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Cap and Trade Model – Economic Indicators of Hungarian Enterprises Involved in Emissions Trading

SUMMARY

In their article, the authors examined the stability and efficiency of Hungarian companies participating in emissions trading. Their research covered the period before the energy crisis, so we can get a comprehensive picture of the economic situation from which the investigated companies had to cope with the crisis. To this day, it is a question of whether businesses can finance investments that will require fewer resources to produce products and at the same time result in fewer emissions. The study presents the economic situation of the enterprises with the ten highest emission values, given that they are responsible for more than 98 percent of emissions.

Keywords: carbon accounting, climate change policy, emissions trading, accounting statements

Jel-code: M48, Q52, Q56, F64, F65

INTRODUCTION

The European Union (EU) is also looking for answers to global environmental challenges.

Companies are under increasing pressure to take responsibility for their environmental impact as a result of global economic, social, and environmental changes. Pollutant emission and its research are just a few of the many activities involved in this multifaceted and difficult subject. This obligation must be mentioned in the reports as well, however as of right now, it is not included in all business reports (Szóka, 2022b).

To achieve a more ecologically sustainable society, it became necessary to limit resource emissions. The cornerstone of the EU's climate change policy is the cost-effective and economical reduction of greenhouse gas (GHG) emissions.

The EU established the GHG quota trading system (in a given period, each emission unit contains 1 ton of CO₂ or CO₂ equivalent). The EU's emissions trading system is an output-side regulatory tool, that regulates the maximum amount of greenhouse gases that can be emitted through its emissions trading system. The regulation covers power plants, a wide range of energy-intensive industrial sectors, and airlines. Emissions regulation applies to the following greenhouse gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), fluorinated hydrocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆) (European Parliament and Council Directive 2003/87/EC).

The „cap and trade” model seeks the answer to global challenges, on the one hand, by limiting the emission of certain gases and the use of resources, and on the other hand, by authorizing and distributing a certain amount of quota. Based on the quotas, the users/emitters are obliged to cover their car-

bon dioxide emissions/resource consumption. The quotas are available in a finite number as a result of a defined emission/consumption limit, so the quotas have value. Stakeholders must ensure sufficient quotas, either by complying with the permitted emission/use quantity or by purchasing extra rights to cover the gases produced or resources used during their activities. If they fail to do so, they will be fined according to the system. In the cap and trade model, the manager decides to prioritize investments that reduce emissions/resource consumption or, if he does not have enough quota, buy another quota.

If we want to compare companies, it is not enough just to use some indicators, comparability requires relative indicators. It is even better if the indicators are compared to some reference value, for example an industry average. It is necessary to include the expected negative effects of climate change on the company in the evaluations also, as the company must adapt to them (Szóka, 2022a).

CARBON EMISSIONS OF HUNGARIAN COMPANIES

Looking back over the past decade, the carbon emissions of Hungarian businesses are consistent, which indicates that no reduction in emissions has been achieved, so the amount of purchased quotas has increased year by year. The free use quota decreased significantly in 2013 – the free quota was halved – thus the amount of purchased quota increased. The reason for the change is that until 2013, 60% of the quotas were allocated, while 40% could be purchased through auctions. As of 2013, auction trading of quotas dominates, which directs managers' attention to the implementation of low-carbon investments. This is supported by the research of Bartholy (2013) and her co-authors.

The period between 2013-2020 differed from the previous years because, in addition to reducing the amount of free quotas, the range of actors in the industry was broadened. Carbon dioxide emitters are energy-intensive industrial sectors, oil refineries, metal and iron producers, heat and electricity producers, and airlines. Nitrogen oxide emitters and aluminum producers that emit perfluorocarbon are also among those affected. A significant change is that from 2021, the annual multiplier for the reduction of the upper limit for maximum permitted emissions has changed from 1.74% to 2.2%. Member States with a GDP per capita lower than 60 percent of the EU average can decide to continue to provide the energy sector with free allowances until 2030, the amount of which can amount to no more than 40% of the allowances allocated to the auction (EUCO 169/14 European Council).

During our research, we looked for the answer to the fact

that because the emission does not decrease, the purchased quota increases, as well as the quota costs - in 2017, the price of a carbon dioxide quota was 5.84 euros on average, but in 2018 it was already 16.03 euros - how much of a burden did this represent for the company (<https://www2.deloitte.com/hu/hu/pages/energia-energiakorlatok/articles/novekedett-a-magyar-cegek-szen-dioxid-kitettsege.html>).

Our research covered the period before the energy crisis, so we can get a comprehensive picture of the economic situation from which the examined companies had to cope with the crisis. Are they able to finance investments that will require fewer resources to produce products and at the same time result in fewer emissions?

With all these goals in mind, we examined the stability and efficiency of domestic companies participating in emissions trading. We used data from their accounting reports for the economic calculations.

HYPOTHESES

At the beginning of our research, we used the following assumptions:

H1: A significant difference can be assumed between the carbon dioxide emissions of individual activities. *The range of activities affects the amount of emissions*, so depending on the activity of the given company and the sector it belongs to, its emissions differ.

H2: Due to their scope of activity, the companies that participate in emissions trading, in terms of the ratio of fixed assets and current assets, cannot be assumed to have a significant difference compared to other companies operating in the given sector. The scope of the activity itself presupposes a specific set of assets, keeping economies of scale in mind. Thus, within assets, a higher proportion of fixed assets, including fixed assets (technical equipment), must be expected.

H3: The proportion of provisioning is higher for those participating in emissions trading, as their expected obligations for the future are higher due to the payment of quotas, compared to the value of enterprises operating in the given sector.

H4: In the period before the energy crisis, the value of the asset ratio was higher for companies participating in emissions trading, compared to the value of companies operating in the given sector:

– on the one hand, this was due to economies of scale,

– on the other hand, in the case of certain activities, the market is limited, so even though both the purchased quota and the unit of the quota increased, they were able to enforce it when selling the service (product) and in pricing.

H5: *The return on investment and the values of the equity-proportional result for those involved in emissions trading differ significantly from those not involved in emissions trading within the given scope of activity.*

RESEARCH METHODOLOGY

The purpose of our research was to examine whether the economic indicators of the companies involved in emissions trading differ significantly from the indicators of the given sector. How much of a burden is the emission payment obligation, and to what extent does it represent a risk factor for the operation of your business? In the course of our research, we reviewed the emission values of the 24 sectors involved in emissions trading. The emission values were analyzed over a period of 8 years (2010-2017), with 2010 as the base year. The source of the emission data was the website published by Deloitte.

