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The Impact of Investments in Energy Conservation Technologies on the Economic Performance of Companies – Example from the Czech Republic

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The article deals with an evaluation of the impact on companies of activities that take a friendly approach to the environment, using a sample of companies in the Czech Republic. The importance of business activities in this area is discussed. The potential benefits and problems connected with these activities are mentioned.
The aim of the present paper is to verify the positive impact of activities aimed at using environmentally friendly technologies on the indicators of productivity and profitability. A sample of businesses that have been supported in their activities by state aid was used. This sample covered 222 companies. The representativeness of the analyzed sample was verified. For evaluation of the impact, a t-test (paired two-sample for means), F-test for variance analysis, ANOVA and regression analysis were used. For a qualitative point of view, three examples of analyzed projects are given. The main conclusion is that it failed to demonstrate a statistically significant improvement in the chosen indicators. We were unable to verify any statistically important impact on the indicators of profitability and productivity. Further analysis showed a statistically important difference in the profitability indicator one year after subvention use, depending on the value of the subvention. The results of regression analysis also confirmed the negative dependence of the profitability indicator on subvention use. Examples given in the article show that not all projects had a positive impact on economic indicators.

Keywords: *Environmental Strategy; Innovation; Economic Performance; Sustainability, Czech Republic.*

Introduction

The management of companies must take into consideration a rapidly changing environment (Johnson *et al.*, 2011; Grant, 2016; Neverauskas *et al.*, 2008). Reflecting on the importance of environmental concerns within the activities of companies is a very current topic. This is due to global trends, including climate change, development of renewable energy, the threat of water shortages in some areas, warming, and biodiversity loss (Smil, 2008; Gates *et al.*, 2009; Dabelko, 2009; Done, 2012). Various opportunities as well as threats arise from climate changes (e.g. rising prices of materials and energy). Companies must identify these factors and take them into consideration when building their competitiveness (Lash, 2007; Hyrslova *et al.*, 2015). Environmental factors (green energy, land use policy, pollution) must also be considered when envisioning the future of cities (Snieska *et al.*, 2014). Sustainable development is another area supported by structural funds of the European Union (Dumciuviene *et al.*, 2015).

It is required that companies take these factors into account in their activities, as environmental protection is included in a number of national and international legal standards. However, companies also use a number of tools and approaches that are entirely voluntary. These tools include the voluntary EMAS (Environmental Management Audit Scheme) standards of ISO 1400, environmental labelling, cleaner production, etc.

Sustainable growth is perceived as a comprehensive way of doing business in some companies. This concept can bring great economic value and make it possible to exploit new opportunities (Holliday, 2001). Based on their research, some authors have designated sustainability as a megatrend (Lubin *et al.*, 2010). Businesses focused on sustainability are considered according to some authors to be more innovative and profitable (Young *et al.*, 2013). Sustainable development is closely linked with the concept of corporate social responsibility (Slapikaite *et al.*, 2015; Srpova *et al.*, 2012).

Company activities aimed at improving the corporate environment can have many positive effects on the productivity of resources. The main potential procedural advantages are lower energy consumption in the production process, better use of by-products, waste material savings, lower storage and material-handling costs, lower costs associated with the elimination of waste, and better overall control of the production process. Products can achieve higher quality at a lower cost, packaging costs can be reduced, products are safer, product disposal costs for customers can be lowered, and a higher-value resale product can be considered (Porter *et al.*, 1995; Madu, 2004). Environmental concern on the part of companies can also increase the attractiveness of specific companies in various industries. Examples include the idea of green tourism (Li *et al.*, 2014) or research done by Hyrslova et al. (2015) on the chemical industry.

Apart from the advantages in production and energy consumption, companies can realize even more benefits. These benefits include building a competitive advantage based on goodwill, searching for environmentally friendly products for customers, enhancing the company's

attractiveness to potential employees, differentiating it from competitors, and influencing the future of the industry (Madsen *et al.,* 2003; Senge *et al.,* 2008; Molina *et al.,* 2015). These factors allow a company to improve its performance. Some authors have come to the conclusion that it is possible to confirm the positive effects of environmental activities on the economic results of companies (Huang *et al.,* 2010). The authors of this study observed the impact of environmental strategy on the corporate performance of ISO 14000 companies in Taiwan. The conclusion was that environmental strategy is positively associated with corporate performance. Other researchers have also reached a similar conclusion (Klassen *et al.,* 1996; Russo *et al.,* 1997).

