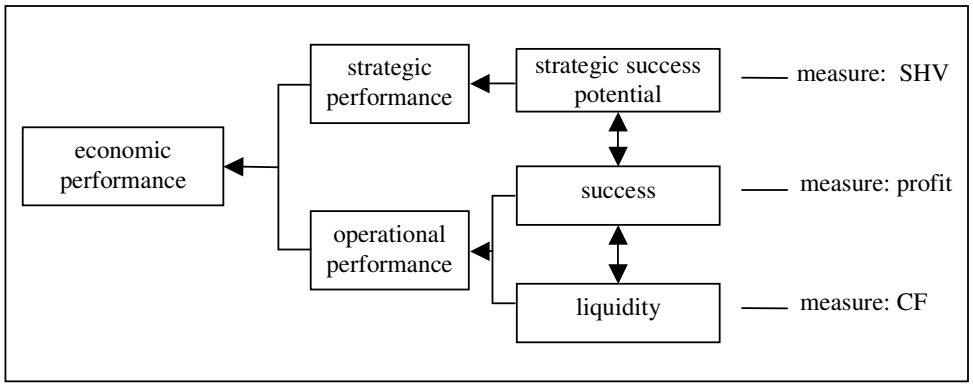

Figure 3: Economic performance (with reference to: Sturm, A. (2000), p. 24)

Traditional valuation methods such as the intrinsic value are, in contrary to value-oriented methods[40], only partly adapted to include qualitative aspects into their valuation scheme. However, the recognition of qualitative aspects with regard to environmental aspects is unavoidable, as the qualitative and even more the monetary assessment of environmental aspects is very difficult if even feasible.[41]

This is for example the case for environmental improvements that represent a benefit for everyone (society). This kind of company-related "benefits" may be considered as value-adding processes.[42]

Moreover, value-oriented methods are future-oriented and long-term assessment methods, and are therefore optimal for the assessment of environmental aspects.[43] For instance it becomes possible to include the reduction of environmental risks and their effects on profit and capital costs accordingly in strategic planning.

Value-oriented methods are however still inadequate. This partly results from the difficulties to find a proper discount rate in order to valuate environmental aspects. Firstly, the discounting period might be too short with regard to environment, i.e. some environmental aspects only start having effects after the discounting period has come to an end and can therefore not be considered.[44] Secondly, the later it occurs (with regard to t_0), the less effects

[40] Cf SCHALTEGGER, S. (1998), p. 6f., KROTZINGER, J. E. (1998), p. 100.
[41] Cf KROTZINGER, J. E. (1998), p. 93.
[42] Cf STAHLMANN, V. (2000), p. 57.
[43] Cf SCHALTEGGER, S. (1998), p. 7., BEUERMANN, G. (2003), p. 32.
[44] Cf BEUERMANN, G. (2003), p. 32.

future value added will have.[45] As a result, future developments might be underestimated and the solution for environmental problems might be postponed. Determining a discounting rate often proves problematic as well, especially when the time preference related to the environment is chosen.

The recognition of environmental aspects is further handicapped by the inadequacy of information about their measurement and effects.[46] Hence, the recognised value added might be a difficult to grasp mixture of subjective and objective values.[47]

Define value orientation according to strict criteria results in undertaking mainly value adding activities.[48] However, such a procedure is not always optimal if external effects are taken into consideration. This is why the state plays an important role, for it can intervene by setting a legal and economic framework involving laws and taxes. Environmental protection measures, which normally appear negative, can hereby have positive effects.[49]

In order to address all the problems mentioned, value-oriented methods such as the shareholder value network have to be supplemented by additional instruments. Figge (2001)[50] and Schaltegger (2000)[51] for example, suggest the use of option models, and Beuermann (2003)[52] and Wipfli (1998)[53] the use of the shareholder value model linked with the stakeholder management.

This process makes it possible to understand the indirect feedback (via stakeholders) of environmental aspects onto the company that will then be integrated separately into the SHV-model. Consequently it is assumed that environmental aspects have not only a direct incidence on the value of a company, e.g. by means of cost reduction, but also an indirect one that results from the reaction of different stakeholders to the environmental impacts of a company.[54] This concept helps to identify the effects of environmental aspects and to integrate stakeholder requirements into value-oriented models. However, problems may arise

[45] Cf SCHALTEGGER, S. (1998), p. 7.
[46] Cf FIGGE, F. (2002), p. 11.
[47] Cf KROTZINGER, S. (1998), p. 100.
[48] Cf BEUERMANN, G. (2003) p. 11.
[49] Cf ZAHN, E. IN KRALLMANN, H. (ED) (1996), p. 157.
[50] Cf FIGGE, F. (2001), p. 10.
[51] Cf SCHALTEGGER, S. (2000), p. 40.
[52] Cf BEUERMANN, G. (2003), p. 45.
[53] Cf WIPFLI, C. (1998), p. 1390ff.
[54] Cf WIPFLI, C. (1998), p. 1390.

when differentiating between indirect and direct effects due to a lack of information and to unknown effects.

The following example of investment in a new production facility is used to illustrate the system: A company invests into a new production facility, which is equipped with state-of-the-art, environment-friendly technology. Following this investment, the company is more efficient and produces less emission. In addition, the investment in general involves a profit above the market average and is therefore value adding; this is a direct effect. At the same time, emission reduction has a positive effect on the public, thereby enhancing the company's image and increasing its sales: this is indirectly value adding.

However, the relative effect of environmental aspects onto a company's value still has to be quantified. As several distinct parameters are influencing a company's value in this process, every single one has to be considered as minor.[55] This may also affect the empirical determination of the relationship between environmental and economic performance, especially when the environmental effect is difficult to measure and the other parameters affecting the economic performance are not considered simultaneously.[56] In this paper, the part of the company's value resulting from environmental aspects is called "environmental value". The environmental value as the sum of all value-adding and value-destroying effects triggered by environmental aspects is an independent part of the company's value and ergo can be positive, neutral or negative. When using the term environmental value, the respective related activities have to be determined. Thereby one question arises: Can only activities be allocated, which are primarily aiming at reducing a company's environmental impact, or also the ones, which consider environmental impacts as unintentional side effects? Nonetheless that is a critical question that will not be addressed in this paper and should be the subject of further research.

3.2 Environmental performance

This chapter analyses the term environmental performance and its different aspects. Thereby the results of a survey related to the understanding of the term and a final definition is presented.

[55] Cf LANKOSKI, L. (2000), p. 55.
[56] Cf LANKOSKI, L. (2000), p. 55.

Both the EMAS II and the series of ISO 14000, particularly ISO 14031, define environmental performance as "results of an organisation's management of its environmental aspects"[57]. The research project EPM-KOMPAS[58] in cooperation with small and medium-sized enterprises from the mechanical engineering industry in Saxony showed however that this term has many other definitions. In order to clarify this, the authors have questioned experts from companies and research institutes dealing with "Management instruments for sustainable business" within the INA-Network (www.ina-netzwerk.de). For the following reasons, a broad empirical study did not appear appropriate:

1. directions to the definition of environmental performance should be given by experts,
2. results should be the basis for further research of the term.

Beside those of researchers, companies gave about 25% of all answers, 40% of the answers came from not clear attributable practice or research teams. 91,4% of all respondents had an understanding of the concept, and only 8,6% had none. The majority (80%) was already familiar with the term environmental performance. Although the remaining respondents were not, they could provide an interpretation of the term.

The survey results showed three main directions that were almost identically represented: about one third of the respondents defined the term environmental performance "according to standardisation" (either with reference to the respective standard or as verbal quotation). Another third of the respondents defined the term as "a decrease of the environmental impact" (i.e. a reduction of environmental aspects with connection to a company / a product / a process). The remaining 28,1% understand "environmental performance as general overview" (i.e. the overall resource consumption of a company / a product / a process in a given period) (cf fig. 4).

Other answers, e.g. "Value-added results from environmental protection measures" or "Operational performance of the environment" were only given individually.

[57] NAGUS (ED) (1999), p. 5; cf The European parliament and the Council of the European Union (ED) (2001), Article 2c

[58] Further information about the project: "Environmental Performance Measurement as an Instrument for Sustainable Management: Conception, operationalisation and multiplication of a controlling instrument for the environmental performance measurement as a basis for a publicly available specification" under: www.tu-dresden.de/wwbwlbu/forschung/laufende_projekte/epm_kompas/en/

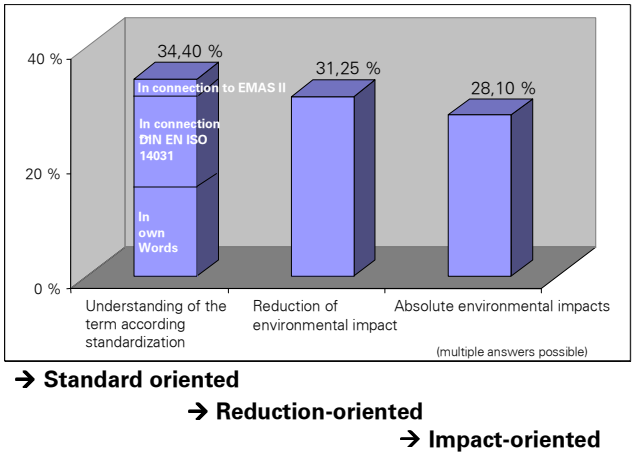

Figure 4: Understanding of the term environmental performance[59]

Only 34,4% of the respondents could mention a source for the definition they gave and 59,35% defined the term with their own words. Hence it must be determined, whether the answers according to the standardisation actually reflect a concrete understanding of the term and/or what is hereby meant. Do the "results of an organisation's management of its environmental aspects" represent the total amount of environmental aspects arising, or precisely the improvement/reduction, which has been reached?

In order to answer this question and to come to a definition of environmental performance, the results of the above-mentioned survey, those from previous studies and specialised literature have been gathered and interpreted. Three possible directions have crystallised (cf fig. 5):

- Environmental performance as defined by the standards (referred to by 34,4% of the respondents),
- Environmental performance as defined in specialised literature, e. g. also performance measurement assessments (59,35% of all answers),
- Environmental performance as defined by other researches.

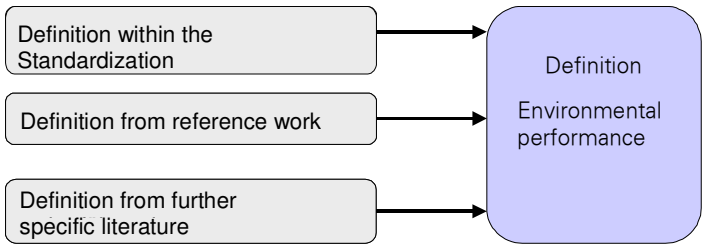

Figure 5: Possible approaches for a definition for environmental performance

[59] The numbers are only related to the respondents who give a statement concerning the definition (91,4% of the respondents).

The great number of existing understandings define the performance either as result of an activity or as the activity itself.[60] By analogy, this statement, also accepted in business administration, can help to define environmental performance. In addition to the results of the above-mentioned survey (global environmental aspects and/or decrease of environmental), two other directions have been identified:

- environmental performance as an activity (result of environmental management),
- environmental performance as a result of an activity (change of the operating environmental aspects/impacts)[61].

The matrix below (cf figure 6) summarizes the results of the whole research. Each definition and the respective considered elements are indicated.

In this table, it is obvious that some definitions contain all three understandings, and that others only refer either to the survey or to the standard. It also points out that environmental performance is defined both as an activity and as a result of this activity. As a result, the matrix delivers a variety of concepts, no matter which literature was used to formulate the definition specific to the given firm.

In order to formulate a definition for this analysis and for further research the previous analysis will be taken as a cornerstone.

Environmental performance is to be considered as the absolute performance of a company with regard to the environment, i.e. environmental impact. If the activities of a company are not related to its environmental aspects or cannot be measured directly, environmental performance may be recorded and evaluated qualitatively.[62]

The definition of environmental performance comprises not only the absolute results of environmental impacts (e.g. CO_2 emissions per year) but also activities that cannot be directly measured with regard to environmental aspects (e.g. trainings).

