Synergy Effects in the Mergers of Collieries

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Abstract
Purpose – The article focuses on measurement and assessment of the direction and scale of synergy effects in the mergers of collieries in the Polish hard coal mining.
Design/methodology/approach – The research included 4 mergers of collieries conducted in years 2006-2011. The measurement of synergy effects was made by subtraction calculation between the total and base effect, according to the definition of synergy effects.
Findings – Positive synergy effects were achieved in case of two mergers. These were the mergers of collieries in a good or average financial condition and with a favorable conditions for extraction. The effects of merger in one of them were additionally highlighted by the improvement on the market of hard coal.
Practical implications – The research conducted allows to assess the mergers realized in the Polish hard coal mining in the frames of industry restructuring. They also constitute a basis for indicating directions of further industrial restructuring using the mergers of collieries.
Social implications – In the article there are also issues analyzed concerning employment in the collieries merged. The mergers of mining enterprises aim to mitigate the scale and results of employment restructuring in the Polish mining.
Originality/value – The identification of synergy effects in the Polish hard coal mining has not been analyzed so far. The role of such research is currently increasing due to the economic growth on the market of traditional resources and due to the necessity of competitiveness improvement of Polish coal on the global markets.
Keywords – synergy, synergy effects, mergers of collieries, Polish hard coal mining.
Article type – Research paper

1. Introduction

The phenomenon of synergy always occurs when it comes to a junction of different elements and to their cooperation. However, before synergy appeared in the area of economy and management it was defined and used in many other sciences. On such basis it may be concluded that the law of synergy is a universal law of nature present everywhere (Kordus, 1978).

In the hereby article the phenomenon of synergy is considered in the context of mergers of collieries which concerned the two biggest Polish mining enterprises. The basic objective of the article is to assess the synergy effects obtained in the mergers of hard coal mines (collieries) realized in the Polish mining in the years 2006-2011. On the grounds of the assessment conducted there was also an attempt made to identify the internal and external factors determining the success of mergers in the Polish hard coal mining.

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2. Literature review

2.1. Synergy in economy and management

When forming the synergy definition in the area of economic sciences the earlier interdisciplinary interpretations were mostly used. In the first place it was emphasized that synergy in economy, similarly to other sciences, is connected with cooperation. It is a dynamic act occurring in time. Therefore, it accompanies many actions taken by economic subjects (Kieżun, 1980; Schumpeter, 1960; Blaik, 1989; Misiąg, 1957; Komai, 1977; Altkom and Strużycki, 1984).

Along with the development of economic sciences the interest in the phenomenon of synergy was rising (Moustaghfir, 2012). Synergy was not only considered in the context of work or production but there was an attempt made to analyze this phenomenon in a holistic approach – as a result of total economic activity (Zhao, 2005). Such approach was connected with a situation in which a visible, additional effect of actions appeared in the course of conducting activity (Kotrabiński, 1975). Such effect was connected with the process of resources management. Indeed, there is a constant recombination of resources in the economic subjects and therefore, it may be expected that such processes will be accompanied by synergy and its effects. Consequently, synergy in economy is perceived as phenomenon accompanying the endless process of resources recombination. It is generally defined as "phenomenon of mutual strengthening, amplification of two or more elements closely related (economic factors, production factors, ways of conducting economic activity etc.) cooperating in the same or similar time and leading to the occurrence of combined effects" (Suszyński, 2003). All in all, it is connected with the processes of cooperation taking place constantly and it provides some particular effects in the system of interacting elements.

Along with the progress in economy the sources of synergy were searched in the complex processes between the economic subjects (Chatterjee, 1986). Therefore, these days synergy is most often perceived in the context of businesses cooperation (Gaggiotti, 2012). In this way there is the resources recombination appearing in a big scale and accordingly, the expectations about synergy effects are higher (Hitt, 2009).

The phenomenon of synergy is also present in the managerial sciences (Bojnec and Drakulić, 2012). T. Kotarbiński, in his praxeologic works concludes that „synergy occurs when the performing subject gains more due to a particular way of functioning if it works within the assistance of other performing subject" (Kieżun, 1980). Consequently, he emphasizes such additional effect which may be realized thanks to synergy (Juga, 1996). He also puts pressure on the necessity of cooperation in order to generate synergy (Kumar and Bansal, 2008). In turn, in the system theory synergy means two cooperating subsystems producing more than the total sum of their production would equal if they were working separately (Griffin, 2002). Also in this case synergy effect is highlighted which was achieved due to the mutual work of connected subsystems (Fluck and Lynch, 1999). In management the phenomenon of synergy is embedded in such combination of two or more elements with each other which creates a different subject from them, however, its interaction provides a higher result of some kind than the sum of results caused by each element separately (Harris, 2004). Sometimes the definition of synergy is also used in the meaning of cooperation of any elements in the same direction,

nevertheless, this direction may be understood in an intuitional way and exemplification starts from the statement that synergy is a resultant force created as a sum of forces which do not mitigate or liquidate but amplify each other (Piekarz, 1993).