Research focused specifically on "green innovation" has also concluded that this type of innovation has a positive effect on competitive advantage, and that companies should invest in product and process innovation in the environmental field (Chen *et al.,* 2006). In addition, investments in "socially responsible mutual funds" are beneficial to investors (Tamosiuniene *et al.,* 2012).

However, other authors emphasize that concern for the environment does not automatically have a positive impact on a company's performance. The reason for this is that customers do not automatically evaluate products based on whether they are produced in an environmentally friendly way. If they have to choose between the characteristics of a product and its environmental friendliness, the product characteristics are usually more important (Ginsberg *et al.,* 2004). This conclusion is also supported by other researchers, who studied the impact of environmental strategies in the service sector on the performance of companies. It can be concluded from their research that companies with more highly developed environmental strategies do not necessarily achieve better economic performance, even though their environmental performance is better (Carmona-Moreno *et al.,* 2004).

However, it is necessary to recognize that in order to optimize the economic returns from environmental investments, different businesses will benefit from different approaches to achieving an environmental competitive advantage (Orsato, 2006).

Eco-efficiency is seen as an approach which integrates sustainable development with business concerns. This consistency is generally achieved over the long term. In the short term, there may be some conflicts (between business concerns and sustainable development) (Fussler *et al.,* 1996).

Previous research has generally been focused on the impact of environmental activities on competitive advantage. These studies take into account, for example, the corporate image in the eyes of customers and other interest groups. Other studies try to assess the impact of environmental activities on specific performance indicators.

Furthermore, as can be seen from studying the presented literature, it has not been clearly demonstrated that activities dealing with environmental considerations have a positive effect. Most of the research compared companies active in this area with companies that did not engage in these activities or engaged in them on much lower levels.

It is possible to see a gap in research that evaluates the effect of implementing environmentally friendly technologies within specific companies. The article presents the results of research in the regions of Central and Eastern Europe, where this topic has not been studied to a great extent.

Relevance of Aim to the Research Topic and Problem

Activities related to care for the environment are important for the successful development of businesses. Environmental protection is a global trend promoted by multinational organizations and national governments. This creates opportunities for businesses, e.g. in the area of using subsidies. Opportunities also arise from consumers who value environmentally friendly approaches. Businesses are not taking full advantage of these opportunities. Determining the economic impact of environmentally friendly activities is necessary in order to look for and confirm rules which may be beneficial for businesses. For this reason, this area of research is highly relevant for professionals. Academicians must continually develop various disciplines of management in order to provide future managers with practical knowledge and skills. Simultaneously, academicians must develop new approaches for the business sector.

The goal of the present paper is to verify the positive impact of activities aimed at using environmentally friendly technologies on the selected indicators of productivity and profitability in a sample of enterprises in the Czech Republic.

Methods

Companies which implemented innovation within a subsidy program aimed at saving energy, including the use of renewable and secondary energy sources. The activities supported increased efficiency in consumption, transmission and energy generation. The supported projects focused on reducing the demand for energy in manufacturing and technological processes, introducing and modernizing control and regulation systems, modernizing and decreasing energy loss in heating and electrical power systems, and modernizing power generating devices for a company's own use. The unsupported areas are the synthetic fibre industry, coal industry, steel industry, and the agriculture and fishing industries.

The recipients of support are companies that are authorized to do business in the Czech Republic. The companies cannot have any unsettled arrears towards, e.g., the tax office or the Ministry of Finance. They cannot owe unpaid salaries to employees. They must keep accounting records.

The projects were chosen primarily according to long-term energy-savings achievements, ecological benefits and economic effectiveness.

The grant is awarded in the range of 30 – 60 % according to geographic location in the Czech Republic and company size. The minimum grant was 0.5 mil CZK. The maximum was 250 mil CZK.