[60] Cf Gleich, R. (2001), p. 36. Becker established also a combined term of result and activity based performance and a technology based term of performance. cf Becker, F. G. (1992), p. 44f.
[61] Cf Günther, E.; Berger, A. (2001), p. 51.
[62] Examples are environmental trainings, the afforestation of the rain forest by companies like Krombacher with no business connection to forestry.

definition environmental performance	activity	result of an activity	overall environmental damage	reduction of environmental damage
Pape, J./Doluschitz, R. (2002): environmental performance in a narrow sense is embracing direct environmental aspects and impacts in contrast to environmental performance in a broad sense, which embraces the indirect environmental aspects and impacts too. [63]	☒	☑	☑	☒
BMU/UBA (1997): environmental impacts caused by a company [64]	☒	☑ [65]	☑	☒
Stahlmann/Clausen (2000): "The direct and indirect caused reduction of environmental damage i.e. revitalisation of the natural environment"[66]	☑ [67]	☑ [68]	☒	☑ [69]
Loew/Kottmann (1997): environmental damage and repair in comparison to self set objectives and external standards[70]	☒	☑	☒	☑
Kottmann/Loew/Clausen (1999): environmental damage (term environmental performance as euphemistic variable)[71]	☒	☑	☑ [72]	☒
Schaltegger/Wagner/Wehrmeyer (2001): "Environmental performance is the total of a firm's behaviour towards the natural environment (i. e. its level of total resource consumption and emissions)."[73]	☒	☑	☑	☒ [74]
standardisation: "result of a organisation's management of its environmental aspects"[75]	☑ [76]	☑ [77]	☑ [78]	☒ [79]
☒ not included		☑ included		

Figure 6: Definitions of environmental performance

[63] Cf Pape, J.; Doluschitz, R. (2002), p. 4.
[64] Cf BMU; UBA (ED) (1997), p. 5.
[65] Those are measured by ratios.
[66] Stahlmann, V.; Clausen, J. (2000), p. 31.
[67] In regard to the revitalisation of the environment.
[68] Directly and indirectly caused reduction of environmental damage.
[69] This definition regards to the case that environmental performance only embraces a positive change of the environmental aspects.
[70] Loew, T.; Kottmann, H.; Clausen, J. (1997), p. 22.
[71] Kottmann, H.; Loew, T.; Clausen, J. (1999), p. 10.
[72] Environmental impact is meant here in absolute terms.
[73] Wagner, M.; Schaltegger, S.; Wehrmeyer, W. (2001), p. 97.
[74] Contains however the implicit objective. The definition does not focus on it explicitly.
[75] NAGUS (1999), p. 5. The definition used by EMAS is not quoted separately, because it is equal to the one used by DIN EN ISO 14031.
[76] Recording and depiction with management ratios.
[77] Recording and depiction with operating ratios.
[78] Depiction with operating ratios.
[79] Contains however the implicit objective. The definition does not focus on it explicitly.

Environmental performance can be separated into a strategic and an operational part, like its economic counterpart. The operational level deals with the objective of the environmental efficiency.[80] To evaluate environmental performance (in comparison to another company, another year or a target), the corresponding ecological success has to be calculated.[81] In general success is meant to be the consideration of a difference. Ecological success records either the difference at different periods in time (e.g. emissions in year t compared to emissions in year t+1) or the difference between the current state and a company's objective. Therefore ecological success – following its economic counterpart – may be either positive or negative.

The strategic level of environmental performance aims at the environmental effectivness[82] by exploiting the strategic success potential.[83] Therefore it guarantees long-term flexibility and adaptability[84] as preconditions of survival. Examples for strategic environmental performance are the establishment of environmental objectives[85] or an environmental management system (EMS), an existing environmental marketing concept and in general investments in tangible or intangible assets affecting the environmental aspects of a company. In principle it is assumed that strategic environmental performance leads to operational environmental performance.

Sometimes external environmental reporting is considered to be a measure for environmental performance.[86] This analysis does not follow this view. Moreover external environmental reporting is considered as a carrier of documentation and an instrument for communicating environmental performance to external stakeholder. Without an exact examination it cannot be guaranteed that environmental reporting of what quality and quantity ever, correctly displays environmental performance.[87] For instance Bansal, P. (2000) could show that a company can influence its public received environmental performance by means of public relation activities.[88]

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[80] Cf GÜNTHER, E. (2002), p. 20.
[81] Cf Sturm, A. (2000), p. 111.
[82] Cf GÜNTHER, E. (2002), p. 20.
[83] Cf COENENBERG, A. G. (1987), p. 37f.
[84] Cf STURM, A. (2000), p. 278.
[85] "...an overall environmental goal, arising from the environmental policy, that an organisation sets itself to achieve, and which is quantified where practicable." The European parliament and the Council of the European Union (ED), (2001), L114/3.
[86] Cf LANKOSKI, L. (2000), p. 12.
[87] Cf ULLMANN, A. A. (1985), p. 541.
[88] Cf BANSAL, P. (2000), p. 6.

In practice it is quiet difficult to measure environmental performance. That grounds in the complex characteristics of environmental performance in general and in the different availability of information about environmental aspects in special. It follows from the fact that only a part of all environmental aspects can be quantified.[89] Additionally there are environmental aspects whose effects and importance are not known or visible till now, therefore their true nature will only be obvious in future.[90]

Therefore it is recommendable to divide environmental performance into different aspects. By doing so it becomes possible to better identify, measure and control environmental performance. Thereby it becomes more realistic to grasp the economic importance of environmental performance as well. But even if all aspects would be recognisable the single aspects are still to be weighted and combined in order to specify environmental performance as a whole.[91] Such recognition could be realised in form of a key ratio. This key ratio could be combined with an economic ratio, e.g. the SHV in order to gain specific insight into the relationship between economic and environmental performance.

The basis for setting up a key ratio is a ratio system[92].[93] The advantages of a key ratio, used as well to analyse the economic performance[94], consists in an increase in transparency, objectivity and a more efficient application compared to non-aggregative ratios. A more detailed discussion can not be part of this paper, for further reading about aggregative methods to recognise environmental performance see for example: Braunschweig, A. (1993), Böning, J. (1995) and Bundesumweltministerium (Ed) (1995).

[89] Cf KROTZINGER, J. E. (1998), p. 66.
[90] Cf BEUERMANN, G. (2003), p. 32.
[91] Cf LANKOSKI, L. (2000), p. 11.
[92] In general a ratio system is understood as a combination of quantitative variables, where the single ratios are logical related, complement or explain each other and are targeted at a mutual objective. REICHMANN, T. (1990), p. 19.
[93] Cf BRAUNSCHWEIG, A. (1993), p. 43.
[94] In economic practice it is tried to explain the change of a key ratio with directly related, subordinate ratios with the help of a ratio system. REICHMANN, T. (1995), p. 18ff. und 52ff., cited by COENENBERG, A. D. (1997), p. 578.

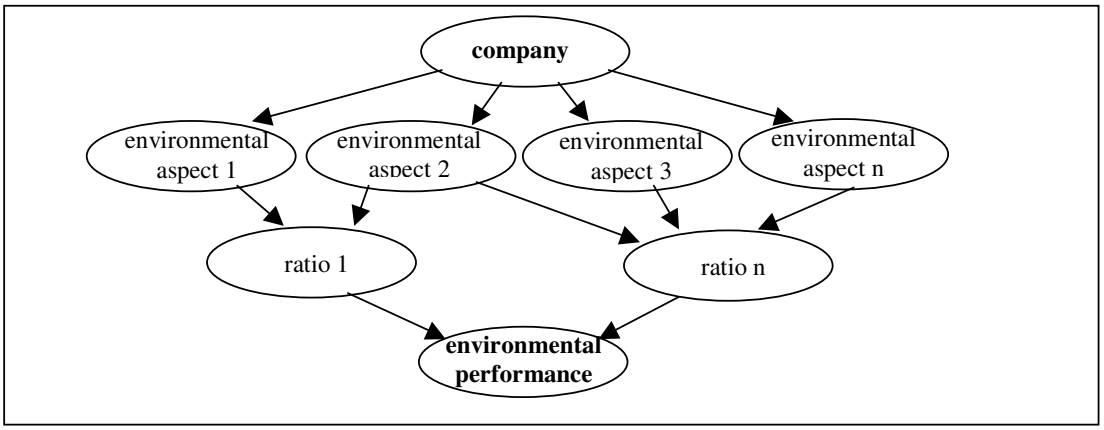

Figure 7: The aggregation of enviromental performance
(With reference to Lankoski, L. (2000), p. 11)

3.3 Hypotheses about the relationship between economic and environmental performance

After the environmental and economic performances are specified both components will be combined. Accordingly hypotheses clarifying their relationship are presented and discussed briefly in the following.

The analysed relationship consists of different dimensions. Firstly, economic performance may influence the environmental performance (H1 in figure 8). But it could be the other way around too and the economic performance is influenced (H2 in figure 8).[95]

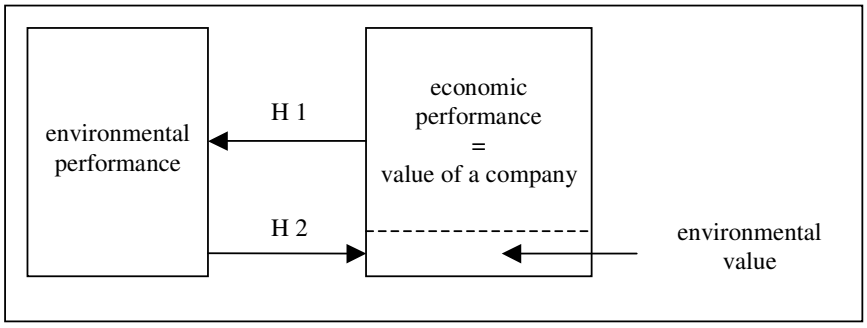

Figure 8: First dimension of the relationship between environmental and economic performance

Secondly, the sign of the effects H1 and H2 can be either positive or negative, building a second dimension. That means the effect of one of the performances on the other is either positive or negative. Furthermore the signs might change their direction while economic and/or environmental performance are changing their value. That means for example that the

[95] Cf SCHALTEGGER, S. (2001), p. 2f.

effect of H2 can enhance or reduce the economic performance depending on the actual value of the environmental performance. In consequence the relationship is complex. The interplay of enhancing or reducing effects will depend on the specific value of the performance components.

A third dimension results from the situation that H1 and H2 simultaneously exist. The effect is a combination of all other already mentioned. Economic and environmental performance are interdependent (H3).

Finally, another hypothesis supports the view that economic and environmental performance are independent of each other. This hypothesis is not supported because that would demonstrate the absurdity of all statements made in chapter 2.

For further reading related to the possible hypotheses the following publications are recommended: Lankoski, L. (2001); Moore, G. (2001); Preston, L. (1997); Schaltegger, S. (2001) and Wagner, M. (2001).

Summarized the following hypotheses can be presented:

- Hypothesis 1: economic performance leads to environmental performance
    a) The direction of the effect is positive
    b) The direction of the effect is negative
    c) The direction of the effect is varying
- Hypothesis 2: environmental performance leads to economic performance
    a) The direction of the effect is positive
    b) The direction of the effect is negative
    c) The direction of the effect is varying
- Hypothesis 3: environmental and economic performance are interdependent

Regardless which type of relationship is considered; the hypotheses presented above are not covering the topic thoroughly and may be target of some critics. For example some variables can affect the relationship between economic and environmental performance directly or indirectly.[96] Such variables are: the size of a company[97], the market structure, the legal

[96] Cf MOORE, G. (2001), p. 301.
[97] BANZ (1981), detected as first the effect of size on stock profit. Cf BANZ, R. W. (1981), p. n.a. cited by MOLLOY, L. (2002), p. 12.

requirements, the chosen strategy[98], the industry and the quality of the management. Also special time effects[99] are not taken into consideration by the listed hypothesis. Time effects cover effects, which occur not immediately, but delayed. In the presented analyses time effects can be a delayed occurring effect from the environmental onto the economic performance. I. e. the enhancement of the environmental performance will not immediately influence economic performance but a few periods (months, years) later. This type of time effect thereafter is called time delay effect.

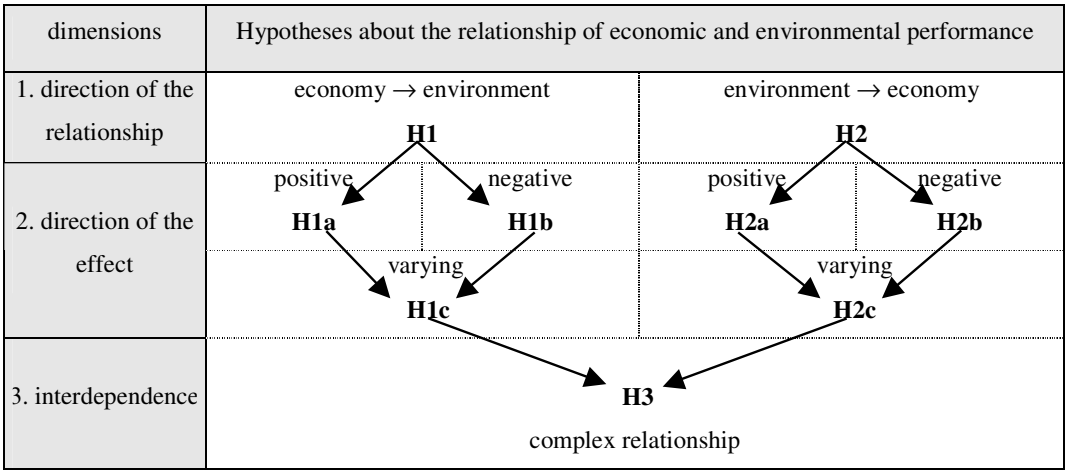

Figure 9: Hypotheses about the relationship of economic and environmental performance

Overall we can conclude that the theoretical framework for the analysis of the relationship between economic and environmental performance is still inadequate. There are shortcomings and at the same moment the existing hypothesis are contrary. Already Ullmann, A. A. (1985) shared that point of view. He summarizes in regard to the existing empirical research at that time: "Empirical data in search of an adequate theory".[100] Connected with the inadequacy of many empirical models not to show causality, i. e. if economic performance leads to environmental performance or vice versa[101] that statement becomes crucial. Hence a theoretically sound model is the basic to determine the relationship between economy and environment.