In management there is a strong connection of synergy and corporate strategy emphasized as well (Rowley, 2002). In frames of the basic components of corporate strategy synergy is understood as the ability of using the current business possibilities for expansion associated especially with entering new markets (Ansoff, 1987). Close connections of synergy with corporate strategy are highlighted in the statement that "the essence of strategy is mostly meant by searching for synergy effect as strategy (...) is not just about achieving a maximal effectiveness of particular factors but about finding such a combination which has the highest impact force on the chosen elements of external environment" (Misiąg, 1977). Seeking such synergy effect in the company should be conducted in the way of including the activities linked to innovativeness into the corporate strategy which would translate into resources recombination (Pun, 2003). In practice it means, for example, introducing a new product, new forms and methods of economic activity or also a new market entrance (Suszyński, 2003).

The term "synergy" is also embedded in the research area of process management (Pun, 2004). The process is connected with action (Stoner and Wankel, 2001). It means a course of ordered tasks leading to the creation of a certain effect (Kaplan and Norton, 2001). In the process each task adds new value to the effect of the previous task (Rummler and Branche, 2000). Consequently, in the process there is a connection of elements – tasks as well as their cooperation (Goold, M. and Campbell, 2000). There is also a particular effect created (Pool, 2011). The phenomenon of synergy is present in different processes taking place in businesses (Krawczyk, 2011). It is related to the process of businesses' cooperation too where one leads to realizing synergy perceived as a situation in which the entirety is bigger than the sum of its parts (Kieżun, 1980; Brigham, 1996).

Managers, thanks to businesses' cooperation, want to achieve better results than it would equal from an algebraic summary of previously achieved effects realized by each business separately (Crompton, 1990). In businesses' cooperation synergy most often appears as: possibility of realization of mutual investment undertaking exceeding the funds of businesses performing independently (Larsson and Finkelstein, 1999), opportunity to implement modern technical and technological solutions and rationalization of production factors usage due to the savings on their consumption and more efficient recombination of resources (Logan, 1995).

2.2. Synergy effects

In relation to the necessity of tying synergy to its effects, highlighted in the previous points, the following aspects should be considered:

- positive synergy,
- negative synergy (dissynergy),
- asynergy.

Such division means that the phenomenon of synergy itself will be interpreted as a cooperation of elements with different effects (Ensign, 1998). In a general context of

considerations, the cooperation means a combination of separate elements and creating a bond between them. The effect of such cooperation will decide about classifying synergy to one of the options listed above (Griffin, 2002).

Table 2: Interpretation and classification of synergy effects

Types of effects	Interpretation
Positive effects (positive synergy)	The cooperation of element A with element B causes a total effect when the following conditions are met: 1) the effect obtained is different in terms of subject (in terms of quantity and quality) from the base effect, 2) the effect achieved is evaluated as higher than the base effect.
Negative effects (negative synergy)	The cooperation of element A with element B causes a total effect when the following conditions are met: 1) the effect achieved is different in terms of subject (in terms of quality and quality) from the base effect, 2) the effect achieved is evaluated as lower than the base effect (Mahajan, V. and Wind, 1988).
Zero effects (asynergy)	The cooperation of element A with element B causes a total effect when the following conditions are met: 1) the effect achieved is different in terms of subject (in terms of quality and quality) from the base effect, 2) the effect achieved is evaluated as an identical one as the base effect.

Source: own work based on H. Piekarz,: Piekarz, H. (1993), „Efekt organizacyjny jako kryterium oceny systemu wytwórczego", Monografie, Wydawnictwo Akademii Ekonomicznej in Kraków, Kraków, pp. 11-12.

The interpretations presented in table 2 determine in what circumstances, as a result of cooperation of element A with element B, there will be negative synergy, positive synergy or asynergy achieved (Rawski, 2002), that is, when the system A+B will generate negative, positive or zero synergy effects. The general formula does not change. The synergy effect is the difference between the total effect and the base effect, written in the following form (Krzyżanowski, 1992):

$$ef = ef(A+B) - (ef\ (A) + ef\ (B))$$

where:

ef_{syn} – synergy effect,

$ef(A+B)$ – total (combined) effect realized as a result of cooperation of element A with element B,

$ef(A)+ef(B)$ – base effect, realized by independent (non-cooperating) elements A and B.