For the article, companies which completed the project were chosen for evaluation. The grant is awarded in arrears after completion of the project.

The original sample had 419 companies. Some companies were excluded due to unavailability of data. After excluding extreme values, a sample of 222 companies was evaluated.

To determine the minimum sample size, a procedure by Krejci et al. (1970) was used. The following formula was used to determine the minimum sample size:

$$s = \frac{X^2 * N * P * (1 - P)}{d^2 * (N - 1) + X^2 * P * (1 - P)}$$

Considered variables are:
s = sample size required
X2 = value of chi-square for 1 degree of freedom
N = population size
P = population proportion
d = degree of accuracy

The table value of chi-square for 1 degree of freedom is 1.96. The original number of supported companies is 419. The population proportion is 0.5 and the degree of accuracy is 0.05. The final calculation of sample size is:

$$s = \frac{1{,}96^2 * 419 * 0{,}5 * (1 - 0{,}5)}{(0{,}05^2 * (419 - 1) + 1{,}96^2 * 0{,}5 * (1 - 0{,}5)}$$

$$s = 402{,}4076 \div 2{,}0054 = 200{,}662$$

The volume of the used sample is representative.

Details of Sample Companies

The companies included in the sample are privately held. Details about the size of the companies according to number of employees are given in Table 1.

Table 1

Information About the Number of Employees

Number of employees	Quotient of companies
0-50	48 %
51-249	32 %
Above 250	19 %

48 % of companies included in the sample are in the category of small companies with 0–50 employees. 32 % of companies are in the category of medium-sized companies with 51–250 employees. 19 % of companies are in the category of large companies with more than 250 employees.

The structure of the companies according to CZ-NACE sectors is:

•Manufacturing 43 %
•Electricity, gas, steam, air conditioning supply 23 %
•Construction 12 %
•Real estate activities 6 %
•Wholesale and retail trade 5 %
•Transportation and storage 2 %
•Accommodation and food service activities 2 %
•Other NACE sectors 7 %

The companies included in the research were those supported in the years 2010, 2011 and 2012. The list of supported companies was obtained from the state agency which oversees the implementation of grant programs in the Czech Republic. The data from the financial statements was obtained from the Albertina database. This database is available at our university for educational and research needs.

The impact of innovation in the environmental area on ROA (return on assets) and the productivity ratio was evaluated.

ROA is constructed as:

ROA = (Earnings before Interest and Taxes)/(Total Assets)

The productivity ratio is constructed as:

Productivity = (Sales of Manufactured Goods and Services)/(Material and Energy Consumption)

The values of ROA are standardized according to values of ROA for the area "CZ-NACE Industry". These values are available from the Ministry of Industry and Trade of the Czech Republic. The impact of the economic cycle was minimized by this calculation.

The input data for the calculation of efficiency are normally considered variable values. Hence it is not necessary to standardize this data.

It was evaluated whether the values of the indicators monitored in the years after the implementation of innovation, in comparison with the values in the year prior to the implementation and realization of innovation, was higher or lower.

A two-sample t-test with paired samples was used for the evaluation. Furthermore, companies were divided into three groups according to the total amount of subvention. The impact of the amount of subvention on the chosen indicators was then evaluated. A one-way ANOVA, two-sample t-test, and F-test for variance analysis were used. A Bonferroni correction for the use of a two-sample t-test was used. Furthermore, regression analysis to determine the dependence of the selected variables was used. The statistical program Gretl was used for the analysis.

The Rationale and Characterization of Methods Used

Two-Sample T-Test

Hendl (2012) formulates four situations for two-sample t-test use:

a) The object is measured twice - before the attempt and after the attempt. For each monitored object, two values are obtained.

b) The objects are aligned in pairs by a certain factor into the blocks. A treatment is realized randomly on the tracked object. The values of the dependent variable are compared.

c) Objects with paired parts. Measurements are performed on both parts (e.g. eyes).

d) Two object treatments are performed in random order.

The application in this article is an example of the first instance of a two-sample t-test use formulated in the scientific literature.