[98] Klassen, R. D. (1999) finds a difference for end-of-pipe technology (effecting economic performance sign. negative) and integrated technology (effecting economic performance sig. positive). Cf KLASSEN, R. D. (1999), p. 1ff.
[99] Assumption: It is possible that economic and environmental performance are changing their relationship over time because of changing conditions.
[100] ULLMANN, A. A. (1985), p. 555.
[101] Cf COHEN, M. A. (1997), p. 2.

4. Empirical research methods

Empirical research searches for insight by the systematic analysing of experiences.[102] Thereby one objective is to examine clearly logical relations, by proofing them in reality.[103] Consequently empirical research aims at the transfer of theoretical models into reality. At the same time the results of empirical research give new starting points for theoretical research by delivering new practise-based knowledge. Ergo empirical research is starting and endpoint at the same time.

The examination of the theoretical relationship between environmental and economic performance is part of the interplay between theory and empiricism. How the empirical research investigates the analysed relationship will be topic of the following part of this paper. Firstly a brief overview of the literature research and the characteristics of the analysed studies is presented. Secondly, variables applied in empirical studies to measure the performance components will be analysed. Thirdly a short insight into the empirical research methods applied will be given.

4.1 Basis of literature analysed

The empirical research about the relationship between economic and environmental performance reaches back until the 1970`s. One of the first empirical studies related to the topic was done by Bragdon and Marlin (1972)[104]. The topic is under discussion since then and there is still no final result so far. Even contrary, the studies undertaken show the same picture as theory does.

The criteria for including studies into the analysis presented here embrace:

- Firstly, the study is situated on the level of the single company or production facility.
- Secondly, there is at least one variable, which covers the environmental performance.
- Thirdly, there is at least one variable, which covers the economic performance.
- Fourthly the study is no case study.

[102] Cf BORTZ, J. (1995), p. 5.
[103] Cf WÖHE, G. (1990), p. 38ff.
[104] Cf WAGNER, M. (2001), p.10.

Furthermore it is not necessary that a study has its main focus on the research of the relationship between the economic and environmental variables. For example there are studies included into the analysis, which research the relationship between social[105] and economic performance, if an environmental variable is used. In the opinion of the authors such a procedure is justified, for some studies use environmental variables in order to proxy[106] for social performance.[107]

In addition it has to be noticed that the presented analysis is not able to cover the existing empirical research as a whole. The reason for that is availability. Because of the used investigation process it cannot be guaranteed that all relevant studies are identified, be it because of application errors using different databases or because of limitations of the applied databases itself. For instance the applied databases are limited to english publications on the whole. Even when the references were known, it was sometimes impossible to procure them. This applies especially in regard to working papers. Furthermore publication biases have to be considered.[108] A publication bias is based on the assumption that there is a large quantity of unpublished research[109], which could not be found by the literature research consequently, but nevertheless could influence the research at large and therefore the result of this analysis as well. Additionally, literature research is limited in terms of time, i.e. is a snapshot, for the research on a topic goes on even if the literature research is finished.[110] Summarized the following critics arise:

- Limited number of non-english publications
- Small number of unpublished papers
- Small number of difficult to procure papers (e.g. working papers, dissertations, diploma thesis, "internal" documents)
- Limited literature research

[105] "Social Disclosure refers to the extent to which an organisation meets the needs, expectations, and demands of certain external constituencies beyond those directly linked to the company's products/markets." ULLMANN, A. A. (1985), p. 543.
[106] "The variables…are termed proxy variables since they are being used to approximate the real thing." SCHROEDER, L. D. (1983), p. 70.
[107] Cf STANWICK, P. A. (1998), p. 195., MOORE, G. (2001), p. 305ff.
[108] Cf BEELMANN, A. (1994), p. 216.
[109] For instance Chan, Sacks und Chalmers (1982) could show in a survey of 300 academic researcher that 72% of all studies with positive findings, i.e. fulfilling the expectations, were published but only 42% of all studies which did not fulfil the expectations. Cf BEELMANN, A. (1994), p. 216.
[110] Cf GRIFFIN, J. J. (1997), p. 7.

In order to ease the problems stated above not procurable studies are included into the analysis if there is any information available through secondary sources. [111]

Figure 10 summarises the literature research process and indicates the different steps of the research and their results.

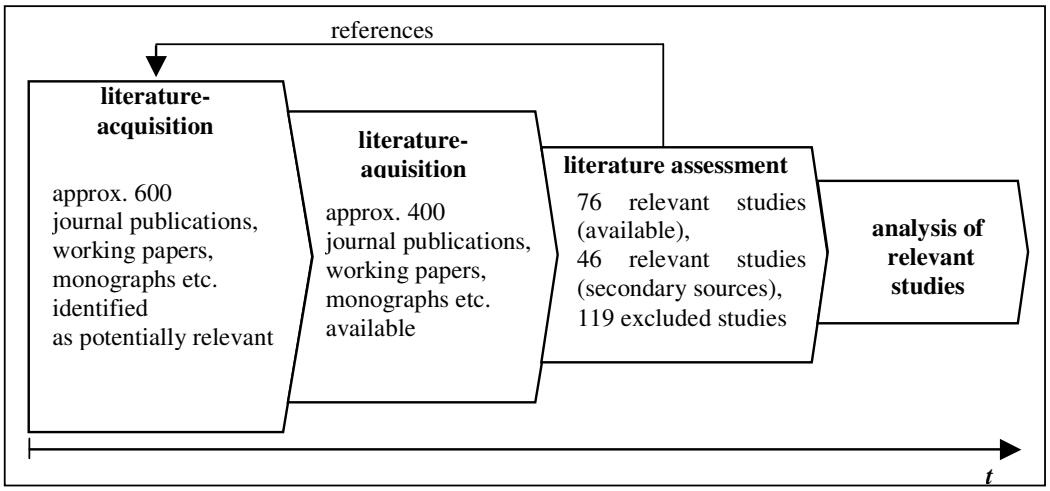

Figure 10: Working steps of the analysis

4.2 Characteristics of the analysed studies

Considering the publication period of the analysed studies the distribution shown in figure 11 can be compiled. However it cannot be guaranteed that the publication-date of a study identified is really the first one, because occasionally studies are published as working papers or dissertations before they will be made public-available by publishing them in journals etc. If a study encompasses results of different empirical research methods the study is counted several times, i.e. every method as an independent publication.

Taking into account the investigation period of a study figure 11 gives an overview of the development of environmental issues. The first studies were published in the 1970`s when public started to discuss the relationship between economic production and environmental issues.[112] The increasing number of studies at the end of the 1980`s is corresponding to the increasing public discussion as well.[113] And it seems as if the climax of the academic interest is not reached so far even if public attention on the topic is slightly decreasing.

[111] Because of that already existing study reviews are examined.
[112] Cf BRODEL, D. (1996), p. 8.
[113] Cf BRODEL, D. (1996), p. 9f.

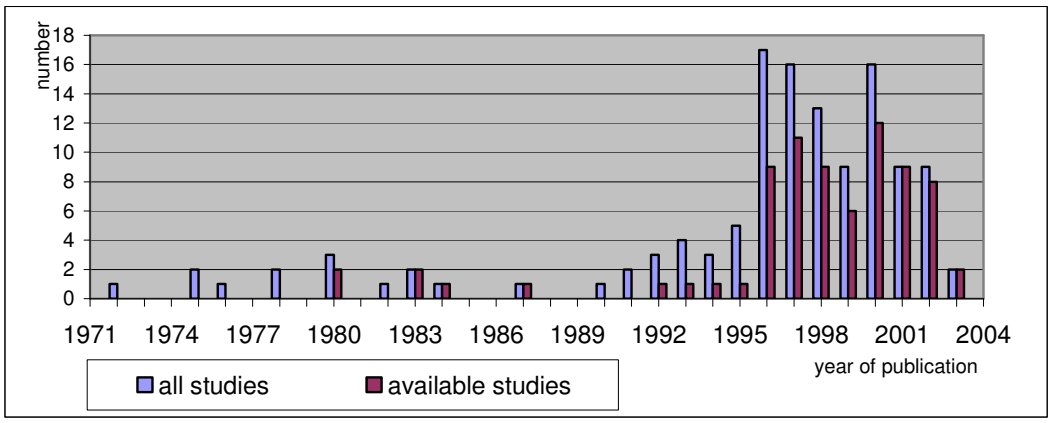

Figure 11: Years of publication of the sample

Considering the geographical distribution of the samples of studies included into the sample[114] a clear concentration on the United States of America can be recognised. There the relationship between environmental and economic performance has been researched for more than 20 years now.[115] The first study on European companies included in this analysis is Nehrt, C. (1996). Included into the category "others" are two Canadian, two international and one study from Costa Rica and Singapore each.

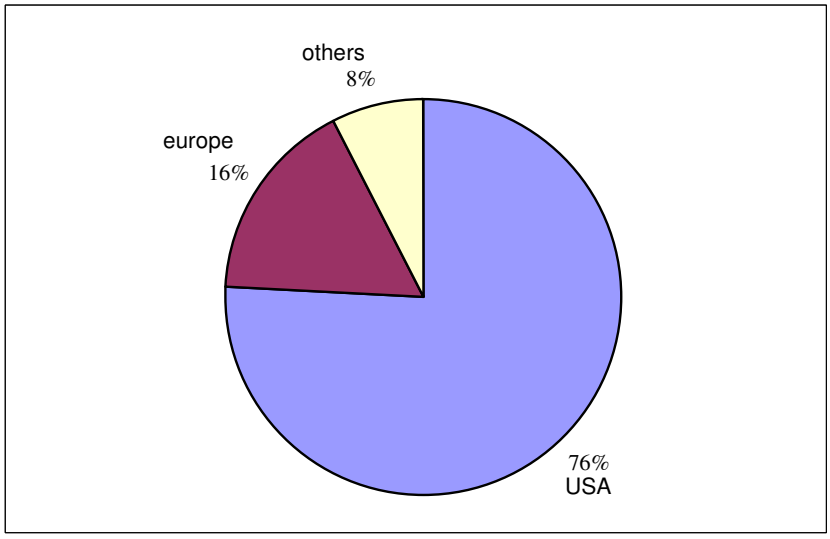

Figure 12: Geographical regions of the sample

Because of missing information a detailed analysis of the sample in terms of industries covered or other criteria is impossible. However it can be noticed that about 80% of all studies are based on stock market listed companies.

[114] Only available studies are taken into consideration.
[115] Cf WAGNER, M. (2001), p. 10.

In principle most studies can be categorised into three groups[116]: event-studies, regression-studies and portfolio-studies. Moreover studies can be categorised in terms of their measures applied.[117] Both categorisation methods will be presented in the following part.

4.3 Variables of the analysed studies

It is the aim of this chapter to demonstrate how empirical studies measure environmental and economic performance. In general a wide range of measures are used. It seems to the authors as if the empirical research at large is not set up on each other but runs parallel. There are only a few studies, which use already existing results in order to check them or use them as basis for new research.[118]

4.3.1 Economic measures applied

The number of economic measures applied is large and every different measure relates to a different, even if only slightly different, part of economic performance.[119] For instance there are ratios concerning liquidity, profitability or risk applied. The use of different measures makes it difficult to develop control mechanisms for validity[120] and compare studies.

In summary five economic categories can be found. Those are:

a) Accounting based measures,
b) Stock market based measures,
c) Stock market and accounting based measures,
d) Questionnaire based measures (perceived performance) and
c) Other measures.

a) The most widespread measures applied are based on accounting measures. There are ratios like return on assets (ROA), return on equity (ROE) or slightly modified ones applied and related to environmental measure. The common use of accounting based measures is founded "…on the criteria of convenience to the researcher and in terms of the ease of

[116] Cf WAGNER, M. (2001), p. 9.
[117] Cf WAGNER, M. (2001), p. 10.
[118] Exceptions are the studies by CHEN, H. C. (1980), who re-examines SPICER, B. (1978a) or MCWILLIAMS, A. (2000), who re-examines WADDOCK, S. A. (1997).
[119] Cf LANKOSKI, L. (2000), p. 14.
[120] Cf GRIFFIN, J. J. (1997), p. 11.

getting data for analysis."[121] Nevertheless it is not clarified if accounting based measures are effectively measuring the economic effect of environmental performance.

b) A second group of measures comprise stock market based measures. They represent the profit available to the shareholders of a company, i.e. the stock market profits and are mostly applied in event studies (induced by the method). Following Lankoski, L. (2000) the use of stock market based measures is founded on the consideration: "The logic behind these ... 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."[122] If stock market based measures are applied the companies included into the sample of a study have to be listed. This limitation has be kept in mind while analysing the result of a study.

c) Some studies apply a mixture of accounting and stock market based measures in order to quantify economic performance. Examples are the price-earning-ratio (PER) or Tobin's q.

d) Another group of studies applies questionnaires in order to specify economic performance as perceived performance. Mostly the questions are set out that way that the respondent has to assess the economic performance of his company in comparison to its competitors. A major limitation of questionnaires is the willingness-to-cooperate of the respondent. However the usually existing limitation in terms of public accessible information about companies can be avoided. A drawback of questionnaires is their poor reproducibility and subjective character.

e) A last group of studies applies measures, like shadow prices[123], rankings[124], or occupancy rates, not included in any category presented so far. This last category is named "others".