The minuend in the formula above is the total effect that was created as a result of cooperation while the subtrahend is the base effect determined by the sum of boundary elements A and B (Vizjak, 1994). The values of both components determine the sign and the final value of the synergy effect, which means it can be negative, positive or it can be equal to zero. Positive synergy occurs when the synergy effect is greater than zero, negative synergy occurs when the synergy effect is lower than zero and finally, asynergy occurs when the synergy effect is equal to zero.

synergy (+) $\Leftrightarrow ef_{syn} > 0$
synergy (–) $\Leftrightarrow ef_{syn} < 0$
asynergy (0) $\Leftrightarrow ef_{syn} = 0$

If the synergy effect could be different, in terms of value as well as in terms of sign, that means that the synergy releases some additional features in the combined elements that do not occur between independent elements. Those additional features may 'weaken' the newly-created system, and then a negative synergy effect occurs or they may 'strengthen' it and then a positive synergy effect occurs (Goold and Campbell, 1999). They may also be neutral or cancelling each other and then the synergy effect equals zero (Piekarz, 1993).

3. Research methodology

3.1. Research procedure

The research period covered the years 2006-2001. The research was conducted on the Polish hard coal mining industry, in which there are three large mining enterprises owned by the state and one private colliery. In the year 2006 in the structures of national enterprises there were 26 collieries operating. In two of them in the analyzed period a merger of collieries occurred. These mergers were one of the elements of restructuring process of the hard coal mining industry in Poland. As a part of the mergers conducted 8 collieries were combined. As a result of this, in the last year of analysis, in the Polish hard coal mining industry there were 22 collieries operating without taking into consideration the private colliery.

In the further part of the analysis all of the mergers conducted and their synergy effects were analyzed. The identification of synergy effects was based on the determination of base effect achieved by the examined collieries before the merger and on analyzing the total effects in the years following the merger.

3.2. The measurement of synergy effects

In the measurement of synergy effects, which are the difference between the total effect and the sum of base effects, 2 indicators were used: sales profitability (P) and work efficiency (E). The first one is the ratio of net profit to the income on sales of products, goods and materials (Rozemeijer, 2000). The second one is the ratio of employment to mining production. Both indicators were calculated on the basis of annual periods.

The base effect was calculated for the period preceding the merger of collieries. It included the weighted average of sales profitability and the work efficiency of integrated collieries. The weights were determined according to the mining production of particular mines. The sales profitability and the work efficiency obtained by the merged collieries in the years following the merger constitute the total effect. As a result the synergy effects were implemented by the change of sales profitability:

$$efP_{syn} = efP(A+B) - (efP\ (A) + Pef\ (B))$$

and by the change of work efficiency:

$$efE_{syn} = efE(A+B) - (efE(A) + Eef(B))$$

ef_{syn} – synergy effect,
$ef(A+B)$ – total effect (combined),
$ef(A)+ef(B)$ – base effect,
P – sales profitability,
E – work efficiency.

Additionally, in the analysis conducted the mining production, level of employment and unit production costs for the examined collieries before and after the merger in the years 2006-2011 were taken into consideration.

4. Mergers of collieries in the context of specificity of the Polish hard coal mining

Polish hard coal mining has been an industry of a great significance for the Polish economy for many years. Mining enterprises are the biggest employers in the region of Upper Silesia – one of the biggest agglomeration in country. Coal extracted in these enterprises is the basic source of satisfying the national energetic needs. Therefore, it is the industry also providing the energetic safety in Poland.

As it was mentioned before, currently there are 3 big mining enterprises functioning in Poland and in their structure there are 22 collieries. The mining enterprises belong to the State Treasury. The private colliery is located in Lubelskie Coal Basin.

Despite a strategic economic significance the Polish hard coal mining has been facing numerous problems for many years. The key ones are the unit production costs which are high and very quickly rising in time. The basic reason for the rise is a high share of cost of salaries in total costs as well as strong pressure from the trade unions on systematic pay rise, not always connected with work effects.

The subsequent restructuring programs of the industry initiated in 90s still have not brought the expected effects in the form of effectiveness improvement of hard coal mining functioning. Their most difficult element was and still is the employment restructuring (Turek and Jonek-Kowalska, 2008). Such restructuring consists in employment reduction and implementation of a pro-effective motivational system linked to the work effects (Jonek-Kowalska, 2009). However, its full realization has serious social and economic consequences. It means the liquidation of key workplaces for the region and the country as well as pauperization of Upper Silesia.