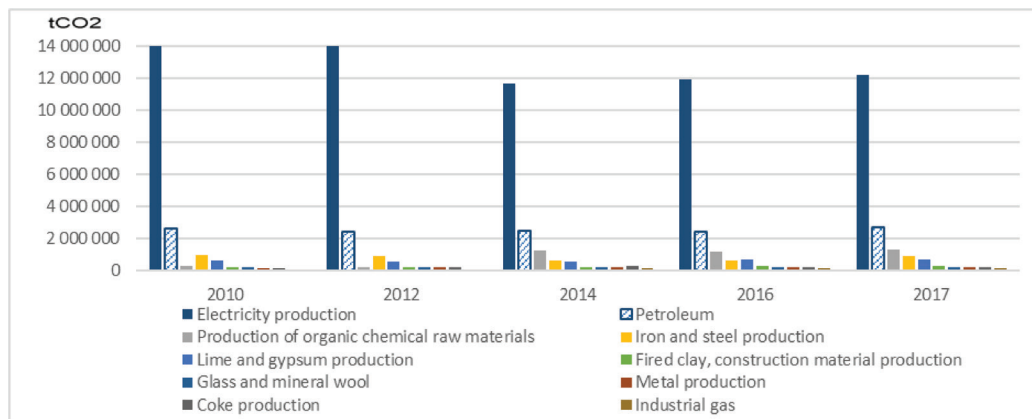
The values for the economic data were given by the reports of the enterprises, which we downloaded from the Opten database. The data was collected for all activities. The economic data of all businesses within the given scope of activity were downloaded for three business years (2016-2018). After „cleaning” the database, we performed an annual economic analysis of a total of 1,904 companies. The average values were calculated for the financial position, economic efficiency, and return per activity. These average values were compared with the average values of companies involved in emissions trading.

In our study, with transparency in mind, we focused on the economic situation of the enterprises of the ten activities with the highest emission value, considering that the enterprises included in the sample are responsible for more than 98 percent of the emissions.

Of the 1,904 companies included in our sample, 56 companies were involved in emissions trading.

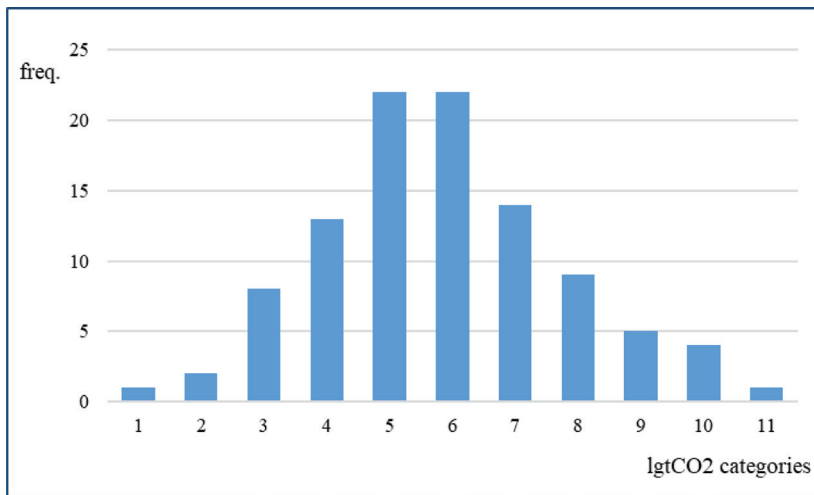
EMISSIONS OF PARTICIPANTS IN EMISSIONS TRADING, INVESTIGATION OF THE CONNECTION BETWEEN ECONOMIC INDICATORS

With the ten highest emission values – electricity; petroleum processing; production of organic chemical raw materials; iron



1. Figure: Those with the highest carbon dioxide emissions - carbon dioxide emissions of companies in the I circle of activities

Source: Own calculation based on the Deloitte database



2. Figure: Distribution of the logarithmic emissions of those with the highest emissions

Source: Own calculation based on the Deloitte database

and steel production; lime-gypsum production, burnt clay, construction material production, glass, and mineral wool production; metal fabrication; production of coke and industrial gas – we examined the economic indicators of the companies in the field of activity. The companies of the ten activities included in the study account for more than 98% of the total CO₂ emissions.

Based on the overview of the emission data and their organization by activity, it can be assumed that there is a significant difference between the carbon dioxide emissions of each activity, i.e. the activity itself influences the value of the emission.

The assumption was tested using the ANOVA model, which, from a methodological point of view, tests whether the scope

of activity, as a grouping criterion, significantly influences the emission value (quantitative criterion) in this case, i.e. whether there is a significant difference in the average emission values of each group between. The condition for using the method is the normal distribution of the data. The output follows a lognormal distribution, so the condition was met after the data was logarithmized.

The analysis of the data according to activities was supported by the relationship analysis carried out with the SPSS statistical program.

Based on the ANOVA output table of the conducted study, it can be established that the value of 3.036 of the test function F has a significance level of 0.003 = 0.3%. In a statistical sense, this means that at any level of significance greater than 0.3%, i.e. all commonly used, we must reject the assumption that the average values of each group are not significantly different from

each other. It clearly follows from all this, that *there is a significant difference between the average emissions of each activity, so the activity affects the amount of emissions.*

The different values for each activity are clearly visible in the Means plots of the SPSS ANOVA output.

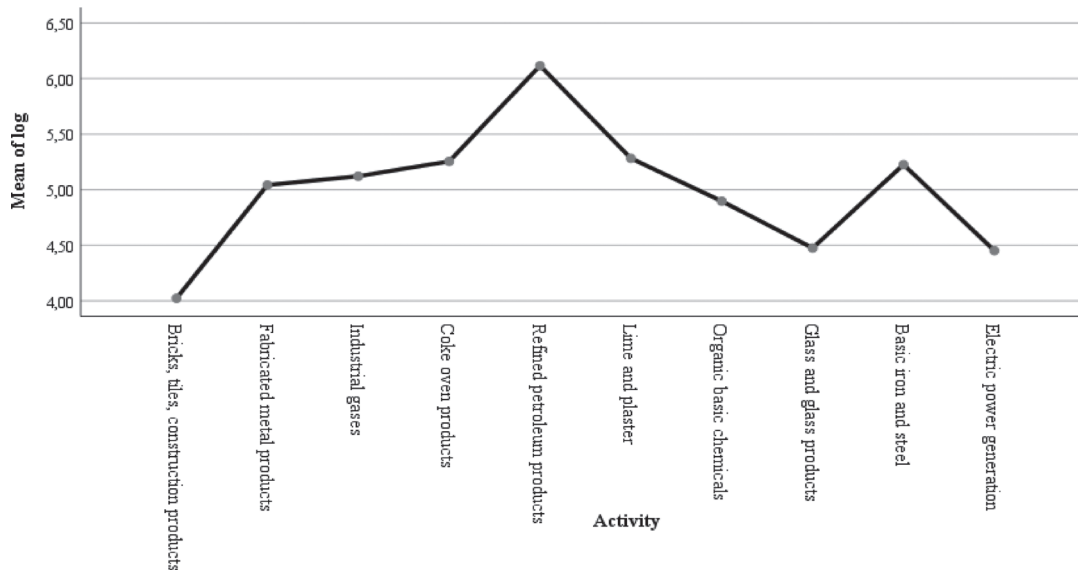
The annual publication of key performance indicators can greatly contribute to the transparency of the economic activity of enterprises. The indicators that can be easily compiled from the accounting reports - regarding the property, financial, and income situation - can provide an overview of the economic situation not only of the given company but also of a sector/activity.