Cyhelsky et al. (1996) formulates this test criterion:

$$\mathrm{t} = \frac{\bar{d}}{\sqrt{\frac{s_d^2}{n-1}}}$$

Considered variables are:
$\bar{d}$ average of paired values,
s_d^2 variance
in the number of observations.

The following hypothesis is tested H0: μ1 = μ2 of mean values conformity of the two paired samples. In case of rejection of the null hypothesis at the chosen level of significance, it is possible to conclude that the mean values of individual measurements differ.

Regression analysis was used for additional quantitative analysis. The basic shape of the regression line is (Marek et al. 2007):

$$y = b_0 + b_1 * x + \varepsilon$$

Considered variables are:
y is the dependent variable,
x is the independent variable,
b0 is the regression constant,
b1 is the regression coefficient,
ε is the residual component.

An estimation of the regression line parameters is made using the least squares method (Marek et al. 2007). The following formulas are used for the estimation:

$$b_1 = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{n\sum x_i^2 - (\sum x_i)(\sum x_i)}$$

$$b_0 = \frac{\sum y_i}{n} - b_i \frac{\sum x_i}{n}$$

Analysis of variance

Analysis of variance is a method used for the comparison of an arbitrary number of averages. The effect of the observed factor on the dependent variable is analyzed. Analysis of variance works with F-statistics of dissimilarity of group averages. It is observed if the averages in groups differ by more than the random fluctuation. The F-statistic in analysis of variance has the following form (Hendl, 2012):

$$F = \frac{\text{weighted variance between averages of groups}}{\textit{variance between individuals in the same group}}$$

Qualitative Research

The presented article also contains three examples of companies that implemented projects aimed at resolving environmental issues. Examples include a brief description of the projects and their effects (financial as well as non-financial).

Results

Profitability and Productivity Evaluation - Evaluation of ROA

Table 2 provides information about the average of standardized values of ROA and variance.

Table 2

Values of the Profitability Indicator (ROA)

Year	Y_{-1}	Y_0	Y_{+1}
Average	-0.182	-0.097	-0.111
Variance	1.393	3.011	0.989

Note: Y0 – value in the year of subvention use
Y-1 – value one year before subvention use
Y+1 – value one year after subvention use

The value of the profitability indicator is greatest in the year of subvention use. The value in this year is greater than one year before subvention use, and also one year after subvention use. The variance of the analyzed data is also the greatest of the analyzed years.

Table 3 provides the results of an evaluation using a two-sample t-test with paired samples.

Table 3

Results of the t-test

Year	t-statistic	t-critical*	P-value
Y_{-1}/ Y_0	0.783	1.971	0.434
Y_{+1}/ Y_0	0.127	1.971	0.899
Y_{+1}/ Y_{-1}	0.941	1.971	0.348

Note: * – significance level α = 0.05

No positive effect on the selected profitability indicator was demonstrated for any of the given comparisons.

No statistically important differences between the values of profitability were obtained. The minimum p-value for confirmation of a statistically important difference between the values of profitability in the year of subvention use and one year before subvention use is 0.434, between the values of profitability in the year of subvention use and one year after subvention use is 0.899, and between the values of profitability one year before subvention use and one year after subvention use is 0.348.

Profitability and Productivity Evaluation - Evaluation of Productivity

Table 4 provides information about the average of the productivity indicator and its variance.

Table 4

Values of the productivity indicator

Year	Y_{-1}	Y_0	Y_{+1}
Average	3.567	3.685	3.717
Variance	26.611	28.197	26.885

Note: Y0 – value in the year of subvention use
Y-1 – value one year before subvention use
Y+1 – value one year after subvention use

The values of the productivity indicator grew during the covered years. The value of the indicator is greatest one year after subvention use and lowest one year before subvention use.

Table 5 provides the results of an evaluation using a two-sample t-test with paired samples.