Due to the circumstances above, managing the state-owned mining enterprises cannot be compared with managing private businesses. The co-existence and even the prism of social objectives over the economic ones implies the necessity of looking from a different point of view at the activity of these subjects (Sierpińska, 2007). Nevertheless, there are still actions taken necessary for maintaining the industry which strengthen its economic condition (Turek and Jonek-Kowalska, 2009). An example of such action is

the privatization of Jastrzębska Spółka Węglowa SA and consequent implementation of rules typical for businesses performing in the free-market economy in its structures. However, these actions are accompanied by a strong resistance from the trade unions and social protests.

It should be also emphasized that the collieries belonging to the mining enterprises are not the independent subjects. The do not take strategic decisions on their own. There are only the temporary decisions left at their disposal. The decisions concerning the development directions and technical-economic plans are created on the level of mining enterprise. The single collieries serve only the role of data providers in these processes (Turek, 2001).

Taking into account the circumstances above, there should be a different view taken on the objectives and effects of mergers of mining enterprises being the object of considerations conducted in the hereby article. Their purpose is not only to achieve the economic synergy effects. The premises for the mergers of collieries are also of a social character. In frames of the mining enterprise there are collieries merged in a difficult mining-geological or/and social situation in order to decrease the exploitation systematically in them but also to protect the workplaces and guarantee the social order. The similar actions are taken in the collieries where the deposits are running out. The synergy effects in the mergers of collieries, in accordance with the above, are mostly of social and political character. However, in a long perspective they may also bring the measurable economic effects for the whole mining enterprise and this is the original objective of their conduction.

5. Data analysis

In the hereby point, there are the parameters presented characterizing the collieries merged together with their description marked accordingly as: A+B, C+D, E+F and G+H. In table 2 there is data included for the first of the examined collieries.

First of the integrated enterprises, marked as A+B, was created in 2006 in the course of merger between the two collieries belonging to Katowicka Grupa Kapitałowa SA. It was an integration of a small mine, extracting over 1.5 million tons yearly, with a big mine producing over 3.3 million tons of resources yearly. After the merger the extraction was systematically decreased until the year 2009. In 2010 and 2011 it slightly increased due to the improvement on domestic and international market of hard coal. Five years after the integration it equaled about 75% of extraction before the merger of the two collieries. In the researched period also a gradual employment reduction occurred. Finally, in 2011 it was lower by 11% in comparison with the year 2006 when the collieries were functioning separately.

In the whole analyzed period work efficiency is lower than the weighted average efficiency before the merger. It is caused by the extraction decreasing faster than employment. The pace of work efficiency decrease was stopped in the year 2010 and significantly recovered only almost four years after the integration. The unit production cost behaves in a similar manner which in the years 2007-2010 was higher than the total unit costs in the Polish mining. The growth in the cost started to impede in the years 2010-2011. However, it is worth to mention that before the merger the colliery A was

Specification	Years					
	2006	2007	2008	2009	2010	2011
EXTRACTION						
Colliery A [t]	1 576 000					
Colliery B [t]	3 381 700					
Colliery A+B [t]	4 957 700	4 080 100	3 153 374	3 333 970	3 600 000	3 735 704
Quantitative change [t]		-877 600	-1 804 326	-1 623 730	-1 357 700	-1 221 996
Percentage change [%]		-17.70%	-36.39%	-32.75%	-27.39%	-24.65%
EMPLOYMENT						
Colliery A [employees]	2488					
Colliery B [employees]	3784					
Colliery A+B [employees]	6272	5849	5692	5696	5772	5556
Quantitative change [employees]		-423	-580	-576	-500	-716
Percentage change [%]		-6.74%	-9.25%	-9.18%	-7.97%	-11.42%
WORK EFFICIENCY						
Colliery A [t/person]	633					
Colliery B [t/person]	894					
Colliery A+B [t/person]	790	698	554	585	624	672
Quantitative change [t/person]		-93	-236	-205	-167	-118
Percentage change [%]		-11.75%	-29.91%	-25.95%	-21.10%	-14.94%
UNIT PRODUCTION COST						
Colliery A [PLN/t]	206					
Colliery B [PLN/t]	156					
Colliery A+B [PLN/t]	172	193	266	285	273	261
Quantitative change [PLN/t]		21	94	113	101	89
Percentage change [%]		12.28%	54.75%	65.80%	58.82%	51.84%