To examine the hypotheses of our research, the average values for the economic indicators were calculated for each activity

1. table: Examination of the significance of those with the highest carbon dioxide emissions - according to their spheres of activity

	Descriptives							
	N	Mean	Std. Dev.	Std. Error	95% Conf. Interval for Mean		Min	Max
					Lower Bound	Upper Bound		
Bricks, tiles, construction products	15	4,02	0,54	0,14	3,72	4,32	2,92	4,83
Fabricated metal products	2	5,04	0,21	0,14	3,21	6,87	4,90	5,19
Industrial gases	1	5,12					5,12	5,12
Coke oven products	1	5,25					5,25	5,254
Refined petroleum products	2	6,12	0,14	0,10	4,87	7,36	6,02	6,21
Lime and plaster	3	5,28	0,33	0,19	4,46	6,103	5,07	5,66
Organic basic chemicals	4	4,90	1,19	0,59	3,00	6,79	3,21	6,00
Glass and glass products	5	4,47	0,53	0,24	3,81	5,14	3,64	5,05
Basic iron and steel	2	5,23	0,99	0,70	-3,72	14,17	4,52	5,93
Electric power generation	66	4,45	0,73	0,09	4,27	4,63	2,77	6,76
Total	101	4,51	0,77	0,08	4,35	4,66	2,77	6,76
ANOVA								
	Sum of Squares		df	Mean Square	F	Sig.		
Between Groups	13,85		9	1,54	3,04	0,003		
Within Groups	46,12		91	0,51				
Total	59,97		100					

Source: Own calculation based on the Deloitte database



3. Figure: Significance analysis of TOP ten emission activities

Source: Own calculation based on the Deloitte database

ty. These average values were compared with the average values of companies involved in emissions trading.

The Pearson correlation coefficient was used to examine the correlation between the indicators and the output. By logarithmizing the data - similarly to the ANOVA model - a normal distribution was achieved, i.e. size effects were filtered out.

We examined the companies based on their scope of activity, in addition to those involved in emissions trading, we also examined the characteristics of the scope of activity in general. In terms of

their company size, those obliged to pay the quota are medium and large companies. The size of the company is not a negligible factor, because it does not matter which type of accounting report it is obliged to prepare. After all, in the case of those who prepare a simplified annual report, they are not obliged to prepare a business report. Thus, there is a lot of important information that only the business report contains - among other things, we are thinking of measures taken for the sake of environmental sustainability and plans - was not made public.

2. table: Type of accounting reports - based on activities

DESIGNATION	Type of accounting reports			
	They prepare annual reports	Prepares simplified annual reports	Micro-farmers prepare simplified annual reports	Altogether
Electricity production	111	1118	323	1552
of which - involved in emissions trading	4	18	1	23
Petroleum processing	3	4	2	9
of which - involved in emissions trading	1			1
Production of organic chemical raw materials	23	64	11	98
of which - involved in emissions trading	4			4
Iron and steel production	8	16	4	28
of which - involved in emissions trading	2			2
Lime and gypsum production	4	87	7	98
of which - involved in emissions trading	3			3
Fired clay, construction material production	11	18	2	31
of which - involved in emissions trading	11	3		14
Glass and mineral wool	5	0	4	9
of which - involved in emissions trading	5			5
Metal production	8	4	0	12
of which - involved in emissions trading	2			2
Coke production	2	1	0	3
of which - involved in emissions trading	1			1
Industrial gas	5	3	0	8
of which - involved in emissions trading	1			1
ALTOGETHER	214	1336	354	1904
of which - involved in emissions trading	34	21	1	56

Source: Own calculation, based on the Opten database

In terms of company size, there are 1,904 enterprises 11 percent prepare an annual report, 70 percent prepare a simplified annual report, and 19 percent prepare a simplified annual report for micro-entrepreneurs.

Of the companies involved in emissions trading, 61 percent prepare annual reports (large companies), 38 percent prepare simplified annual reports, and 1 percent prepare simplified annual reports for micro-entrepreneurs.

In the case of those involved in emissions trading, due to the size of the company, the majority are those who prepare annual reports, but even so, 40 percent of the companies do not prepare the highest form of reporting.

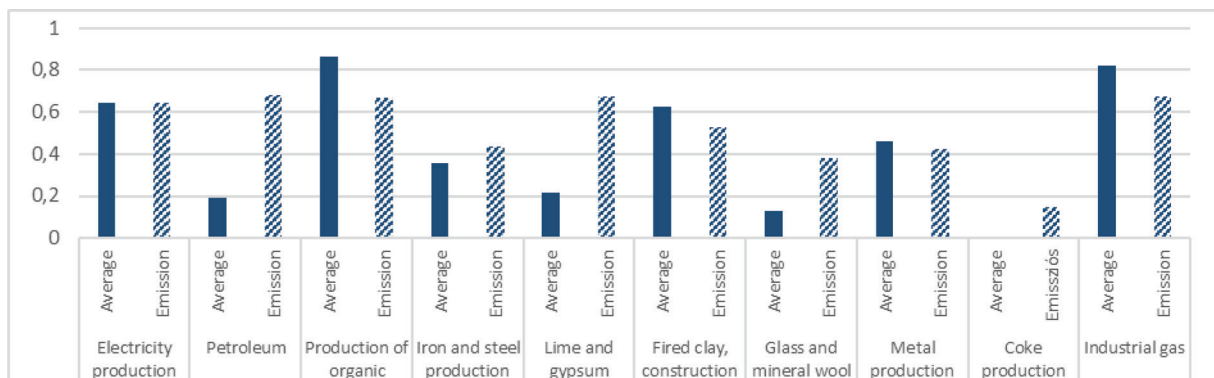
In the case of the largest CO₂ emitter, electricity production, we examined the economic indicators of 1,552 businesses at the sectoral level and compared them with electricity production companies participating in emissions trading. Among the companies (70) involved in the emission electricity trade, 23 companies account for more than 90 percent (92.42%) of the emission, so these companies were included in the sample, representing the given field of activity.

Beyond the numerical data, we also relied on the text evaluation of the supplemental annex to the report, and in some cases on the information published on the companies' websites. We only had limited access to the textual documentation, even though we consider the issue of corporate communication to be one of the cornerstones of environmental sustainability, which applies on the one hand to the *publication*

of information and the promotion of awareness, which means the assessment and management of environmental risks and effects. In the field of decision support and accounting there are many factors to be adapted to: in addition to increasing global competition and the ever-more rapid evolution of technology, a relatively new factor is social and governmental demand for sustainability (Demény, Musinszki, 2016). The guidelines of the corporate strategy and the question of environmental sustainability could only be followed in one case. *At the same time, the responsibility of the legislator should not be forgotten either, because with reasonable regulation, the process of supporting common objectives can be accelerated.*