The assignment of measures (variables) into the different categories will be subdivided into measure groups (variable groups). This process combines measures based on the same concept into one group. For instance all measures based on the return on assets, using specifications like risk adjustment or not are assigned to one group (ROA).

[121] GRIFFIN, J. J. (1997), p. 11.
[122] LANKOSKI, L. (2000), p. 38.
[123] Shadow prices are the same as opportunity costs. And a opportunity cost "...is a cost that measures the opportunity that is lost or sacrificed when the choice of one course of action requires that an alternative course of action be given up." DRURY, C. (1996), p. 45.
[124] A ranking groups companies by some criteria.

Figure 14 contains a summary of all measures applied including frequency of use. Frequency of use is determined in regard to the number of studies applying measures of one category as well as of one variable group. If measures of different variable groups of one category are used by a study, the study is counted several times on the level of the variable groups but only once on the level of the category. If all variables used can be assigned to the same variable group the study will be counted only once. If a study uses measures of different categories the study will be counted for each category. The number of studies is shown after the "S". Figure 13 illustrates the assignment process:

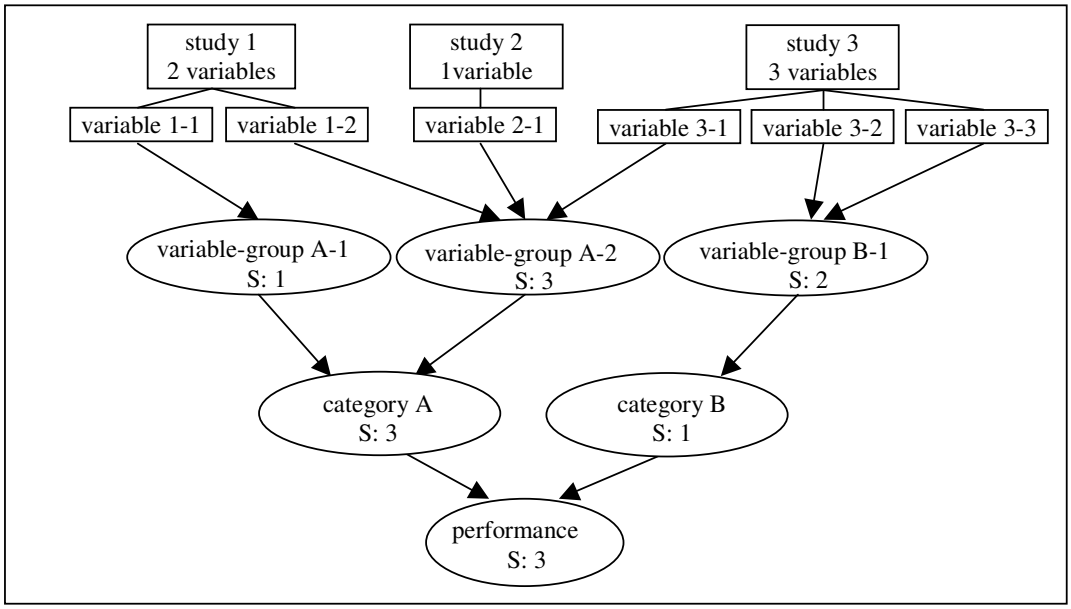

Figure 13: Procedure measure assignment (S = number of studies)

By analysing the economic variables 112 studies are taken into consideration. Based on that sample 124 categorisations and 193 assignments to the different variable groups are carried out.

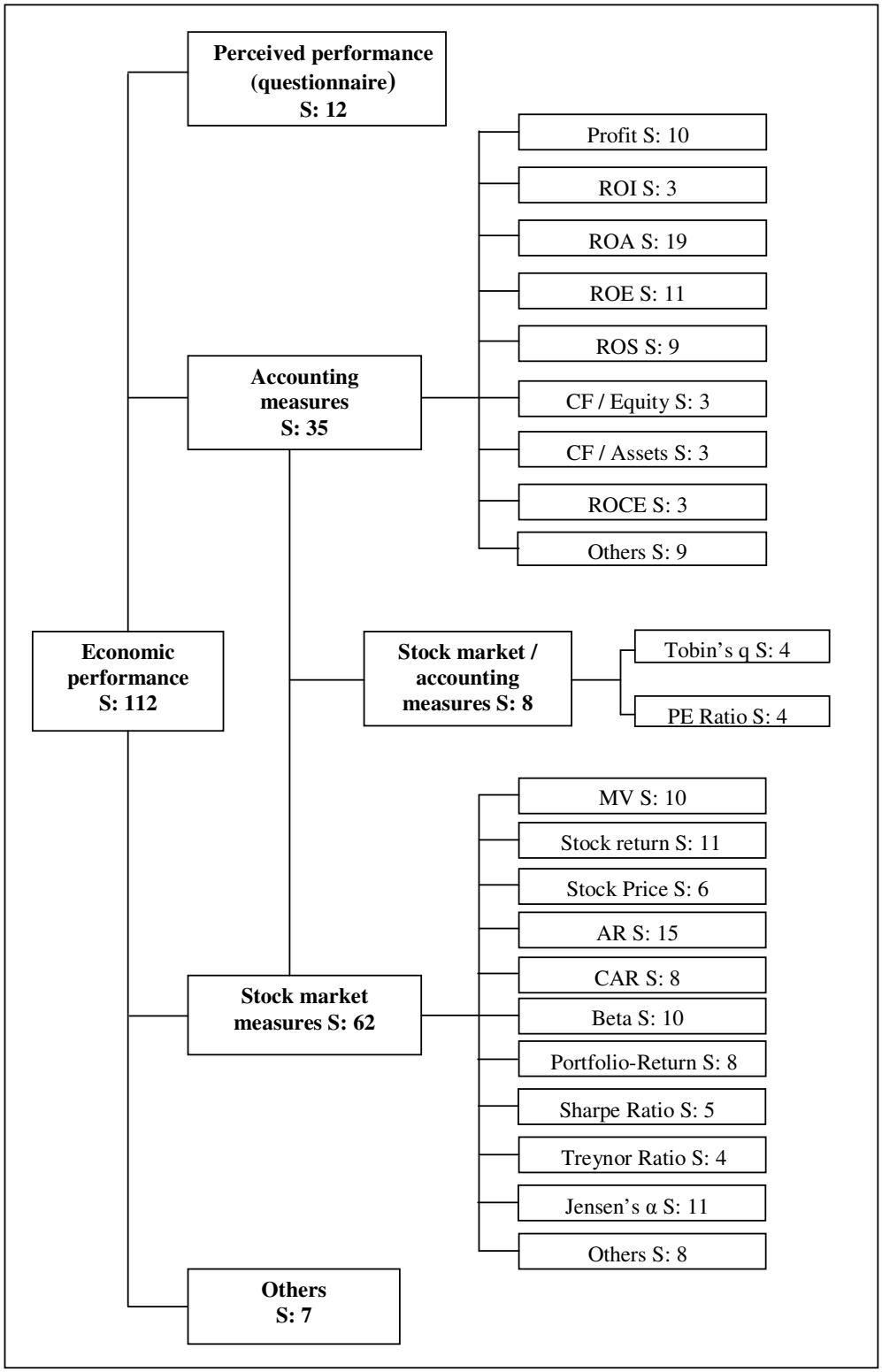

Figure 14: Applied economic measures (S = number of studies)

4.3.2 Environmental measures applied

The environmental measures applied by the analysed studies will be discussed and summarised into seven categories in the following. Although external environmental reporting is not considered as a part of environmental performance, studies applying measures of environmental reporting in combination with stock market measures will be integrated into the analysis. Reason for that is the assumption that the reaction of the stock market onto environmental reporting has got a value relevant character. Therefore the evaluation of environmental performance, i.e. environmental reporting by the stock market can be assessed. It is not taken into consideration whether environmental reporting reproduces environmental performance.

Overall 109 studies could be assessed in terms of their environmental measures (variables). 13 studies, all from secondary sources, could not be assessed because of missing data.

Even from a theoretical point of view an integral recognition of environmental performance seems troublesome, but it becomes even more difficult to measure and recognise environmental performance in practice. For that reason researcher use so called proxy-variables in order to substitute for environmental performance at large. By doing so the recognised environmental aspects and impacts are reduced to single ones, e.g. water pollution measured by chemical-oxygen-demand[125] (COD). Hence only a single part of environmental performance is recognised. Theoretically environmental performance as a whole could be specified by summing up all single aspects. Therefore the direction of the effect of a single part of the environmental performance becomes feasible. This procedure corresponds to the assessment of environmental performance on the basis of a ratio system. Overall the following seven categories are used to group the environmental variables applied:

a) Strategic environmental performance,
b) Operational environmental performance,
c) Perceived performance (questionnaire),
d) Rating and ranking,
e) Environment related events,
f) Environmental reporting,
g) Environmental funds.

[125] The COD measures the oxygen demand for oxidize all organic material contained in water. Cf MUTSCHMANN, J. (1999), p. 190.

Categorisations are based on the already presented process (see figure 13) for grouping economic measures. For instance all measures based on the toxic-release-inventory (TRI)[126] are part of the variable group "TRI". Variable group "TRI" is allocated into category "operational environmental performance", because it records the amount of emissions emitted.

The setting up of the different categories is focused on a separation in operational and strategic variables. Since all the different variables cannot be assigned absolutely exactly because of their characteristics or missing information five additionally categories are added. The variables assigned to those possess the same characteristics and can be both strategic and operational. In the following the different categories and their variable groups are presented briefly:

a) Strategic environmental performance:

   This category comprises measures related to the strategic environmental performance. The most of the included measures determine the realisation of environmental protection activities in a company, e.g. the application of an EMS. Measures determining the environmental performance on the basis of a questionnaire are included too, if they are targeted at strategic issues. Therefore an overlapping of categories takes place, i.e. measures are included in the category "strategic environmental performance" and as well into the category "perceived performance" (questionnaires).

b) Operational environmental performance:

   This category comprises a great number of different environmental measures with different characteristics. Their common ground is the fact, that all of them measure the environmental impacts of a company, i.e. the environmental relevant results of doing business. For instance measures like TRI, water pollution indices, number of dumps used or number of leakages are covering various historical environmental impacts of a company. The assignment of measures like environmental expenditures or legal actions to the category "operational environmental performance" is based on the assumption that a reduction of environmental impacts has an influence on expenditures and for the other case that legal actions are related to not complying to environmental regulations, i.e. a bad environmental performance.

   Predominantly TRI data are applied in order to recognise environmental performance. The toxic release inventory consists of quantitative emission data. In general TRI data are an

[126] Explanation follows.

objective, transparent measure to record the environmental performance of a company. They are publicly available and therefore used by researchers. Nevertheless it has to be kept in mind that TRI data are only partly covering environmental performance, i.e. they are covering not all types of emissions and do not allow a comparison of end-of-pipe and integrated technologies. Furthermore, the scope of TRI data is limited to the region of the United States of America.

c) Perceived performance (questionnaires):

With the help of questionnaires data about environmental issues, the environmental performance can be derived, where they had not been available otherwise.