PLACE IN THE RANKING OF TOTAL UNIT COSTS IN MINING						
Colliery A	24					
Colliery B	9					
Colliery A+B	16.5	16	21	20	14	9
Quantitative change		0.5	-4.5	-3.5	2.5	7.5
SALES PROFITABILITY						
Colliery A [%]	-8.03%					
Colliery B [%]	9.43%					
Colliery A+B [%]	3.49%	4.89%	-4.07%	9.32%	10.02%	22.41%
Quantitative change [%]		1.40%	-7.56%	5.83%	6.53%	18.92%
Percentage change [%]		40%	-217%	167%	187%	542%

Table 2: Parameters characterizing the collieries A, B and A+B in years 2006-2011

Source: own work on the basis of the data from the examined collieries

specific for a much lower unit production cost than the colliery B. Additionally, unit cost in the colliery A was also lower in the year of merger by over 12% than the total average unit costs in mining.

Such level of unit costs put the colliery A on the 9th place among the 26 mines functioning in Poland in the year 2006. The colliery B took 24th place in this ranking. A year after the integration the enterprise A+B was on the 20th place and next 21st in the analyzed ranking. The merged enterprise managed to gain the balance in 2010 – 14th place. A further improvement occurred in 2011 and then the enterprise A+B was on the 9th place in terms of unit production cost in Poland.

Sales profitability in the examined collieries slightly increased in the year of the merger. Afterwards it obtained a negative value. In the years 2008 and 2009 sales profitability recovered, reaching the level of 9-10%. Thanks to the economy improvement on the markets of hard coal and to the price rise of this resource, in the year 2011 sales profitability reached a record level in the analyzed period, exceeding 22%.

According to the above, the merger of a small mine of a low effectiveness with a very effective mine allowed after two years of integration to achieve positive synergy effects in the form of sales profitability growth.

The second of the researched merger was also created in the year 2006 but in frames of the structure in Kompania Węglowa SA. As the result of merger, there was a colliery producing almost 3 million tons yearly integrated with one, half smaller, extracting over 1.2 million tons yearly. In the merged collieries the extraction was dramatically and quickly reduced. The fall was stopped only in the year 2010 due to the aforementioned market demand increase. Finally, the extraction was limited by 46% in comparison with the year 2006.

Employment was systematically reduced in the merged collieries as well. In comparison with the state before the integration it was decreased by almost 4%. Despite

Specification	Years					
	2006	2007	2008	2009	2010	2011
EXTRACTION						
Colliery C [t]	2 974 900					
Colliery D [t]	1 242 260					
Colliery C+D [t]	4 217 160	3 323 990	2 646 290	2 335 200	1 749 500	1 916 200
Quantitative change [t]		-893 170	-1 570 870	-1 881 960	-2 467 660	-2 300 960
Percentage change [%]		-21.18%	-37.25%	-44.63%	-58.51%	-54.56%
EMPLOYMENT						
Colliery C [employees]	4 218					
Colliery D [employees]	2 350					
Colliery C+D [employees]	6 568	5 945	5 470	5 065	4 683	4 014
Quantitative change [employees]		-623	-1098	-1503	-1885	-2554
Percentage change [%]		-9.49%	-16.72%	-22.88%	-28.70%	-38.89%
WORK EFFICIENCY						
Colliery C [t/os.]	705					
Colliery D [t/os.]	529					
Colliery C+D [t/os.]	642	559	484	461	374	477
Quantitative change [t/os.]		-83	-158	-181	-268	-165
Percentage change [%]		-12.92%	-24.65%	-28.19%	-41.82%	-25.65%
UNIT PRODUCTION COST						
Colliery C [PLN/t]	164					
Colliery D [PLN/t]	225					
Colliery C+D [PLN/t]	182	226	318	343	404	303
Quantitative change [PLN/t]		44	136	161	222	121
Percentage change [%]		24.20%	74.76%	88.49%	122.02%	66.51%

PLACE IN THE RANKING OF TOTAL UNIT COSTS IN MINING						
Colliery C	26					
Colliery D	13					
Colliery C+D	19.5	23	24	24	23	16
Quantitative change		-3.5	-4.5	-4.5	-3.5	3.5
SALES PROFITABILITY						
Colliery C [%]	-11.20%					
Colliery D [%]	-19.88%					
Colliery C+D [%]	-17.55%	-45.11%	-41.16%	-27.78%	-90.78%	-13.02%
Quantitative change [%]		-27.56%	-23.60%	-10.23%	-73.23%	4.53%
Percentage change [%]		-157%	-134%	-58%	-417%	392%