Table 5

Results of the t-test

Year	t-statistic	t-critical*	P-value
Y_{-1}/ Y_0	0.647	1.971	0.518
Y_{+1}/ Y_0	0.346	1.971	0.729
Y_{+1}/ Y_{-1}	0.749	1.971	0.455

Note: * – significance level α = 0.05

No statistically important differences between the values of the productivity indicator in the covered years were obtained. The minimum p-value for a statistically important confirmation of the differences between the year of subvention use and one year before subvention use is 0.518. The minimum p-value for confirmation of differences between the year of subvention use and one year after subvention use is 0.729. The minimum p-value for confirmation of statistically important differences one year after subvention use and one year before subvention use is 0.455.

No positive effect on the selected productivity indicator was demonstrated for any of the given comparisons.

ANOVA Analysis

The next step in the evaluation was an examination of the impact of the subvention amount on the values of the chosen indicators. The companies were divided into three groups according to the size of the subvention. Table 6 provides the average values of the indicators.

Table 6

Average Values of the Indicators in Czech Crowns

Year	Group 1	Group 2	Group 3
ROA (Y_{+1})	-0.034	0.031	-0.678
ROA (Y_0)	0.077	-0.186	-0.693
Productivity	3.959	3.747	2.628
Productivity	3.972	3.571	2.646

The values of ROA for the two chosen years are lower in the group of companies with the highest subvention. The values of the productivity indicator have a linear trend. The values decline with rising subvention amounts.

Table 7 provides the results of the ANOVA analysis.

Table 7

Results of the ANOVA Analysis

Year	F-statistic	P-value	F-critical*
ROA (Y_{+1})	6.461	0.002	3.037
ROA (Y_0)	2.686	0.070	3.037
Productivity	0.856	0.427	4.703
Productivity	0.824	0.440	7.703

Note: * – significance level α = 0.05

No statistically significant difference was observed in the productivity indicator during the chosen years, and no statistical difference was observed in the ROA indicator in the year with subvention use. ANOVA analysis showed a statistically significant difference in the ROA indicator between the created groups of companies, one year after subvention use.

The differences between the groups of companies created according to the ROA indicator, one year after subvention use, were determined. The first step was an analysis of the variance between these groups. The results are given in Table 8.

Table 8

Results of the F-Test

Groups	F-statistic	P-value	F-critical*
Group 1 x Group 2	1.455	0.062	1.493
Group 2 x Group 3	1.472	0.125	1.743
Group 1 x Group 3	2.143	0.008	1.663

Note: * – significance level α = 0.05

The F-test provides a recommendation for the use of the correct t-test. The variance between groups 1 and 2 and between 2 and 3 is equal, but the variance between groups 1 and 3 is unequal. The results of the two-sample t-test are given in Table 9.

Table 9

Results of the two-sample t-test (ROA, Y_{+1})

Year	t-statistic	P-value	t-critical*
Group 1 x Group 2	0.401	0.689	2.346
Group 2 x Group 3	3.871	0.000	2.372
Group 1 x Group 3	4.136	0.000	2.384

Note: * – significance level α = 0.02

The difference between group 1 and group 2 is not statistically significant. The differences between group 1 and group 3 and between group 2 and group 3 are statistically significant. The group of companies with the highest total subvention had significantly lower ROA one year after the use of subvention, in comparison with the other two groups with lower total subvention.

Regression Analysis

Statistically significant differences between ROA values depending on size of subvention were found by ANOVA analysis. This dependence is further researched by regression analysis. The regression function is computed for the year after the subvention year.

Regression Function with Constant

First, the result with the constant consideration are processed. Table 10 shows the results.

Table 10

Results of the Regression Analysis (With Constant)

Variable	Coefficient	Std. Error	t-ratio	p-value
Constant	0.00488713	0.0738562	0.06617	0.9473
Subvention	-1.72012e-08	5.12390e-09	-3.357	0.0009***

*** for 0.01

The regression function is

$ROA_{normalized}$ = 0.00488713 – 1.72012e-08 * subvention.

The regression function is consistent with the ANOVA analysis result. The Y-intercept is 0.00488713 and the size of the negative slope is 0.0000000172012. The parameters of the regression line tell us that every million crowns of subvention means a decrease in the normalized ROA of 0.0172.