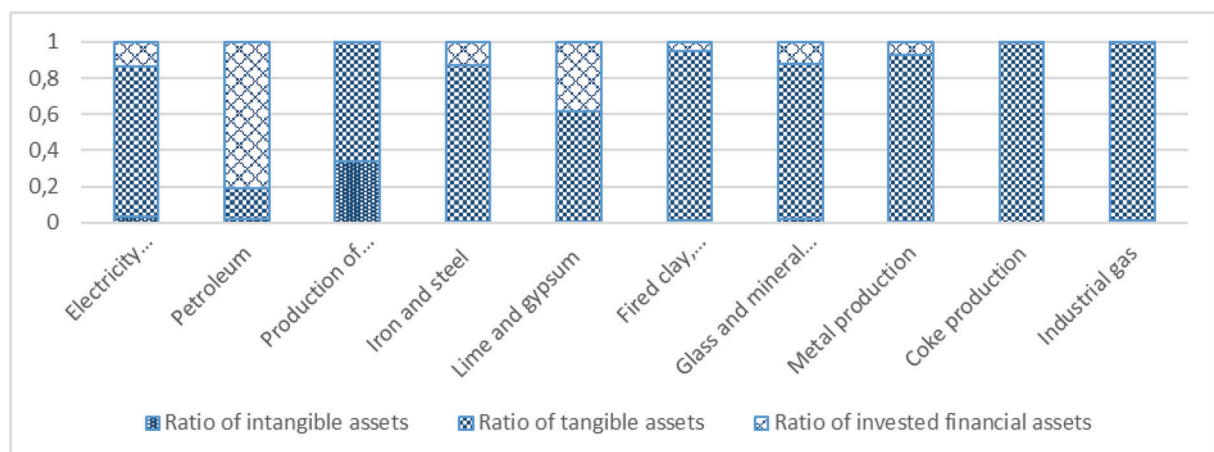
ECONOMIC INDICATORS - ASSET SITUATION EXAMINATION

There are numerous methods for gathering and storing data, but cost-benefit analysis must be used. Based on the gathered economic, social, and environmental data, the company's sustainability performance can be assessed, but different performance indicators and evaluation techniques are needed for this. For instance, the ratio of the carbon dioxide quota among the stocks, or how much was obtained for free from the state in relation to the overall stock value, may serve as such an indicator. The provision for meeting the emission quota and the provision for fulfilling environmental protection requirements are defined that will be investigated. Reserves for duties related to environmental protection, soil and groundwater remedi-



4. Figure: Ratio of fixed assets - average values of companies in the scope of activity and those participating in emissions trading

Source: Own calculation, based on the Opten database



5. Figure: Balance sheet items of fixed assets - average values of participants in emissions trading

Source: Own calculation, based on the Opten database

ation tasks, post-control procedures, etc., must be specified in the case of exceptional requirements (Mattiasich-Szokoli; Szóka, 2022).

BALANCE SHEET ITEMS OF FIXED ASSETS AND CURRENT ASSETS

The companies involved in emissions trading are the dominant companies in the sector, they have a more predictable and stable financial position, compared to smaller companies operating in the given field of activity.

Ratio of Fixed Assets

Within the fixed assets, the stock of tangible assets typically represents a very high value. On the one hand, this results from the value of the property and technical equipment. The high proportion of technical equipment is justified by the fact that they are engaged in production, so the tools that directly serve production are decisive about the scope of activities.

The financial situation of the electricity sector shows similar results at the entire sector level and when compared with the indicators of the companies involved in emissions trading in the sector. On the asset side, the proportion of fixed assets is high, 64 percent of its assets are fixed assets, which represents a very high value (90% and 80%) of tangible assets within the asset element. This shows that the investment is continuous, and the supply of technical equipment is ensured.

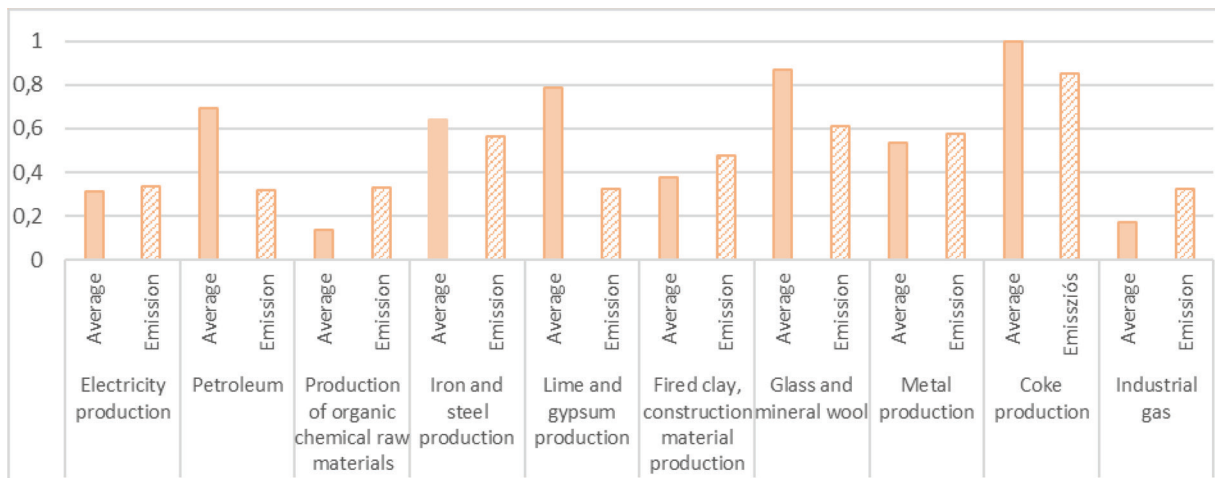
Crude oil processing, which has the second highest emission value, is an exception, since within the fixed assets, the proportion of invested financial assets is more than 80 percent. In the case of petroleum production, a company in a monopoly position determines the market. It has unique assets - the company has been around for decades, producing extra profit - its invested financial assets indicate its place and weight in the market.

In the case of lime and gypsum production, in the case of those involved in emission trading, in addition to tangible assets, invested financial assets represent a very significant proportion (38%). In emissions trading, in addition to the two smaller companies, there is also a company with a decisive influence on the market.

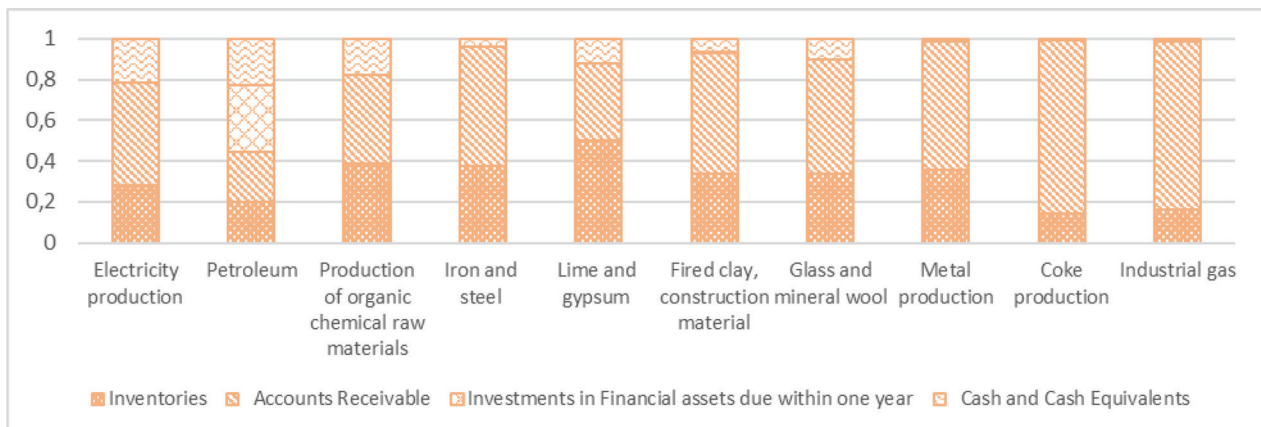
Ratio of Current Assets

The stock of current assets also develops similarly at the sector and emission level. What is interesting is that, except for petroleum processing, the financial investments of businesses represent a modest amount. This is also true for their short-term investments beyond the year and within the year. They typically do not have short-term (within a year) securities investments, that is, they keep their free funds in a bank account (cash).