Table 3: Parameters characterizing the collieries C, D and C+D in years 2006-2011

Source: own work on the basis of the data from the examined collieries

a significant employment reduction work efficiency deterioration was not prevented. This parameter was falling until the year 2010 when it was lower than the weighted average before the merger by over 41%. Although a considerable improvement occurred in 2011 in the integrated enterprise, the work efficiency was not regained even on the level of less efficient before the inclusion of the colliery D. The unit production cost was also growing rapidly. In 2010 it was higher by 122% than the total weighted unit cost of mines before the merger. The pace of this cost increase, as a result of extraction increase and further employment reduction, was stopped in the year 2011 when the unit production cost after the integration was higher only by 66% than the unit cost in the year 2006.

The tendency described causes that the enterprise C+D in the ranking of unit costs in the Polish hard coal mining takes 23rd and 24th place among the 24 functioning collieries in the years 2007-2010. It should also be added that the smaller of the integrated mines was on the last place in the ranking before the merger and the second one was placed in the middle of the researched group. The state of enterprise C+D improved in the year 2011 when this mine was put on the 16th place in the ranking. High costs and low efficiency translate into sales profitability which both, before and in the whole period after the merger, was negative. A record value of over -90% was reached in the year 2010. The economic improvement in mining allowed to increase it to -13% in 2011, which is the highest value in the years 2006-2011.

According to the above, in Kompania Węglowa SA in the year 2006 two collieries of low efficiency and effectiveness were merged. It should also be added that the colliery C was gradually running out of its deposits and was in a final stage of exploitation. The colliery D possessed significant deposits, however, due to a high level of natural hazards their extraction was hindered and costly. The examined merger may be then considered to provide positive synergy effects only in the year 2011. At that time sales profitability was higher than before the integration but it still remained negative.

Specification	Years					
	2006	2007	2008	2009	2010	2011
EXTRACTION						
Colliery E [t]	2 108 500	2 104 400	2 195 900	1 932 300		
Colliery F [t]	3 653 300	3 363 000	2 842 010	2 842 000		
Colliery E+F [t]	5 761 800	5 467 400	5 037 910	4 774 300	4 266 730	4 427 216
Quantitative change [t]					- 507 570	-347 084
Percentage change [%]					-10.63%	-7.27%
EMPLOYMENT						
Colliery E [employees]	2 960	2 950	2 968	3 019		
Colliery F [employees]	3 836	3 393	3 924	4 135		
Colliery E+F [employees]	6 796	6 343	6 892	7 154	6908	6504
Quantitative change [employees]					-246	-650
Percentage change [%]					-3.44%	-9.09%
WORK EFFICIENCY						
Colliery E [t/os.]	712	713	740	640		
Colliery F [t/os.]	952	991	724	687		
Colliery E+F [t/os.]	848	862	731	667	617	680
Quantitative change [t/os.]					-50	13
Percentage change [%]					-7.50%	1.95%
UNIT PRODUCTION COST						
Colliery E [PLN/t]	181	171	208	262		
Colliery F [PLN/t]	157	171	212	236		
Colliery E+F [PLN/t]	166	171	210	247	266	262
Quantitative change [PLN/t]					19	15
Percentage change [%]					7.69%	6.07%

PLACE IN THE RANKING OF TOTAL UNIT COSTS IN MINING						
Colliery E	19	10	13	16		
Colliery F	10	10	14	10		
Colliery E+F				13	13	10
Quantitative change					0	3
SALES PROFITABILITY						
Colliery E [%]	-18.29%	-7.00%	-8.37%	-7.49%		
Colliery F [%]	14.77%	4.65%	5.52%	14.62%		
Colliery E+F [%]	2.67%	0.39%	0.43%	6.53%	-6.84%	-4.10%
Quantitative change [%]					-13.37%	-10.63%
Percentage change [%]					-305%	-263%

Table 4. Parameters characterizing the collieries E, F and E+F in years 2006-2011

Source: own work on the basis of the data from the examined collieries

The merger of the two next collieries took place in the year 2010. The collieries belonging to Katowicki Holding Węglowy SA were integrated, producing over 3.6 million tons and 2.1 million tons yearly in the first year of analysis. Until the year 2010, in which the merger was conducted, the extraction was systematically decreased in these collieries. In 2009 the extraction in the colliery E equaled 1.8 million tons and in the colliery F 2.8 million tons. After the integration the extraction level fell by over one tenth.