Furthermore, heteroscedasticity was tested in the model. For the validity of the model, it is necessary to exclude heteroscedasticity. Heteroscedasticity should not be confirmed by the chosen statistical test. The results of White's test of heteroscedasticity are given in Table 11.

Table 11

Results of White's Test of Heteroscedasticity for Model with Constant

Variable	Coefficient	Std. Error	t-ratio	p-value
Constant	1.04452	0.163791	6.377	1.06e-09
Subvention	-2.02183e-08	2.16383e-08	-0.9344	0.3511
Sq_subvention	0.00000	0.00000	0.7063	0.4808

The p-value of White's test is 0.613362. Heteroscedasticity is not confirmed.

The Regression Function without Constant

The results of the regression analysis without constant consideration are given in Table 12.

Table 12

Results of the Regression Analysis (without Constant)

Variable	Coefficient	Std. Error	t-ratio	p-value
Subvention	-1.70422e-08	4.51570e-09	-3.774	0.0002

The regression function is

$ROA_{normalized}$ = -1,70422e-08 * subvention.

The size of the negative slope is -0.0000000170422. This result tells us that every million crowns of subvention means a decrease in the normalized ROA of 0.01704.

The value of the F-criterion is 14.24306 and the p-value (F) is 0.000206. The counted model is, as a whole, also statistically important.

Heteroscedasticity was evaluated in the model. The results of White's test of heteroscedasticity are given in Table 13.

Table 13

Results of White's test of Heteroscedasticity for Model without Constant

Variable	Coefficient	Std. Error	t-ratio	p-value
Subvention	-2.03314e-08	2.16796e-08	-0.9378	0.3494
Sq_subvention	0.00000	0.00000	0.7019	0.4835

The p-value of White's test is 0.608046. Heteroscedasticity is not confirmed.

Qualitative Analysis – Examples of Chosen Projects

Project A - ecological waste heat recovery

The project aims to utilize waste heat from industrial production and its further use in the enterprise. Heat exchangers, heat pumps, cooling units and other technical facilities developed for waste heat recovery are used. An industrial production hall was constructed as part of this project.

The project does not require an additional source of energy for heating and cooling. The project focuses on further minimizing emissions from the manufacturing process.

Standardized profitability in the year of implementation was -0.73. In the year after implementation, the profitability was 1.29.

The productivity indicator in the year of implementation was 2.59. In the year after the project implementation, the productivity indicator was 2.74. The monitored indicators were improved. The project also has other positive effects - emission minimization (OPEIC (n.d.)).

Project B - reducing the energy intensity of the company

The goal of the project was the reduction of energy intensity in the operating activities of the engineering company. The implemented measures were: insulation of manufacturing plants and office buildings, decentralization and modernization of heating, and the use of solar collectors for heating water. For example, the use of solar energy for heating water covers 70 % of hot water consumption. The measures should lead to a reduction in CO2 emissions.

Standardized profitability in the year of implementation was -0.33. In the year after the project implementation, the standardized profitability was 0.42.

The productivity indicator in the year of project implementation was 2.17. In the year after the implementation, the value of this indicator was 3.07.

Better values of the monitored indicators were achieved by this project. Other benefits (CO2 emissions reduction) can also be declared (OPEIC (n.d.)).

Project C - savings in energy consumption

The goal of the project was to reduce thermal energy consumption by improving the thermal properties of warehouses and production halls.

The implemented measures were replacement of windows, insulation of walls and roofs of buildings, and replacement of the transformer.

Standardized profitability in the year of project implementation was 0.93. In the year after the project implementation, the standardized profitability was -0.62.

The indicator of productivity in the year of implementation was 2.19. In the year after the project implementation, it was 1.52. This project implementation had no positive effect on the chosen indicators (OPEIC (n.d.)).

Discussion

The research did not confirm a relationship between eco-efficiency innovations and organizational performance.

According to other research, there could be a variety of reasons for this. Christman (2000) conducted research in chemical factories. He observed that the condition for simultaneously achieving protection of the environment and lower costs is the ownership of complementary assets. Maxwell et al. (1997) formulate a condition for an effective environmental strategy of companies' environmental systems and the alignment with the existing core activities of companies. Other literature emphasizes that benefits from voluntary instruments as an example of the environmentally friendly care of companies are not a matter of course (Hyrslova, 2012). The author of this research formulates some conditions, for example defining the main and supporting processes, creating process maps, etc.