The scope of activity determines the ratio of assets, typically the ratio of current assets is smaller. When examining the financial situation of the company, it was already mentioned that we are faced with extremely different values for two activities, the



6. Figure: Ratio of current assets - average values of enterprises in the scope of activity and those participating in emissions trading



7. Figure: Balance sheet items of current assets - average values of participants in emissions trading

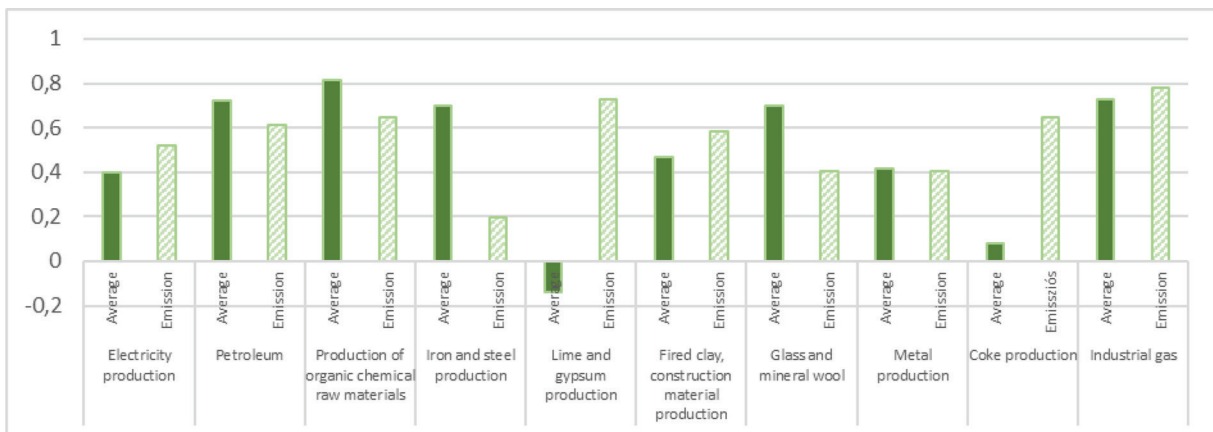
ratio of current assets is very high in the case of glass and mineral wool (87% and 62%) and coke production (99% and 85%). In addition, iron and steel production (64% and 56%) as well as metal production (54% and 58%) have specific characteristics.

Within the stock of current assets, in addition to the ratio of receivables, inventories were the determining factors. The high ratio of current assets is also due to the high value of receivables. In the case of Coke production, the ratio of current assets is very high, and this ratio change is not very fortunate, especially considering that the ratio of receivables is also high (60% and 85%). Looking back over the years, the balance sheet item related to the sale of goods (receivables from the delivery of goods and services) is characterized by a high proportion of receivables. These receivables are related to the companies in which they are the owners, and they have claims against those who are connected and have a significant ownership share relationship. The case is not unique, we find similar data in the reports of previous years. It is thought-provoking that their products are sold to companies what are in an ownership relationship, and the financial settlement will not or has not taken place by December 31. It should not be overlooked that the balance sheet data reflect the financial situation on December 31st, the receivables are credited in the following business year. We are talking about a relatively narrow market. We are talking about a relatively narrow market, in the case of coke production one large company out of three companies is involved in

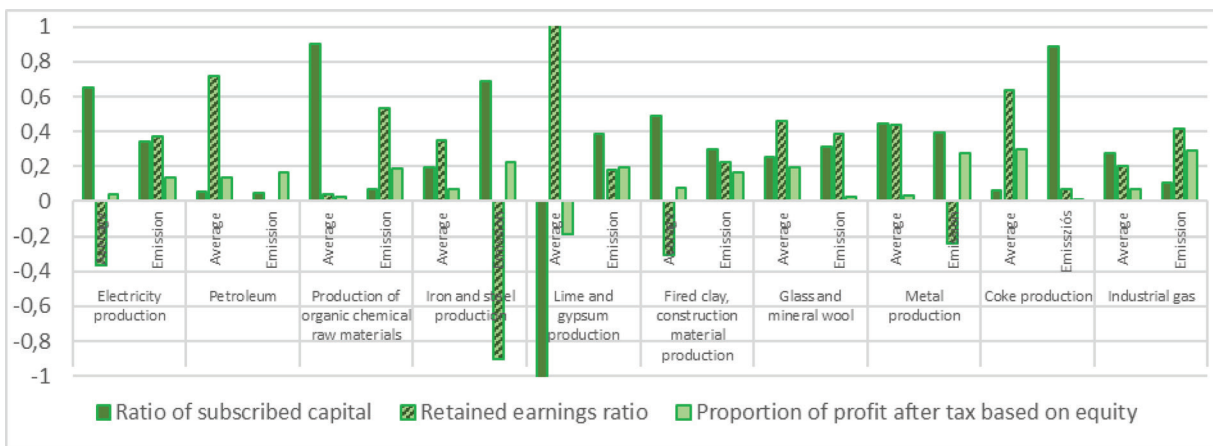
emissions trading, but in this case the principle of continuing the business may be violated. It may be a cause for concern that the consolidated accounts of its parent company were not accepted by the highest decision-making body. The company received a restrictive auditor's report (for its 2018 business year), partly due to the disputed accounting (statement) of receivables, and partly due to the lack of provisioning.

The same group of companies is also interested in iron and steel production, its activities are dominant in the market. A group of companies in a monopoly position, with serious foreign interests, which has significant operating and financing relations with an international group and its subsidiaries and affiliated companies, but its stability and continued operation depends on the financial and operational support of international companies (Source: Independent Auditors' Report).

In the case of companies involved in emissions trading, there is typically a related and significant ownership share-relationship with foreign interests. For the movement in the direction of environmental sustainability to take place, a uniform commitment within each group of companies is necessary. Beyond CO2 emissions, preventive measures taken to protect the environment – soil pollution, and other environmental damage – would play a key role. The question of the coming years is to what extent this can be enforced with legal regulations, and on the other hand, to what extent financial



8. Figure: Equity ratio (Capital availability) - average values of companies in the scope of activity and those participating in emissions trading



9. Figure: Ratio of key items of own capital (Subscribed capital, Earnings reserve, Taxed profit) - average values of activities and participants in emissions trading

Source: Own calculation, based on the Opten database

interests, extra profit, and short-term interests dominate over social values. We formulated our findings (opinion) exclusively based on the information obtained from the accounting reports, however, it is clear that promoting the balance of interests and values is key.

ANALYSIS OF EQUITY AND LIABILITIES

Equity ratio

Analyzing the equity and liabilities of the enterprises, it can generally be said that the share of their resources dominates, they are not in debt. The exception to this is for those participating in emissions trading, *in addition to iron and steel production, metal production has an exceptionally high proportion of foreign sources* in these activities.

Source: Own calculation, based on the Opten database

Special attention is paid to the examination of equity capital, the capital adequacy indicator shows the ratio of equity capital to resources. On the other hand, priority should be given to the share of the subscribed capital, as well as to both the retained earnings and the capital-proportionate taxed profit, which provides information on the success of the enterprise.