Employment in the colliery E was maintained at a similar level with a slightly increasing tendency before the merger. In the colliery F it decreased in 2007 and next it increased in 2008 and 2009. Two years after the merger it fell by almost 9%.

Along with the diminishing extraction work efficiency was also decreasing. Just after the integration the fall continued by over 7%. The year 2011, in which the extraction rose and employment decreased, brought an increase in efficiency by 2% in comparison with the year of the merger.

It is worth to emphasize that the examined collieries are specific for a relatively low and similar unit production cost which balances below the total unit costs in mining in almost all the researched period (Michalak, 2012). Cost parameters of these collieries slightly deteriorate in 2008 and 2009. Nevertheless, a year after the merger the enterprise managed to regain the 10th place in the ranking of unit production cost.

However, a favorable value of unit production cost in the colliery E did not translate into a level of sales profitability due to a low coal price from this mine on the market. It is caused by a low level of quality parameters of the coal extracted there. The situation in the colliery F is different, which in the years 2006-2009 gained positive sales profitability and its resource is appreciated on the market. Unfortunately, after the merger profitability in the integrated mines was negative although its value slightly improved in the year 2011. It is three times worse than before the merger.

According to the above, in the analyzed case, two years after the integration it was not possible to achieve positive synergy effects in the form of efficiency or sales profitability improvement. Negative sales profitability in the colliery E was not balanced by positive sales profitability in the colliery F. However, this mine should be observed in time as sometimes working out positive synergy effects in the integrated subjects requires time.

Specification	Years					
	2006	2007	2008	2009	2010	2011
EXTRACTION						
Colliery G [t]	2 584 750	2 417 400	2 453 300	2 280 400	2 247 650	
Colliery H [t]	2 541 854	2 104 458	1 829 055	1 935 499	1 723 701	
Colliery G+H [t]	5 126 604	4 521 858	4 282 355	4 215 899	4 266 730	4 417 108
Quantitative change [t]						150 378
Percentage change [%]						3.52%
EMPLOYMENT						
Colliery G [employees]	3 292	3 104	3 128	3 179	3 078	
Colliery H [employees]	3 330	3 154	3 111	3 135	3 026	
Colliery G+H [employees]	6 622	6 258	6 239	6 314	6 104	6 116
Quantitative change [employees]						12
Percentage change [%]						0.18%
WORK EFFICIENCY						
Colliery G [t/os.]	785	779	784	717	730	
Colliery H [t/os.]	763	667	588	617	570	
Colliery G+H [t/os.]	774	723	686	668	699	722
Quantitative change [t/os.]						23
Percentage change [%]						3.29%
UNIT PRODUCTION COST						
Colliery G [PLN/t]	168	182	203	248	247	
Colliery H [PLN/t]	176	214	277	277	309	
Colliery G+H [PLN/t]	172	226	318	343	266	273
Quantitative change [PLN/t]						7
Percentage change [%]						2.63%

PLACE IN THE RANKING OF TOTAL UNIT COSTS IN MINING						
Colliery G	15	14	11	13	10	
Colliery H	17	21	22	17	19	
Colliery G+H					14.5	13
Quantitative change						-1,5
SALES PROFITABILITY						
Colliery G [%]	-1.35%	-0.90%	26.18%	7.08%	20.13%	
Colliery H [%]	-4.28%	-14.57%	-19.03%	-0.73%	-2.18%	
Colliery G+H [%]	-2.80%	-7.68%	3.76%	3.21%	9.07%	22.17%
Quantitative change [%]						13.10%
Percentage change [%]						44%

Table 5: Parameters characterizing the collieries G, H and G+H in years 2006–2011

Source: own work on the basis of the data from the examined collieries

The last of the examined mergers took place in 2010 and regarded the collieries belonging to Kompania Węglowa SA. Extraction in both these collieries in 2006 was at a similar level of over 2.5 million tons. In the years 2007-2009 extraction was systematically reduced, however, extraction reduction in the colliery H occurred much faster. After the integration in 2011 the production has been increasing by over 3.5% in comparison with the state before the merger.

Employment in both analyzed collieries was also shaping at a similar level. A significant employment reduction took place in 2006. In the subsequent years total employment was in the range of 6100-6300. After the merger employment has been slightly increasing by 0.18%.

Until the year 2010 work efficiency was also falling. However, year after the integration it was possible to improve this parameter by over 3% and reach its value from 2007.

Unit production cost in the colliery G is definitely lower than in the colliery H. In the whole analyzed period before the merger this cost was also lower than the total average unit cost in mining (Michalak and Turek, 2011). This colliery in the ranking of unit cost took the middle place. The colliery G on the other hand was much worse in this matter as it was put on places from 17 to 21. The collieries after the merger obtained the 13th place in the ranking.