The advantages of questionnaires are their ability to aim straight at a specific topic and that they are theoretically not restricted in terms of their sample. In conjunction with questions related to environmental and economic performance all companies can be assessed therefore. Here the cooperation and honesty of the respondents has to be assumed. The analysed studies apply questionnaires in order to test for different forms of environmental management systems[127], the use of end-of-pipe[128] vs. integrated technologies and so on. Hence it can be differentiated between strategic and operational related questions in general. Nonetheless a questionnaire might cover both parts.

d) Ratings and rankings:

This category comprises environmental measures assessing environmental performance with the help of company-external sources, e.g. rating agencies[129]. The assessment of the environmental performance of companies by external parties is of qualitative nature and based on the assumptions and the appraisal of the assessing person and therefore subjective. Hence the assessment of environmental performance might be questioned because of wrong assumptions or missing information.[130] At the same time the determination by a specialised agency offers the opportunity to assess and combine different criteria and therefore to carry out a multidimensional valuation of environmental performance. Additionally it has to be noticed that the results of a rating agency are not accessible for free, but are property of the specific agency.[131]

Frequently the following ratings and rankings are applied in empirical studies: rating by "Kinder, Lydenberg, Domini and Company" (KLD), the CEP rating and the ranking of the

[127] For instance see JUDGE, W. Q. JR. (1998), p. 241ff.
[128] For instance see STEINLE, C. (1998), p. 61ff.
[129] Rating-methods were developed to classify investments and their emitters by qualitative and quantitative criteria. cf Günther, T. (1997) p. 187.
[130] Cf GRIFFIN, J. J. (1997), p. 14.
[131] Cf HOCKERTS, K. (2001), p. 29.

journal "Fortune". In addition eleven more ratings are applied by the studies analysed, each only once.

e) Environmental related events:

The investigation of the relationship between environmental related events and economic performance is limited to event studies by methodical reasons. In general it can be distinguished among positive events (e.g. an environmental award, the announcement of environmental protection measures or the notification about an reduction in emissions), negative ones (e.g. an oil spill[132] or legal actions[133]) and others (e.g. the announcement of new laws or the publication of an environmental report). On the basis of the reaction of the stock market onto a specific event, the effect of the event on the value can be concluded.

f) Environmental reporting:

The measures assigned to this category are related to the extent and content of voluntary external environmental reporting. Studies applying those measures are examining the relationship between environmental reporting and economic performance. Mostly environmental reporting is considered as an expression of environmental performance and therefore identical to it. It is assumed that a high environmental responsibility, reflected by environmental reporting, effects economic performance positive or at worst neutral.[134]

g) Environmental funds:

This category comprises measures comparing "ecological" funds to "traditional" ones. Companies listed in an ecological fund have to fulfil specific criteria. Those criteria depend on the fund. For instance the formulation of an environmental plan or the exclusion of companies involved in nuclear power are used as criteria. Ecological funds have to be distinguished from funds of the environmental industry. The last include companies offering services related to the environment. An assessment of environmental performance is not included automatically.

In addition to figure 14 figure 15 presents a summary of the environmental variables applied. However there is the exception already mentioned, that variables based on questionnaires may be recorded twice.

[132] In contrast to the category operational environmental performance only the event is of interest and e.g. not the amount or the volume of spills.
[133] Again only the event itself is important and not the number of legal actions which a company has to face.
[134] Cf STANWICK, S. D. (2000), p. 157f.

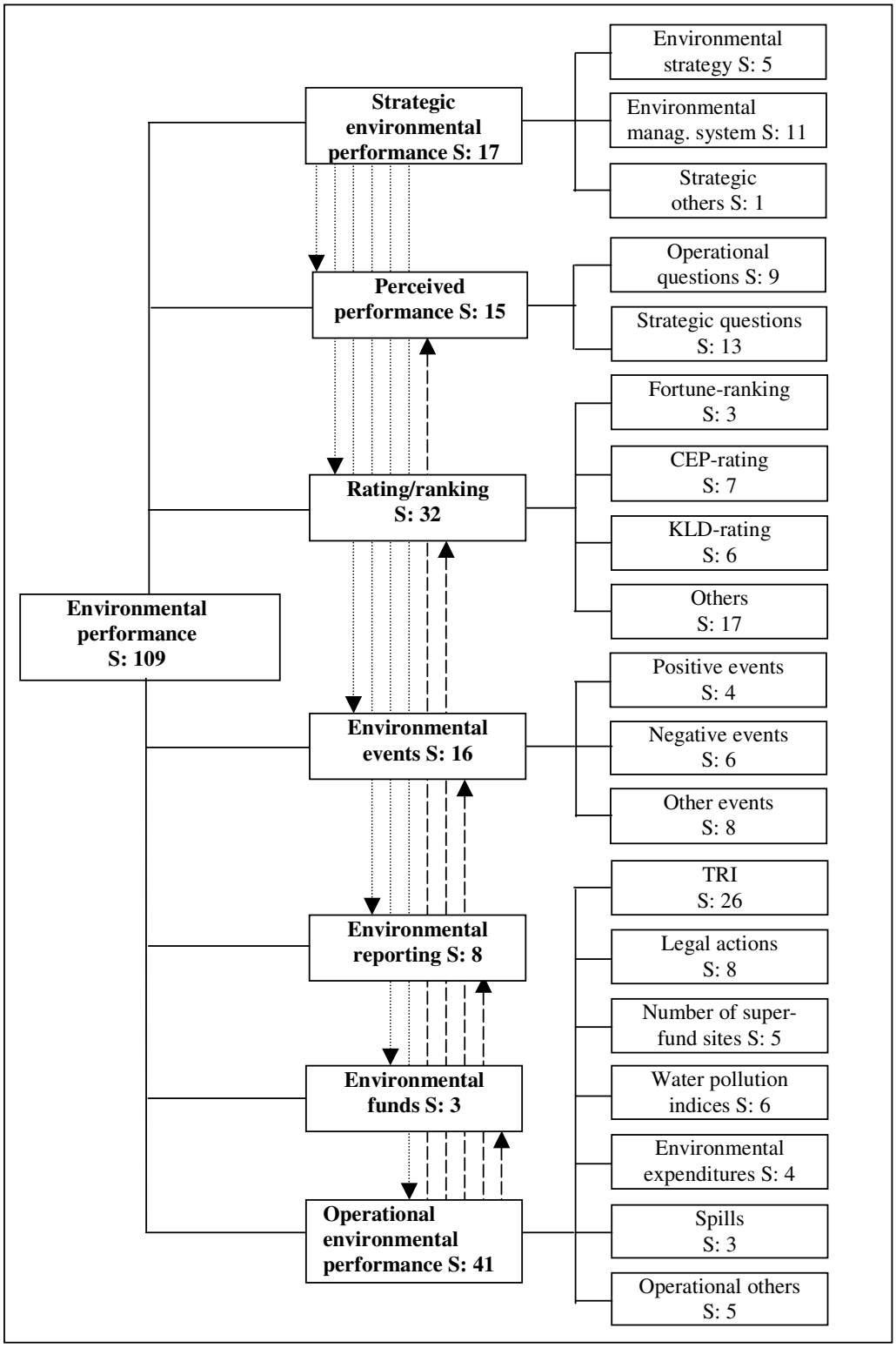

Figure 15: Applied environmental measures (S = number of studies)

4.4 Basics of the empirical research methods

Depending on the objectives, different methods may be used to investigate the relationship between environmental and economic performance. The most common methods are the regression-, the event- and the portfolio methods. The analysis is limited to the 76 available studies. Secondary source based studies cannot be analysed without any detailed data.

From all observed studies, 45 were regression studies, 13 event studies, 13 portfolio studies and 5 were not categorized studies. In the following, the different methods and some related results will be presented

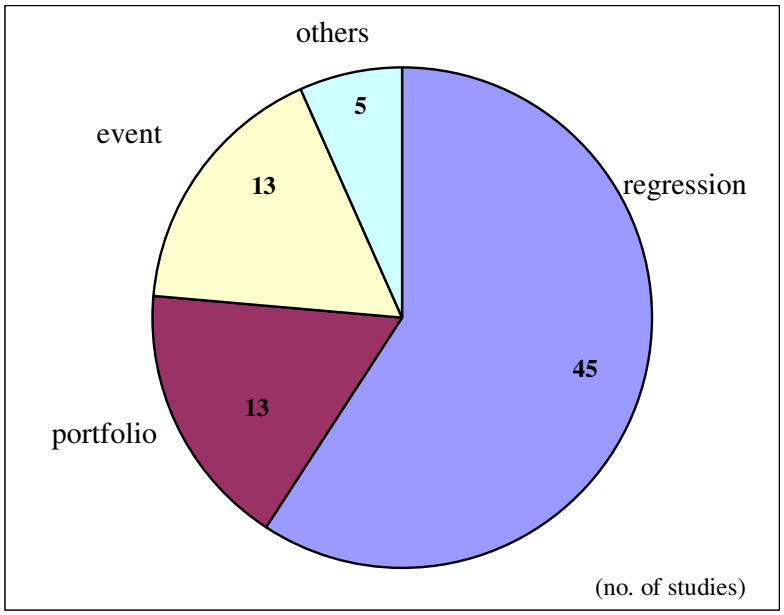

Figure 16: Distribution of study methods

4.4.1 Regression studies

Regression analysis is often used as empirical method to examine the relationship between a dependent and one or several independent variables.[135] The purpose of this method is to get a more precise idea of how the independent variable(s) impact the dependent one.[136]

The direction of the relationship between variables is considered as determined. The regression is therefore based on the theory of this relationship that is translated into a mathematical model.[137] This model is mostly linear.

[135] Cf BACKHAUS, K. (1996), p. 1f.
[136] Cf VOß, W. (2000), p. 511.
[137] Cf FINK, A. (1995), p. 39.

However, the assumption of a linear relationship requires the consideration of problems. As the use of empirical models is restricted to linear models, the relationship between environmental and economic performances in hypothesis H1c, H2c and H3 cannot be observed. In addition, if the relationship is considered as linear whereas it is not, a bias will be obtained. This might explain why the results of the analysed studies are not consistent.

As a conclusion, the following control questions have to be considered to analyse regression studies:

- Are the studies based on theoretical models?
- Are problems like multicollinearity, heteroscedastic and autocorrelation taken into consideration?

The theoretical soundness of the model is tested on the basis of an existing description of the model and using the adjusted correlation coefficient (adj. R^2). If the explanation of the model and the variables used are part of a study a "yes" will be attributed. If a study does not meet these requirements, it will be associated with a "no". The same procedure is to be followed for R^2. The evaluation of the second control question takes place according to the same procedure as above. If a study addresses a problem, it is assigned a "yes", if not, it will be associated with a "no". The second alternative does not mean that the author of the study did not consider the specific problem, it simply shows that there is no indication related to the problem. N.a. means that a analysis of the study was not possible due to differing reasons, e.g. missing information. Results of the analysis are summarized in the following table.

	Explanation of the model	**adj. R^2**	**Multi-collinearity**	**Auto-correlation**	**Hetero-scedastic**
n.a.	3 studies	5 studies	5 studies	5 studies	5 studies
No	5 studies	15 studies	31 studies	26 studies	22 studies
Yes	37 studies	25 studies	9 studies	14 studies	18 studies

Figure 17: Analysis of regression studies

4.4.2 Portfolio studies

The term portfolio study is synonym with screening study. In general, a portfolio is defined as "the collection of investments held by an individual investor or the collection in which a firm

invests."[138] The analysed studies observe a number of companies as samples, as described in the first part of the definition. The objective of a portfolio study is the systematic comparison of different types of companies with their respective attribute.[139] Usually, portfolios are compared in terms of risk, return etc. The analysed studies are guided by an ethical investment and contain non-monetary criteria, i.e. also environmental performance in their assessment.[140]

The question investigates whether profit made by environmental portfolios is better than the one of a reference portfolio. For instance, the portfolio can be compared to the market average[141] or to another portfolio consisting of companies with a value different from the attribute[142] to be observed.

There are two commonly followed procedures to create portfolios:

1. A large quantity of studies examines the performance of a so-called "synthetic" portfolio. To achieve this, some companies are chosen from all the existing (listed) ones and are integrated into a portfolio according to a determined criterion. Based on this, given companies may be sorted out according to a specific criterion, so that companies with equal values for the observed attribute belong to the same given group. If necessary, the resulting portfolios can be subdivided into smaller groups using additional criteria (industry, size).[143]
2. Following another method, the author of a study may choose an already existing portfolio, e.g. an environmental fund or index, and assesses its performance in comparison with a standard portfolio. With regard to the environmental performance, all existing funds or indexes based on environmental criteria could be chosen.

The result of a portfolio analysis is given by the comparison of portfolios in terms of a specific criterion, e.g. the portfolio profit.[144] It is assumed that companies with equal characteristics yield equal profits[145], so that the relationship between two attributes (variables) can be determined. Besides, it has to be considered that the comparison is made with mean

[138] DRURY, C. (1996), p. 361.
[139] Cf BENNETT, M. (1999), p. 70.
[140] Cf VON FLOTOW, P. (2002), p. 71.
[141] Cf BENNETT, M. (1999), p. 70.
[142] Cf WAGNER, M. (2001), p. 19.
[143] Cf WAGNER, M. (2003), p. 50.
[144] Cf HOCKERTS, K. (2001), p. 19.
[145] Cf WAGNER, M. (2003), p. 50.

values per portfolio (sum of the single portfolios divided by the number of companies). The results of a portfolio analysis do not show the direction, i.e. the causality of a relationship.