Stability is characteristic when looking at the composition of the equity capital, apart from the three closely related activities – iron and steel production, metal production, and coke production. This is also shown by the composition of equity capital. Among those involved in emissions trade, in addition to iron and steel production, metal production, while in the case of those not involved in emission sales, electricity production, and fired clay, in the case of construction material production, the ratio of profit reserves is negative, i.e., they are operating at a loss in the long term.

Within the activities, mention should be made of *petroleum processing*. A monopoly company with huge assets dominates the market, its annual after-tax profit is almost four times the subscribed capital.

Electricity production also deserves special mention. With one exception, the 23 companies included in the sample and involved in the issue are characterized by *strong capital and positive retained earnings*. At the same time, it should be mentioned that in the case of equity indicators, the standard deviation is very large.

In the case of electricity production, we would like to highlight the company with the largest assets - it accounted for almost half of emissions (47.11%). It had successful economic indicators, however, it was liquidated and bought by the Hungarian state, to

transform the structure of energy production. *With more environmentally sustainable economic goals in mind*, a solar park is created during the recultivation of lignite mining areas. The strategic plan includes the creation of plant units suitable for waste incineration and the installation of a 500 MW gas turbine block.

Provisioning Ratio

On the source side of equity and liabilities, the creation of provisions carries significant information from the point of view of our study.

The proportion of provisions for those involved in emissions trading shows a slightly higher value. A correlation between the *ratio of provisions and emission* can be observed.

The Pearson correlation coefficient was used to examine the correlation between the indicators and the output. By logarithmizing the data - similarly to the ANOVA model - a normal distribution was achieved, i.e. size effects were filtered out. Within the provisions, the value of the provision showing expected liabilities is dominant.

In the case of enterprises involved in emissions trading, *provision for environmental protection obligations is mandatory*. The provision and the amount of its use must be presented in detail according to legal titles in the supplementary annex.

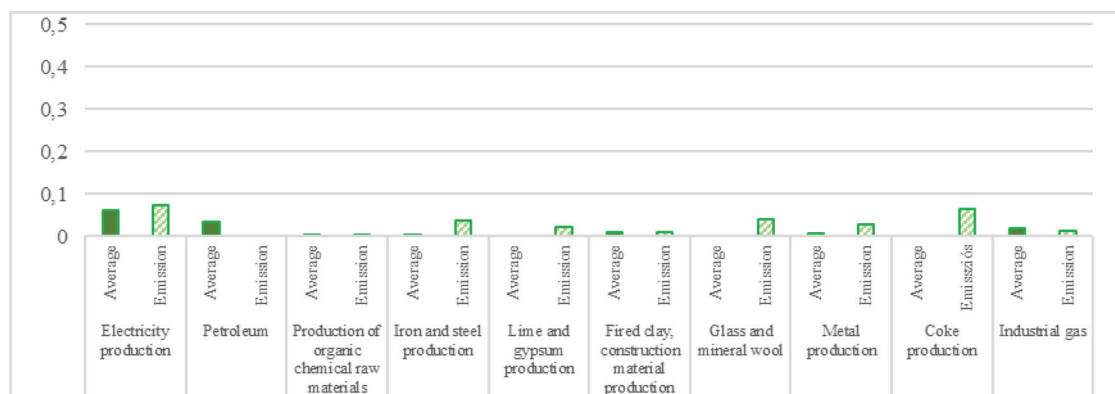
In the supplementary annex, it is necessary to describe the tangible assets that directly serve the protection of the environment, the environmental protection obligations, the costs incurred in connection with the environmental protection, and the amount of provisions formed to cover future costs. Quantitative and value data of the opening and closing stock of substances harmful to the environment, the increase and decrease in the current year.

According to Hungarian regulations, the business report must present the environmental protection policy related to the forma-

3. table: Examination of the correlation between the proportion of provisions and the emission

Index numbers	Correlation and Significance	Pearson's correlation index value
The ratio of provisions to expected liabilities	Pearson Correlation	0.272
	Sig. (2-tailed)	0.046

Source: Own calculation, based on the Opten database, with the SPSS program



10. Figure: Proportion of provisions - average values of companies in the scope of activity and those participating in emissions trading

Source: Own calculation, based on the Opten database

tion of provisions, their system of instruments, the measures closely related to this, and their effects and results. The environmental protection developments, the projects that have already been implemented and those expected to be implemented in the future, as well as the related financing opportunities, must be presented separately. Relatively little substantive information was typically available to us regarding the creation of provisions - in the publicly downloadable supplementary annex. In the case of those who are not required to be audited, only the numerical data is typically presented in the additional annex. We encountered good practice mainly in the case of those obliged to audit.

Liabilities Ratio

The liabilities ratio indicator provides information on the weight of external sources.

Within liabilities, short-term liabilities represent a higher proportion, and this ratio shift is significant in the case of issuing companies. The higher ratio of short-term liabilities is a burden that could not be reported before the energy crisis, as evidenced by the evolution of leverage and the net debt ratio. *In addition to iron and steel production*, in the case of metal production and coke production, the high values of liabilities arise from the relationship between the company in a monopoly position and its subsidiaries.

INDICATORS OF RETURN

In the international literature, the indicators most often used to analyze the effectiveness of farming are the return indicators.

Return on Assets

Return on assets (ROA) answers the income-generating capacity of assets.

In the case of companies involved in emissions trading, the values are more favorable.

The return on assets (ROA) shows a difference of 1.4% in the case of companies involved in the issue and companies not involved in the issue.

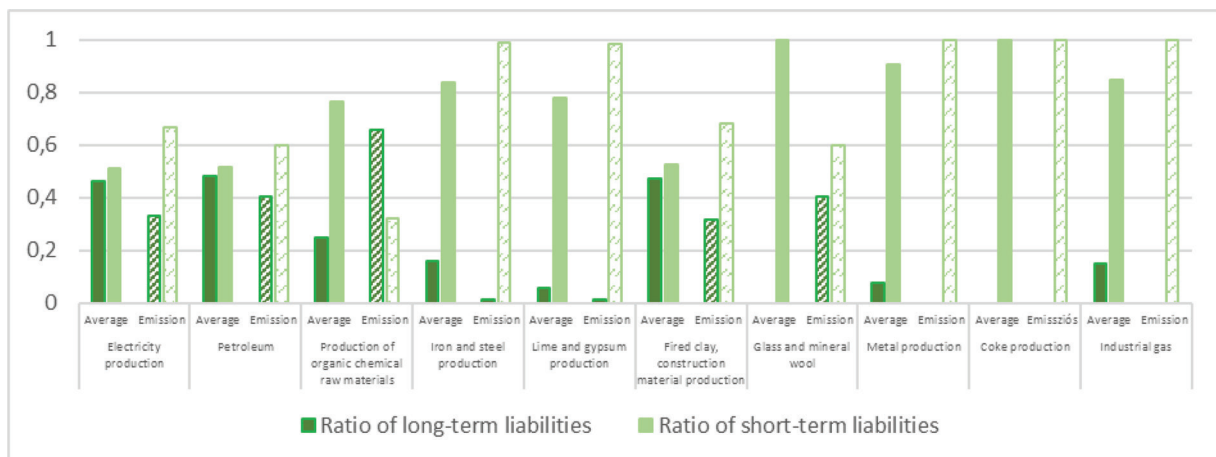
RETURN ON INVESTMENT

The return on investment (ROI) shows how much of the assets are returned from the current year's after-tax profit.