In general, it is possible to hold the opinion that taking an environmentally friendly approach brings great challenges and opportunities for businesses (Hart, 1997). However, it should be emphasized that for businesses to realize the benefits of their environmental strategies, they need to understand what products and services should be developed, and what skills they will need.

The main characteristics of the articles mentioned above are given in Table 14.

Table 14

Comparison of Discussed Articles

Authors	Sample	Type of paper	Topic	Conclusion
Christman (2000)	88 Chemical factories in USA	Quantitative research	Christman (2000)	88 Chemical factories in USA
Maxwell et al. (1997)	Three companies: Volvo, Polaroid Corporation Procter and Gamble	Qualitative research	Implementation of corporate environmental strategy	List of factors contributing to successful implementation of environmental strategy
Hyrslova (2012)	Generally about companies in the Czech Republic	Theoretical paper	Quality management systems Environmental management systems	View of benefits of voluntary instruments
Hart (1997)	Not aimed on specific countries. Only general differences between developed and developing countries	Theoretical paper	A sustainable global economy	Challenges to sustainability; Strategies for a sustainable world; Sustainable business strategies

The novelty of the presented research consists in the concentration on the concrete country from Central and Eastern Europe. The novelty consists further in the realization of empirical research and statistical evaluation.

In comparison with the content of the presented article, attention was focused only on the evaluation of the impact on chosen indicators of investment into eco-efficiency technologies across various industries. The research was not concerned with a specific industry. In addition, no other factors were examined. It is also possible to discuss the other factors for non-confirmation of the positive effect of investments. The reason could be the lag time between adoption and effect. It can take a certain amount of time for expressions of effect. Another factor that could be considered is the economic crisis after 2009. During a period of economic crisis, the development of some cost and revenue items can be atypical and unexpected.

For a comprehensive assessment of the contribution of the projects, it is possible to use methods of cost-benefit analysis. This method evaluates the costs and benefits for different actors (state, municipalities, businesses, residents, other entities). This method is mainly used for public projects (Nas, 1996; Gramlich, 1981, 1998; Brent, 2006).

There are two major kinds of cost-benefit analysis: ex-ante and ex-post. Ex-ante cost-benefit analysis is carried out before the commencement of the project. This method is often used to assess the feasibility of a particular project. Ex-post cost-benefit analysis is carried out after the project. It serves primarily to improve the knowledge skills of politicians, academics and other subjects about the value of projects or the parts of projects (Boardman, 2014).

The procedure for cost-benefit analysis consists generally of the following steps (Sieber, 2004): defining the nature of the project, defining the structure of beneficiaries, describing the differences between the investment and the zero option, quantifying costs and benefits for all phases of the project, defining other valuable benefits and costs, transferring these costs and benefits to cash flows, determining the discount rate, calculating a criterion indicator, performing a sensitivity analysis and an assessment analysis, and deciding on the acceptability of the project.

Conclusions

The conducted research did not confirm that the investments in saving technologies had a positive effect on the chosen indicators.

At the same time, it is possible to find specific examples of projects that have a positive impact on economic indicators. Furthermore, there are differences between the values of indicators, depending on the amount of subvention.

Works by other authors in this field do not reach uniform conclusions in this area. As it turns out, the activities of companies who take a sustainable approach to the environment do not automatically have the expected effect. Further research should focus on identifying the factors which are important for businesses to achieve the expected economic effects. And at the same time, this research should concern the effects of environmental care on various stakeholders. Cost-benefit analysis, for example, should be used to evaluate the effects of an environmentally friendly project.

The main problem and limitation of the research was the availability of data. In particular, information about the further effect necessary for qualitative evaluation, for example CO_2 reduction, is quite difficult to obtain. This type of research should be supported by government institutions with an interest in environmental effects, for instance the Ministry of the Environment and the Ministry of Industry and Trade. This cooperation should ensure a database.

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