The analysis of the portfolio studies is summarized in table 19. The studies are analysed in terms of the method used to design a portfolio (see above). Also, the studies are controlled for risk adjustment. It is thereby checked whether studies use the application of a risk adjustment or an internal weighting of the portfolios. [146]

	Synthetic portfolio	**Existing portfolio**	**Risk adjustment**
n.a.	-	-	4 studies
No	2 studies	11 studies	4 studies
Yes	11 studies	2 studies	5 studies

Figure 18: Analysis of portfolio studies

4.4.3 Event studies

Empirical studies examining the effects of new information, which are still unknown to the stock market (e.g. accidents, presentations of awards, publications of emission data etc.), on the stock exchange price, are event studies.[147] The increasing use of stock market-based measures is related to the up rise of event studies.[148] Hence event studies are a way to overcome the limitation of accounting-based measures. Moreover, the information needed to perform an event study, i.e. event date, name of the involved companies and their stock prices, are available to the public and therefore easy to access.[149] At the same time, the study is limited to stock market-listed companies. This is why it is not possible to analyse at a deeper level than the global one.[150]

Event studies, contrary to regression and portfolio studies, make it possible to detect the direction of a relationship between variables, i.e. causality.[151] Therefore it becomes possible to show the effect of a high environmental performance on economic performance expressed by stock market-based measures.

[146] A complete description of risk adjustment can be found in ANDERSON, J. C. (1980).
[147] Cf STRONG, N. (1992), p. 533.
[148] Cf MCWILLIAMS, A. (1997), p. 626.
[149] Cf MCWILLIAMS, A. (1997), p. 627.
[150] Cf WAGNER, M. (2003), p. 42.
[151] Cf WAGNER, M. (2001), p. 101.

The cornerstone of all event studies is the assumption that stock market prices reflect all information and expectations related to a company.[152] New information is immediately integrated into stock market prices.[153] Those assumptions are based on the "Efficient market theory".[154]

Researchers have used different models in order to test the influence of specific events,[155] e.g. the "Single index model", the "Market model" and the "Capital asset price model".[156] The "Market model" is used at a particularly high frequency. It assumes a linear relationship between the expected return of a share and the return of a market-based index or portfolio.[157]

Figure 19 shows the characteristics of the analysis: information about the extent of the test period, explains abnormal returns. Information related to the following problems[158] are also presented:

- explanation of the test performed,
- check for confounding events,
- test for outliers.

	Checked for confounding events	**Explained event window**	**Test for outliers**	**Explained abnormal returns**
No	5 studies	7 studies	9 studies	7 studies
Yes	7 studies	6 studies	4 studies	6 studies
Extent of the event window (x)				
x=1d	1d<x≤3d	3d<x≤11d	11d<x≤21d	20d<x
1 study	4 studies	5 studies	2 studies	2 studies

Figure 19: Analysis of event studies

[152] Cf HAMILTON, J. T. (1995), p. 99.
[153] Cf HALL, P. L. (1998), p. 83.
[154] Cf KLASSEN, R. D. (1996), p. 1204.
[155] Cf BROWN, S. (1985) p. n.a., cited by KLASSEN, R. D. (1996), p. 1205.
[156] Cf DASGUPTA, S. (1998), p. 12., STRONG, N. (1992), p. 536ff.
[157] Cf KLASSEN, R. D. (1996), p. 1205.
[158] The choice is quiet similar to the critical points identified by McWilliams and Siegel (1997). Cf MCWILLIAMS, A. (1997), p. 630ff.

4.4.4 Other studies

Five of the analysed studies could not be assigned to one of the methods mentioned above, three of the five studies comparing environmental and economic variables on the basis of rankings. Another one applies discriminant analysis and the last one investigates the financial valuation of fictitious companies by accountants and financial analysts.

5. Investigation of the empirical results

No matter how different the studies might be, every single finding of a study is a proof of some relationship between economic and environmental performance. However a single result does not allow the deduction of a law about the relationship and can not provide a complete overview over the empirical research on the matter altogether.[159] In order to do that a larger number of results has to be analysed and combined.

Therefore a method based on the "vote counting"[160]-method is applied to analyse the findings of the identified studies. The method differentiates between statistically significant positive, not statistically significant and statistically significant negative results. A result is considered positive if it deduces that an increase in environmental performance (e.g. reduction of emissions) leads to an increase in economic performance. Findings reaching a significance level of 10% and less are considered as statistically significant. Beyond that the method used has to meet the requirement to specify the direction of the effect of the relationship between environmental and economic performance. An underlying assumption by choosing this method was that every result has already been proven statistically and therewith can be used as a secure investigation basis of the relationship between the two performances. The integration of every single result allows a conclusion about the empirical research on the whole. The extend of the relationship won't be considered and the final result of the analysis is of a pure qualitative nature.[161]

Another objective of this analysis (besides that to investigate the direction of the relationship between the two performances) is the identification of relevant determinants influencing that relationship. This objective is based on the consideration that environmental performance can't be measured with a single variable, as it's the same with economic performance. Last

[159] Cf BORTZ, J. (1995), p. 589.
[160] "Vote counting" uses a binominal sign test in order to distinguish among significant positive, not significant and significant negative results. Cf PETITTI, D. B. (2000), p. 132.
[161] For the critics of the method see: PETITTI, D. B. (2000), p. 132., CAPON, N. (1990), p. 1146.

but not least different empirical methods are applied in order to test the relationship. Therefore different determinants depending on the study analysed at a time can be assumed. It is therewith necessary to analyse those determinants.

The combined results of all studies analysed serve as a basis for further steps. But in order to identify important determinants the results are broken down on the level of environmental and economic measures applied in studies. It is assumed that, if the use of a specific measure effects the established relationship, the same can be considered for the category level the measure belongs to and not only for that single measure. Hence the results of the studies are sorted to the categories (economic and environmental) and based on that to a combination of both types of categories.

As further possible influencing factors on the relationship between environmental and economic performance the concepts of the ecological success and time delay effects will be tested, too. To accomplish this, operable measures have to be chosen and tested.

Furthermore the influence that the surveying method might have on the results of a study is analysed as well. It is tested whether the application of a specific surveying method leads to specific results.

In a final step the results of the studies analysed are interpreted regarding their value adding potential. Therefore single results are integrated in Rappaport`s shareholder network. This leads to first qualitative evidence of the effects of environmental aspects on the value of a company. Figure 20 shows a summary of the different steps of the analysis.

If a study comprises more than one result, e.g. by having different findings for different measures, all results are counted separately. It has to be pointed out that the considerations about the result(s) of a study are solely based on the opinion of the authors. This subjective character has to be kept in mind.[162]

[162] An example for the different evaluation of the results of studies is GRIFFIN, M. / MAHON, J. F. (1997) und ROMAN, R. M. / HAYTBOR, P. / AGLE, B. (1999). Both publications assess 62 studies and differ in 26 cases. That are 42%!

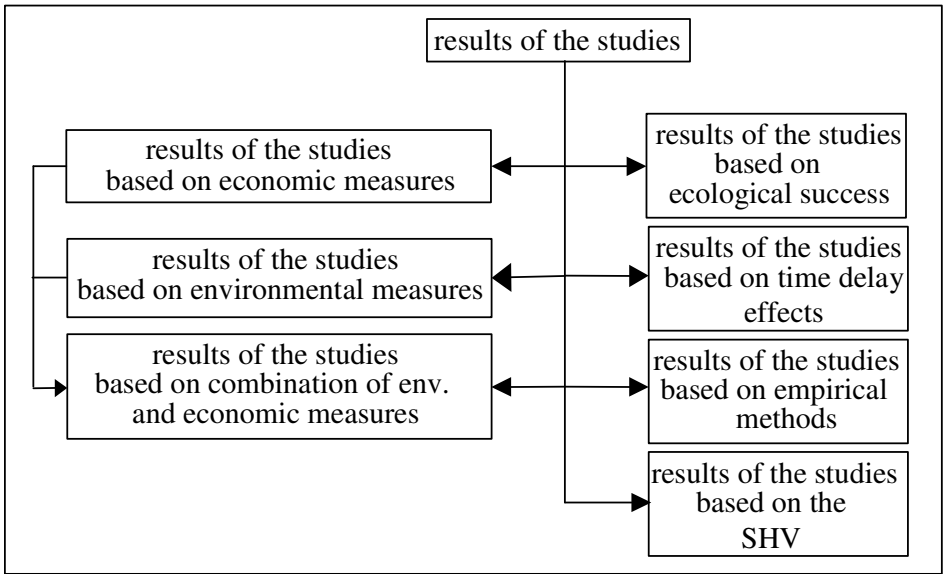

Figure 20: Process of analysing the results of the studies

Throughout the whole analysis all results will be symbolised in the following way:

- significant positive relationship = "++",
- not significant positive relationship = "o",
- significant negative relationship = "--".

5.1 Results of all studies analysed

The analysis of all studies results in the spreading shown in figure 21.

Only statistically significant results are considered to be able to give a reliable statement about the relationship and its direction. That is why only results with a failure probability of α[163] count as proven not to be result of pure chance. By consideration of all significant results a ratio of 58:17 for positive and negative results (statistically significant) can be identified. This equals a relative frequency of 77 % of statistically significant positive results.

The ratio changes dramatically if non-significant results are considered simultaneously. A spreading of 58 significant positive to 80 non-significant and 17 significant negative results arises. Based on this it can be concluded that the majority of results indicate a significant positive (37,42%) and a non-significant (51,61%) relationship between environmental and economic performance respectively. Only a few results provide evidence for a significant

[163] α (in percent), is considered the probability to reject a tested hypothesis even if it is true. Here it means: there is no significant relationship between environmental and economic performance, but nevertheless it is identified with a probability of α.

negative relationship (10,97%). This statement has to be handled with care because of the limitations arising from the chosen qualitative research method.

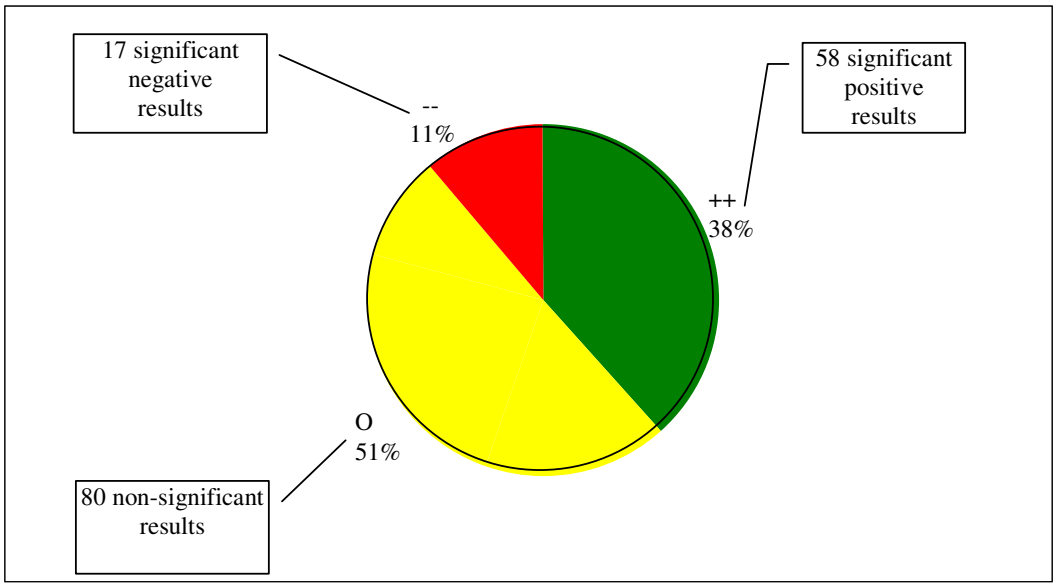

Figure 21: Results of all studies analysed

5.2 Results based on specific characteristics of a study

Only based on the analysis done above it can not be decided for sure whether the results of the studies analysed follow a special system or not. In order to investigate that question it is necessary to analyse specific characteristics of all studies, as can be the environmental and economic measures as well as the empirical method.

5.2.1 Results based on environmental categories

In this step just the environmental categories set up earlier are analysed because an investigation of all single measures of all studies would make it more difficult to identify an underlying system. Therefore all studies providing information about environmental measures are included in the analysis.

The outcome of this analysis is shown in figure 22. The results of the studies are given in absolute and relative value and allocated to the different environmental categories. The overall number of results per category can be seen from the N-value. 109 in the analysis included studies with 132 categorisations provide 166 separate results.

The difference in number of the results compared to number of the studies analysed results from the following research design:

- Comprises a study more variables belonging to different environmental categories, the finding of the study is sorted to each of these categories.
- Comprises a study more than one variable for one environmental category and leads this to different findings, all these results are added to the relevant category.
- Combines a study the variables of one environmental category with different economic variables and do the results for each combination differ, all results are put into the environmental category in question.