A statistically significant difference (1.6%) can be detected in the case of those involved in emissions trading and those not involved in emissions. Businesses involved in emission trading typically have a higher return on their investments.

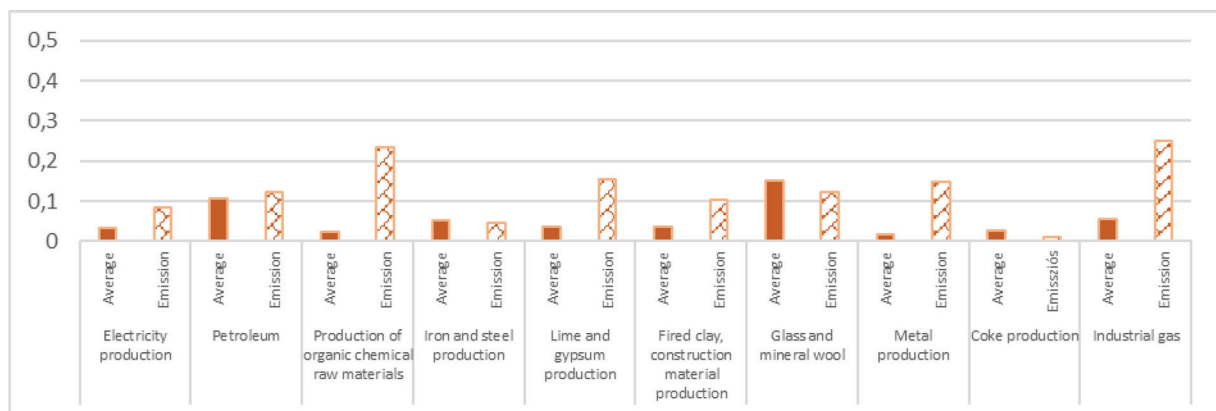
PROFIT PROPORTIONAL TO OWN CAPITAL

Return on equity (ROE) shows the company's return on capital.



11. Figure: Liabilities ratio - average values of businesses in the scope of activity and those participating in emissions trading

Source: Own calculation, based on the Opten database



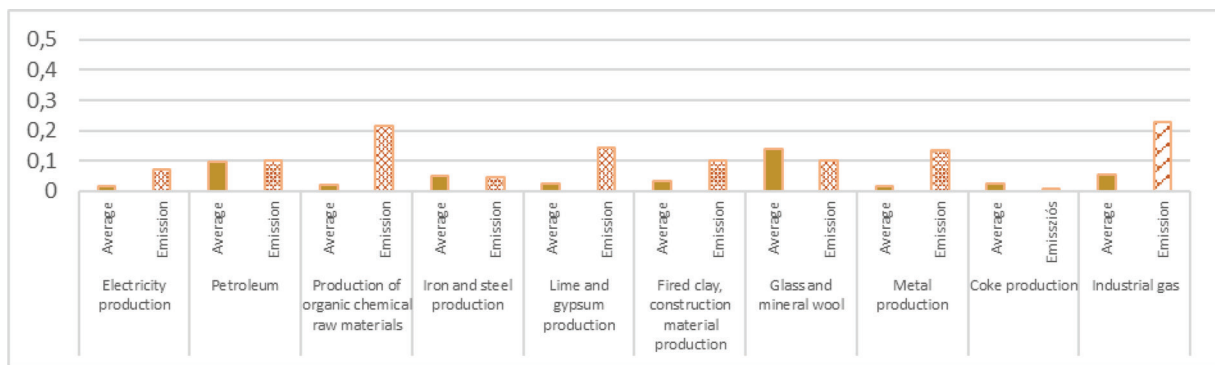
12. Figure: Return on assets (ROA) – average values of businesses in the scope of activity and those participating in emissions trading

Source: Own calculation, based on the Opten database

4. table: Examination of the relationship between the asset-proportional result and emissions

Descriptives								
ROA					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
0	10	0,0539	0,0428	0,0135	0,0233	0,0845	0,0172	0,1511
1	10	0,1278	0,0744	0,0235	0,0745	0,1810	0,0111	0,2496
Total	20	0,0908	0,0702	0,0157	0,0580	0,1237	0,0111	0,2496

ANOVA					
ROA					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0,0272	1	0,0272	7,3920	0,014
Within Groups	0,0663	18	0,0037		
Total	0,0936	19			

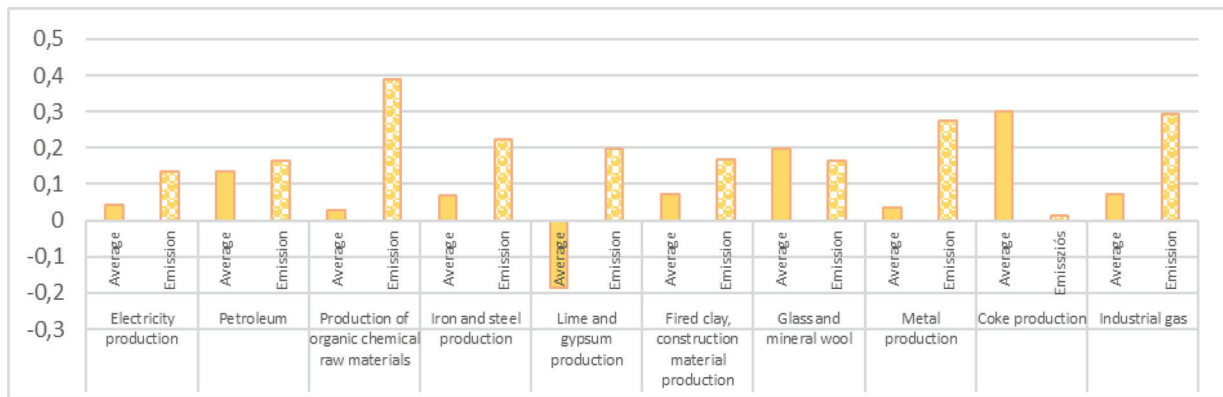
**13. Figure: Return on Investment (ROI) – average values of companies in the scope of activity and those participating in emissions trading**

Source: Own calculation, based on the Opten database

5. table: Investigating the relationship between investment returns and emission

Descriptives								
ROI					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
0	10	0,0474	0,0400	0,0126	0,0188	0,0760	0,0150	0,1373
1	10	0,1146	0,0694	0,0219	0,0649	0,1642	0,0084	0,2280
Total	20	0,0810	0,0650	0,0145	0,0506	0,1114	0,0084	0,2280

ANOVA					
ROI					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0,0226	1	0,0226	7,0372	0,016
Within Groups	0,0577	18	0,0032		
Total	0,0803	19			



14. Figure: Return on equity (ROE)) – average values of companies in the scope of activity and those participating in emissions trading

Source: Own calculation, based on the Opten database

6. table: Investigating the relationship between profitability and emission

Descriptives								
ROE					95% Confidence Interval for Mean			
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
0	10	0,0765	0,1256	0,0397	-0,0134	0,1664	-0,1865	0,2994
1	10	0,2028	0,1022	0,0323	0,1296	0,2759	0,0130	0,3907
Total	20	0,1396	0,1289	0,0288	0,0793	0,2000	-0,1865	0,3907

ANOVA					
ROE					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0,0797	1	0,0797	6,0763	0,024
Within Groups	0,2361	18	0,0131		
Total	0,3158	19			

The proportional return on equity (ROE) shows a difference at a significance level of 2.4% between the two investigated groups of companies.