The colliery G is characterized by much better sales profitability, especially in the years 2008-2010. In turn, the colliery H in the whole analyzed period before the merger has negative sales profitability which slightly improved in the years 2009-2010. After the integration it was possible for both collieries to achieve record sales profitability exceeding 22%.

According to the above, the merger of the examined collieries provides positive synergy effects, both in the form of work efficiency and sales profitability increase.

In this way the enterprise managed to use a potential embedded in the similarity of collieries and in economic opportunities. It is the most effective merger of collieries (Michalak, 2011). Nevertheless, it should be clearly emphasized that to the fast and considerable increase in effectiveness and profitability mainly contributed a high price rise caused by a rapid growth in demand for coal.

6. Conclusions

Synergy is integrally connected with cooperation of particular elements. It is a broad view on synergy. Consequently, a wide understanding of synergy is concentrated on the situation of cooperation itself and it means "an optimal integration of something which previously existed separately" (Piekarz, 1993). On the other hand, a narrow depiction of this notion is linked to the effects generated by synergy and then, synergy means such cooperation of elements which is more profitable than the sum of effects gained by separate functioning of each element, that is independently from each other. A symbolic description of synergy is determined by the formula "2+2=5". Such approach highlights its positive effects but it does not mean that synergy cannot provide negative effects.

In the researched collieries positive synergy effects were observed only in case of two mergers. And only one of them has brought synergy effects both in the form of work efficiency increase and sales profitability increase. A summary of mergers is included in table 6.

Table 6. Summary of mergers parameters in the examined integrated collieries

Table 6. Summary of mergers parameters in the examined integrated collieries	Collieries			
	A+B	C+D	E+F	G+H
Extraction amount	higher by over a half in B	higher by over a half in C	lower by 1/3 in E	at a similar level
Employment	higher by 1/3 in B	higher by over a half in C	lower by 1/3 in E	at a similar level
Unit production cost	low in B high in C	low in C high in D	at a similar level, average	low in G high in H
Synergy effect	yes – sales profitability increase	no	no	yes – work efficiency and sales profitability increase
Time for synergy effects to occur	2 years	-	-	1 year
Economic situation	unfavorable	unfavorable	favorable	favorable

Source: own work

In case of the enterprise A+B the merger took place between the collieries of a different level of extraction, employment and unit production cost, in the situation of unfavorable economic conditions. The integrated collieries managed, however, to realize positive synergy effect two years after the merger. In the year 2011 in the result of considerable growth of demand for hard coal, sales profitability of the enterprise reached over 22%.

Favorable economic conditions also become a trigger for synergy effects in the enterprise G+H. In the result of the two collieries integration year after the merger it was possible to increase both sales profitability and extraction effectiveness. It was possible mostly thanks to the growth of demand for hard coal which, in turn, caused the prices rise of this resource and justified the extraction increase.

Negative synergy effects were observed in the enterprise C+D. Just before the merger the collieries were in a poor financial condition. Furthermore, the situation was deteriorated by a high level of natural hazards in the colliery C and the exhaustion of deposits in the colliery D. The merger was not facilitated by the economic situation in hard coal mining either.

The improvement on the market of hard coal did not help in creating positive synergy effects in the enterprise E+F. Average financial results did not allow to achieve benefits from the merger.

7. Directions for further research

The presented research results constitute a basis for assessment of restructuring actions in the hard coal mining in Poland. A generalization of the results would require conducting similar research in the European countries such as Germany or Spain. Nevertheless, it may constitute a starting point for making decisions concerning the directions of further hard coal mining restructuring in Poland, also including the merger of collieries.

In an industrial aspect the research may be continued in the frames of individual case studies. In this way it would be possible to indentify the internal and external factors in details which determine the creation of positive synergy effects. In frames of the further research it is also possible to modify the reference point for the calculation of base effect. In the article it is the year preceding the merger of collieries what constitutes some kind of simplification. In order to make the result more objective, in accordance with the above, the comparison of final and base effect should be conducted in the same moment of time. However, such approach requires to forecast the parameters presented in the article along with the assumption that the collieries are still functioning separately (Campbell et al., 1997; Gurgul, 2006).

Finally, the analyzed examples may be used for the purpose of creating the model of further hard coal mining restructuring in a perspective up to the year 2030 with the inclusion of collieries' mergers and at the same time maintain energetic safety in Poland and in countries of similar industrial conditions.

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