Despite of all differences between the analysed studies the already identified relationship between statistically significant positive and negative results could be proven as well on the level of the single environmental categories. However some characteristics can be identified, either:

The spreading is quite equal over all categories. The categories “environmental reporting” and “operational environmental performance” are showing the largest occurrence of significant negative results. Vice versa the categories “perceived environmental performance”, “environmental events” and “strategic environmental performance” impart a majority of significant positive results. The category “rating and ranking” shows only very few significant negative results, too, but the frequency of not significant results is the highest over all categories. Because of a very small number of significant results the category “environmental funds” seems to be not significant enough. Furthermore the convergence of the two categories “strategic environmental performance” and “perceived environmental performance” results most likely from the inclusion of almost the same variables.

environmental categories	results (relative/absolute)			Σ results
	++	n.s.	--	
summation over all categories (N = 166)	42,17 % 70	47,59 % 79	10,24 % 17	**100,00%** **166**
funds (N = 3)	0 % 0	100 % 3	0 % 0	**100%** **3**
environmental reporting (N = 11)	36,36 % 4	45,46 % 5	18,18 % 2	**100%** **11**
received performance (N = 18)	50 % 9	44,44 % 8	5,56 % 1	**100%** **18**
rating and ranking (N = 39)	38,46 % 15	58,98 % 23	2,56 % 1	**100%** **39**
env. events (N = 23)	52,17 % 12	39,21 % 9	8,70 % 2	**100%** **23**
operational environmental performance (N = 51)	39,22 % 20	39,21 % 20	21,57 % 11	**100%** **51**
strategic environmental performance (N = 21)	47,62 % 10	52,38 % 11	0 % 0	**100%** **21**

legend:
relative frequency (in percent, rounded) of results
absolute frequency of results
N = number of results

Figure 22: Results of the analysed studies regarding the environmental categories

5.2.2 Results based on economic categories

In order to investigate the influence of the economic variables the results of the studies are sorted to the five economic categories. The outcome of that allocation process is shown in figure 23. Altogether 112 studies are included in this step of the analysis. 124 categorisations are made and 149 results assigned. The difference in number of the results in comparison to the number of the single studies is based on the reasons that have been already mentioned above (see 5.2.1)

economic categories	results (relative/absolute)			Σ results
	++	n.s.	--	
summation of all categories (N = 149)	40,94 % 61	48,99 % 73	10,07 % 15	**100,00%** **149**
others (N = 8)	25 % 2	62,5 % 5	12,5 % 1	**100%** **8**
perceived performance (N = 15)	53,33 % 8	40 % 6	6,67 % 1	**100%** **15**
stock market + accounting (N = 8)	62,5 % 5	25 % 2	12,5 % 1	**100%** **8**
stock market (N = 76)	38,16 % 29	55,26 % 42	6,58 % 5	**100%** **76**
accounting (N = 42)	40,48 % 17	42,85 % 18	16,67 % 7	**100%** **42**

legend:
relative frequency (in percent, rounded) of results
absolute frequency of results
N = number of results

Figure 23: Results of the analysed studies regarding the economic categories

The summation of all categories shows again the already known spreading of significant positive and significant negative results (see 5.1 and 5.2.1). Considering the single economic categories, a high frequency of significant positive results can be identified for the categories "perceived economic performance" and " accounting and stock market measures" The category "perceived economic performance" shows the best ratio (8:1) between significant positive and significant negative results, too. Only the small overall number of involved studies influences the power of this finding negatively.[164] Furthermore the relatively high frequency of significant negative results within the category "accounting measures" compared especially to the category "stock market measures" seems noticeable. As the frequency of significant positive results for both categories are almost equal the ratio between significant positive and significant negative results differs widely. It is 6:1 for the category "stock market measures" and 2,4:1 for the category "accounting measures". Consequently the category

[164] However, a necessary sample-size cannot be identified.

"stock market measures" tends to not significant results instead of significant negative results with high probability.

From the examination of the category "others" a not observable relationship between environmental and economic performance can be concluded, for not significant results (62,5 %) predominate the significant ones (37,5 %). An opposite conclusion can be drawn related to the category "stock market and accounting measures". It contends the smallest frequency of not significant results (25%) in comparison to all other categories. However both categories ("others" and "market and accounting measures") contain only eight results each.

5.2.3 Results based on the combination of environmental and economic categories

The assignment of the findings derived from the studies to the different environmental and economic categories provides a first insight in the characteristics of the results. So far it can be observed that environmental and economic measures are effected differently by each other. That applies as well for the direction as for the size of an effect. To clarify and survey this further investigation seems to be necessary. In the authors´ opinion especially the interplay between economic and environmental variables and the results related to this seem to be of high importance. Hence a combination of the environmental and economic categories is necessary in order to carry out the next step of the analysis.

In order to combine both types of categories the number of studies assigned to the economic categories (112 studies with 124 categorisations) is merged with the number of studies assigned to the environmental categories (109 studies with 132 categorisations). The cross-sectional area comprises 103 studies with 145 combinations. Some studies are allocated several times to the combinations. E.g. if a study is categorised twice at the economic level and at the environmental level it is included four times into the combinations. The absolute spreading of the combinations is presented in figure 24. The tenth column and the sixth line contain the sum of digits of the number of studies per category. The abbreviations used in this figure will be used within the whole paper.

The number of results allocated to the combinations of environmental and economic categories is 174. The difference in numbers between the 174 results and the 155 at the level of the single studies (cf figure 21) results form the numerous assignments of results to different combinations. If a study contains different variables concerning the same category

and the related results are different, too, all results are assigned separately to a combination of categories.

economic category									
	ECRP	9	1	0	0	12	0	0	22
	ACC	5	18	14	0	2	3	0	42
	SM	3	20	19	16	1	5	1	65
	SM-ACC	1	6	1	0	0	1	0	9
	Others	1	3	2	0	1	0	0	7
		19	48	36	16	16	9	1	**∑ 145**
		STRAT	**OP**	**R/R**	**EE**	**ENRP**	**ER**	**FUNDS**	**103 studies**
		environmental categories							

legend:

economic categories:

ECRP = perceived performance
ACC = accounting
SM = stock market
SM-ACC = stock market and accounting
Others = others

environmental categories:

STRAT = strategic environmental performance
OP = operational environmental performance
R/R = rating and ranking
EE = environmental events
ENRP = perceived performance
ER = environmental reporting
FUNDS = funds

Figure 24: Combination of environmental and economic categories

The following spreading results from summing up all combination's results: 78 significant positive results (44,83%) to 81 not significant results (46,66%) to 15 significant negative results (8,62%). In comparison to the spreading based on the general findings within the studies (see chapter 5.1) a slight trend towards significant positive results can be identified. Considering the way of setting up the combinations it can be assumed that studies reporting a significant positive result surveying more variables of different categories than studies with significant negative results. However it is only an assumption.

In figure 25 a summary of all results assigned to the different combinations is shown. The figure corresponds to figure 24 with the difference that not the number of contemplated studies is presented but the number of identified results. Additionally the relative frequency of the different results is presented for the different combinations.

Figure 25: Type and number of results per combination

Considering the results of the analysis presented in figure 25 it can be concluded that the spreading of the results related to the economic and environmental categories respectively is not following an obvious, strict rule in general. It differs for all combinations. The reason for

Categories economy																								
	ECRP	11			2			0			0			15			0			0			28
		55 %	45 %	0 %	50 %	0 %	50 %							47 %	40 %	13 %								
	ACC	6			22			16			0			2			5			0			51
		50 %	50 %	0 %	32 %	54 %	14 %	50 %	50 %	0 %				50 %	50 %	0 %	40 %	20 %	40 %					
	SM	4			22			22			22			1			5			1			77
		25 %	75 %	0 %	45 %	45 %	10 %	36 %	64 %	0 %	54 %	32 %	14 %	0 %	100 %	0 %	60 %	40 %	0 %	0 %	100 %	0 %		
	SM-ACC	1			6			1			0			0			1			0			9
		100 %	0 %	0 %	66 %	17 %	17 %	0 %	100 %	0 %							0 %	100 %	0 %					
	Others	1			4			3			0			1			0			0			9
		100 %	0 %	0 %	0 %	75 %	25 %	66 %	34 %	0 %				100 %	0 %	0 %								
		++	n.s.	--	++	n.s.	--	++	n.s.	--	++	n.s.	--	++	n.s.	--	++	n.s.	--	++	n.s.	--	
		23			56			42			22			19			11			1			174
		STRAT			OP			R/R			EE			ENRP			ER			FUNDS			
		Categories environment																						

Content of the box:
Overall number of results
Relative frequency (rounded): significant positive/not significant/significant negative

that might be seen in the sometimes small number of results per combination. But nevertheless some patterns like the occasionally appearing effect of significant negative results can be identified as well, e.g. for the environmental categories “STRAT“ and “R/R“.

A further examination reveals the following insights: The combinations “SM”-“ER”, “others”-“R/R” and “SM-ACC”-“OP” show the highest relative frequency of significant positive results (combinations with only one result are excluded). However the specific number of results within these combinations is quiet small (maximum of six). The combinations “ECRP”-“OP” and “ACC”-“ER” show the highest frequency of significant negative results.

In addition the combination containing the economic categories “SM“ and “ACC“ differ in their outcomes. For instance the combination “SM”-“OP” clearly shows a higher frequency of significant positive results in comparison to “ACC”-“OP” even though both combinations are equal in number of the results included. The reverse can be identified for the combinations of the environmental category “R/R”.

The combination “SM”-“EE” contains the lowest frequency of not significant results (combinations with less than ten results excluded). Therewith it gives a clear proof for the existence of a relationship between environmental and economic performance. At the same time significant positive results outweigh significant negative results by 4:1 in this combination.

However the certainty of the characteristics identified cannot be evaluated clearly. It might as well be that the observed pattern simply occurs by chance. The smaller the number of results within a combination the higher the probability of haphazardness of the identified pattern might be. But if, as assumed, every single result of the studies is considered as empirically proven, nonetheless a relationship between environmental and economic measures can be stated. Furthermore it was detected that empirical research focused on only a few combinations of environmental and economic measures so far. That explains why 7 of 35 possible combinations contain about 74% of all results. 12 combinations are completely unconsidered, e.g. the category “ACC”-“EE”. The reason for that might be seen in some requirements of the empirical research methods themselves or application problems. [165]

5.3 Results based on ecological success and time delay effects

Point 3.3 of this paper provided a short insight in the possible influence of ecological success and time delay effects (economic performance follows environmental performance but delayed in time). This part of the paper basically investigates the mentioned effects. For this purpose results of studies that can be assigned to these effects are identified. Ecological success expresses the changing of environmental performance, therefore variables recording such a change, i.e. environmental impacts, are considered. The importance of time delay effects is measured by economic and environmental variables differing in terms of their recording time and period. Therefore especially the relationship between environmental variables at one period and economic variables of a later period is of special interest.

[165] An event-study requires the comparison of the categories stock market and environmental events.

Nine studies applying relevant variables could be identified for the ecological success. Each study provides only one result. Six out of nine results are significant positive (66,67%), one is not significant and two are significant negative.

This spreading displays the highest relative frequency of significant results (samples with N≤2 excluded) of the whole analysis. The relative frequency of the significant positive results is also in the top range of all identified frequencies. However the only small number of included results does not suffice for more than an uncertain reliability.

The analysis of time delay effects is based on 16 studies. Mostly the economic variables are measured one year after the environmental ones. By identifying the related results (18) the following spreading can be identified: 11 results are significant positive (61,11%), 5 non-significant (27,78%) and 2 significant negative (11,11%).

Hence for time delay effects some spreading differing from the majority of all spreading can be identified, too. Especially considering the overall number of 18 results the frequency of significant results is quiet high. The same applies for the significant positive results. A higher relative frequency of this type of results was not identified elsewhere in the whole analysis, except for the ecological success (samples N≤2 excluded).

Concluding from the outcomes mentioned above it can be stated that the empirical research provides strong evidence for a distinct relationship between ecological success and economic performance as well as for the influence of environmental performance on later economic performance.

5.4 Results based on empirical research methods

The analysed studies use four different empirical research methods. This step of the analysis assigns the results of the studies to these methods. The objective is to identify special characteristics regarding the results of a study. The analysis contemplates only the level of the complete study and is not broken down to the level of the environmental and economic categories. All studies providing sufficient information about their empirical research method are included into the analysis. Therefore studies from primary as well as secondary sources

are considered.[166] That results in an overall number of 103 included studies. These studies contain 129 results. The difference in number of the results is based on the points already mentioned above.

Figure 26 presents the outcome of this analysis. The relative and absolute frequencies are shown. The method-group "others" is excluded from further investigation because of the small number of comprised results and the differing methods included. However the values for "others" are given in figure 26 nevertheless for the sake of completeness.

methodology (number of studies)	**results (relative/absolute)**			**Σ results**
	++	**n.s.**	**--**	
regression	49,28 %	36,23 %	14,49 %	**100,00%**
(N = 53)	34	25	10	**69**
portfolio	30 %	63,34 %	6,67 %	**100%**
(N = 26)	9	19	2	**30**
event	46 %	38 %	17 %	**100%**
(N = 19)	11	9	4	**24**
others	33,33 %	50,00 %	16,67 %	**100%**
(N = 5)	2	3	1	**6**

legend:
relative frequency (in percent, rounded) of results
absolute frequency of results
N = number of studies

Figure 26: Results based on empirical research methods

Figure 26 shows that the method-groups regression and event are quiet similar, whereas the spreading of the method-group portfolio differs strongly from them.