From the SPSS output tables of all three studies, it can be seen that the given indicator is significantly different in the case of companies involved in emissions and those not involved. The profitability indicators proved that those involved in the issue are conducting effective management.

EXAMINATION OF HYPOTHESES

H1: A significant difference can be assumed between the carbon dioxide emissions of individual activities. The range of activities affects the amount of emissions, so depending on the type of activity a given company performs and the sector it belongs to, its emissions vary.

The companies involved in emissions trading were grouped according to their scope of activity. The largest emitter is the electricity sector, followed by petroleum processing and organic chemical production. We tested with a statistical test (ANOVA model) whether the activity, as a grouping criterion, is significantly influenced by CO₂ emissions. The value of the test function F of 3.036 (Sig. 0.003) had a significance level of 0.3%, so we had to reject the assumption that the average values of each group are

not significantly different from each other. From all this, it follows that there is a significant difference between the average emissions of each activity, that is, the activity affects the amount of emission. We consider the hypothesis accepted.

H2: No significant difference can be assumed between the financial situation of companies participating in emissions trading - in terms of the ratio of fixed assets and current assets - and the financial situation of companies that are not obliged to pay quotas for the given scope of activity. The scope of the activity itself presupposes a specific set of assets, keeping economies of scale in mind. Thus, within assets, a higher proportion of fixed assets, including fixed assets (technical equipment), must be expected.

Within the invested ranges, the stock of tangible assets typically represents a very high value. On the one hand, this results from the value of the property and technical equipment. The high proportion of technical equipment is justified by the fact that they are engaged in productive activities, so the tools that directly serve production are decisive about the scope of activities.

Comparing the financial situation with the indicators of those performing the given activity (without emissions) and the companies involved in emissions trading showed different results. On the asset

side, those involved in *emission trading* are typically dominated by fixed assets, their value is 65 percent.

Examining the assets of the enterprises, we see significantly different values for two activities, the ratio of fixed assets is very low - glass and mineral wool (13% and 37%), and coke production (1% and 15%) - because the ratio of current assets dominates. In addition, iron and steel production (35% and 43%) as well as metal production (46% and 42%), have specific characteristics.

We reject the hypothesis because there is a significant difference in the asset portfolio by activity and within the activity. Of the 10 activities examined, permanent investments dominated in 4 cases (Electricity; Organic chemicals; Burnt clay, construction material production; Industrial gas), in the case of 4 activities the ratio of current assets was higher (Iron and steel production; Glass and mineral wool; Metal production; Coke production), while the asset portfolio of 2 activity areas was determined by whether or not they were involved in emissions trading (Petroleum production and Lime and gypsum production).

H3: The proportion of provisioning is higher for those participating in emissions trading, as their expected obligations for the future due to quota payments are higher compared to the value of enterprises operating in the given sector.

In the case of enterprises involved in emissions trading, provision for environmental protection obligations is mandatory. In the case of crude oil production, the company involved in emissions trading did not create provisions. At the same time, in the case of companies belonging to the given field of activity (petroleum production), provision was made. In the case of metal production, the situation is reversed, provisions were made for those involved in emissions trading, while not for those not involved in emissions. Within the provisions, the value of the provision showing expected liabilities was dominant. The companies' business reports were not available to us, we could only rely on the balance sheet data of the report and the supplementary annex.

The issue of publicity raises a serious dilemma, especially in the case of companies involved in emissions trading. Although the accounting reports are public, the presentation of provisions is regulated by Act C of 2000, however, it is typical that companies do not provide a detailed description. In the case of one of the companies involved in emissions trading in our sample (56 companies), we encountered a restrictive auditor clause. The limited clause was issued due to, on the one hand, the failure to create a provision, and, on the other hand, the disputed accounting of claims.

About the examination of our hypothesis, it can be established that the rate of provisioning is typically higher for those participating in emissions trading. The correlation between the ratio of provisioning and output was confirmed by Pearson's correlation coefficient. We consider the hypothesis accepted.

H4: The value of the asset-to-asset performance indicator is higher in the case of enterprises participating in emissions trading, compared to the value of enterprises belonging to the given activity:

- on the one hand, this is due to economies of scale,
- on the other hand, in the case of certain activities, the market is limited, so even though both the purchased quota and the quota unit have increased, they can enforce it when selling the service (product) and in pricing.

The return on assets (ROA) shows a difference at a 1.4% significance level in the case of companies involved in the issue and companies not involved in the issue.

This also means that it was statistically confirmed that the income-generating capacity of the assets was higher among those affected by the issue.

In terms of economic efficiency indicators, those involved in emissions trading achieved a better performance as a whole. The magnitude of their effectiveness was different depending on which field of activity they belonged to. We consider the hypothesis accepted.

H5: The return on investment and the values of the equity-proportional result for those involved in emissions trading differ significantly from those not involved in emissions trading within the given scope of activity. The profitability indicators have developed favorably in recent years, however, the energy crisis is one of the most seriously affecting the players in the sector. Moving towards energy-saving solutions and new alternative options, in addition to reducing emissions, is one of the cornerstones of their survival and future operation.

In the case of profitability indicators, the given indicator is significantly different for companies involved in the issue and those not involved. Those involved in emissions trading also achieved better results in terms of return on investment (ROI) and proportional return on equity (ROE). In the case of all three profitability indicators, the difference between the two investigated groups of companies was already significant at 3%. The profitability indicators also confirmed that within a given scope of activities, companies involved in emissions must also look for new technological opportunities that involve less energy consumption, which also contribute to the shift in the direction of sustainability. These solutions can lead to the reduction of both energy and quota costs. We consider the hypothesis accepted.

CONCLUSIONS

In our study, we focused on the economic situation (assets, finances, income) of the enterprises of the ten activities with the highest emission value. In addition to the sectoral characteristics, we distinguished between those companies obliged to pay quotas and those not involved in emissions trading.

Our research results proved that there is a significant difference not only in the case of individual activities but also that the businesses within the range of activities have different characteristics, depending on whether they are involved in emissions trading or not.

If risk and scenario analysis are added to conventional calculations, compliance with sustainability can be confirmed. To put it another way, issues that have an impact (outcome) on the environment must also be addressed (Szóka, 2022a).

The scope of the company's activities affects the amount of emissions, thus the quota payment obligation. As a result of the obligation to pay quotas, the provisioning rate is higher among those affected by emissions trading. Although those involved in emissions trading are burdened with additional obligations, their return indicators are favorable - return on investment, return on equity - which provides the opportunity to implement innovative investments that lead to a reduction in emissions, contributing to environmental sustainability. The companies involved in emissions trading are typically large companies,

which are the dominant players in the given market, so their role is significant from an economic, environmental, and social point of view.

The Change Agent role of management and controllers continues to strengthen; the large amount of data that needs to be managed gives new tasks. The reports are expanded with these, and Big Data, supplemented by Artificial Intelligence, acquires even greater importance (Szóka, 2018).

This study was produced in cooperation between and financed by the Magyar Nemzeti Bank and Budapest University of Technology and Economics, in the Green Finance, Green Economy Project.

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