The method-group regression shows the highest frequency of significant positive results compared to the other groups. The result of the method-group event however is almost equal to it as well. This is confirmed by the relative frequency, which is almost identical for both method-groups. The ratio of significant positive results to significant negative ones is for the method group regression (3,4:1) better than for the method-group event (2,75:1). However an absolute conclusion about the effect of different research methods on the direction of the relationship between environmental and economic performance cannot be drawn. The

[166] In contrast to point 4.3 no detailed information about the methodology are required.

presented data show a mostly positive relationship between environmental and economic performance. Whether it's true or not in general cannot be said for sure.

Portfolio studies in comparison to the other methods show the lowest frequency of significant results. Therefore it seems as if portfolio studies are at the least able to certify a positive relationship between environmental and economic performance. The reasons for that are not perceptible. If only significant results are considered a clear predominance of positive results can be identified for studies using that method. The ratio is 4,5:1. That means if a significant result is found it will be positive with about 75% probability. Nevertheless, this statement is only qualitative and potential errors may be included.

5.5 Results based on Rappaports shareholder value network

Based on the analysis so far it can be concluded that economic performance is not measured regarding value orientation, e.g. using the SHV approach. Instead studies apply accounting or stock market based measures. In order to specify the effect of environmental performance on the value, specific economic measures - that can be included into the shareholder value network - are identified and their value relevance is approximated.

Concerning the value driver "value growth duration" no representative study and therewith no measure was identified. For the value drivers on the operating level (sales growth, profit margin, tax shield) eight relevant studies could be identified. These studies apply measures like ROS or another ratio to express the profit margin of a company. Moreover three studies use the ratio: ROI or ROCE which can be connected with the value driver "investment". It is assumed that these ratios express the sustainable strategic success potential of a company's investments.[167]

Furthermore seven studies regarding the systematic risk beta (ß) as environmental measure can be included into this step of the analysis. ß directly influences the value driver "cost of capital" by determining the risk premium of the equity. The value component "Cash Flow" can be approximated by the measures of seven studies, because all those measures are cash flow based.

[167] Cf COENENBERG, A.G. (1997), p. 704ff.

Overall 23 studies with 27 results can be assigned to the different components (value drivers) of the shareholder value network. A detailed description of the spreading of studies and results is presented in figure 27. Thereby a classification in significant positive, not significant and significant negative results is chosen. Additionally the number of studies and description of measures used are given as well as the relative frequencies of the types of results.

The examination of all assignments leads to the result that the effect of environmental performance on the value drivers differs. Concerning "Cash Flow" all assigned measures are statistically significant. Thereby most of the results are positive (71,43%). Hence it can be concluded: the value driver "Cash Flow" is in five out of seven cases positively related to environmental performance.

70% of all results assigned to the operational value drivers point to a significant relation between the two types of performance. In doing so the positive results outweigh the negative ones again.

The results assigned to the financial and investment level do not allow for a reliable conclusion. For instance none of the variables ROI or ROCE is statistically significant. Additionally, the relative frequency of significant variables assigned to the value driver "cost of capital" is just 50%. However 75% out of this 50% are indicating a positive relationship between environmental performance and the systematic risk.

Taking all outcomes of the analysis into account it can be stated that environmental performance is value relevant. Thereby the effects can be assumed as being predominantly value adding. However this conclusion possesses only limited reliability because the value drivers are only roughly covered by the assigned variables. In order to gain a more detailed answer about the value relevance of environmental performance more reliable measures have to be applied.

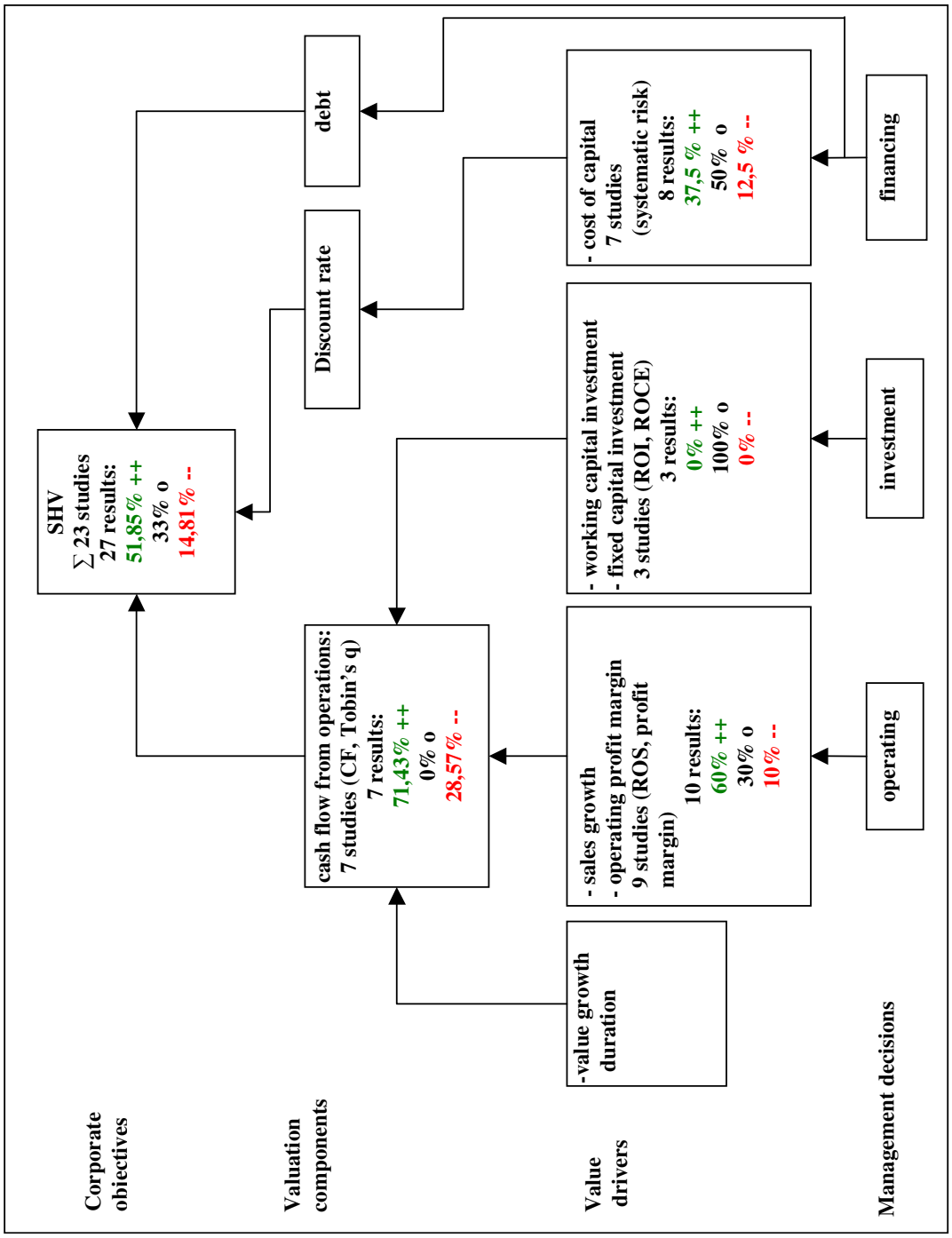

Figure 27: Results based on the SHV-approach

6. Concluding analysis and discussion

The carried out analysis enables an evaluation of the empirical research about the relationship between environmental and economic performance and of the relationship itself. Accordingly all outcomes of the analysis are summarized and evaluated in terms of their theoretical context.

The results of the analysed studies do not allow for a clear understanding of the relationship between economic and environmental performance. Half of all studies cannot identify a relationship between the two types of performance. The reason for that cannot be found. However if only statistically significant results are considered a positive relationship could be assumed.

In regard to the theoretically developed hypotheses it has to be concluded that the empirical research is unable to accept or reject them for sure. A major reason for that is the difficulty to examine and identify causality.

Of all empirical research methods applied, only event studies are able to detect causality. Approximately half of all results based on event studies are significant positive, hence support hypothesis H2a. All other event studies either cannot find a relation between environmental and economic performance or support H2b. The last part is the smallest. The fact that some event studies could not identify a relationship leaves room for some considerations: Firstly it could be that the influence of the environmental performance on the stock market is only minor and therefore not observable. Secondly, the stock market might not consider (information concerning) the environmental performance as value relevant and therefore does not include it into their valuation. Thirdly the existence of significant positive and negative results could be evidence for hypothesis H1c. However a complex relationship cannot be identified by the use of event studies and therefore the last statement is a sheer assumption.

At large regression studies cannot identify causality. Ergo all significant positive results are simultaneously supporting H1a and H2a. At the same time this result could be interpreted as evidence for an interdependent relationship. In contrary all significant negative results are supporting hypothesis H1b as well as hypothesis H2b. Taking positive and negative results together, hypotheses H1c and H2c are supported. Nevertheless there are empirical research methods to examine non-linear relationships (studies using square variables). However in the opinion of the authors they are not suitable to examine the hypotheses H1c, H2c and H3. For this purpose a recording of different values of environmental performance, e.g. high performance in period 1 and medium performance in period 2, is necessary. Consequently such a recording has to be done in different periods of time. However such a method is not applied by any study so far.

Portfolio studies can be effective identifying a complex relationship, because the dividing up of companies into different performance groups might indicate a complex relationship. I.e. companies with a good environmental performance also show good economic performance and companies with a worse environmental performance do not. Concluding portfolio studies reporting a positive result as well as a negative one, support H1c and H2c and maybe even H3. However most portfolio studies are not able to detect a significant relationship at all, therefore their meaningfulness is limited.

In general it can be summarised that most empirical studies support the hypothesis H1a and H2a. Another large part of all studies is not able to show a relationship at all. However this result is not considered as a proof for a not existing relationship. What is more, it is considered as evidence that the effect of environmental performance onto economic performance is only very small compared to the effect of other determinants of economic performance. This statement is supported by the theoretical insight that environmental performance is only one of many parameters influencing the value of a company. Furthermore the inability to identify a relationship between economic and environmental performance might be a proof of the shortcomings in empirical research.

The environmental variables applied by studies are each only partly covering environmental performance. A complete examination of environmental performance is not done so far and whole sections of environmental performance are not yet statistically recorded. A large deficit results from the fact that possible advantages of a strategy of differentiation are not taken into account. But especially the additional benefit of environmentally sound products and the related increase in reputation and consequently the SHV, should not be neglected.

Furthermore the analysis showed that the effects of variables of different environmental categories on economic performance might vary. The reasons for that could not be identified. Nevertheless in almost every environmental category significant positive results outweigh the significant negative ones.

Considering the economic variables it has to be differentiated among the categories and their assigned results, too. In regard to the value orientation none of the applied measures gives a clear statement. However the approximation of the SHV indicates a mainly positive relationship.

The combinations of environmental and economic categories show some clear features. For instance some combinations give clear evidence of a positive relationship between the types of performance (not significant results excluded). The effect of the environmental variables is absorbed by the economic variables differently. The same applies for the reverse case.

By analysing time delay effects and the ecological success extraordinary results can be recognised. The application of both concepts leads to a strong support for the existence of a relationship between environmental and economic performance. And in the most cases it is a positive relationship.

Generally it can be assumed that the relationship between environmental and economic performance is determined by some additional parameters. This could be the explanation for some differences in the distribution of the results, which could be identified in terms of the environmental and economic categories, their combinations, as well as for the empirical research methods. However further details are still unknown.

Despite all its different forms and results empirical research finally indicates a positive relationship between economic and environmental performance. But the meaningfulness of this statement is limited because of its only qualitative characteristics.

Hence, further research is needed. Firstly, the results should be assigned to the different variable-groups of the economic and environmental categories in order to specify the determinants of the relationship. Here the number of studies applying variables of identical variable-groups is the limiting element. Secondly, a meta-analysis could be employed. By using a meta-analysis the influence of different sample-sizes or significance levels could be taken into account. This would eliminate the pure qualitative characteristics of the findings of this analysis. First and foremost it is recommended to summarise studies with identical characteristics (e.g. methodology, measures etc.). In the next step all studies should be combined in order to get a final result. The final result stands for the combined empirical research done till now. However, by using a meta-analysis their critics have to be considered.[168]

[168] For further reading see: BORTZ, J. (1995), p. 589ff., PETITTI, D. B. (2000), p. 23ff.

Additionally, the number of studies included into the analysis should be enhanced. It is recommended to rectify the mentioned limitations.

In general it is recommended to future research to focus on the value relevance of environmental performance. For this purpose a definition of all single aspects of environmental performance and the identification of suitable measures is needed. The same applies for a company's value. Based on this the overall effect of environmental performance on the value of a company has to be established.

7. Closing remarks

All in all this analysis gives theoretical and empirical evidence for the existence of the relationship between environmental and economic performance. The empirical research still shows some shortcomings in identifying the exact relationship. Nevertheless with a bit of optimism, economy and the environment can be considered as compatible.

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