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Concentration of coal production and productivity in the Polish mining sector in the years 1993—2005

Key words

Coal mining sector, concentration of production, productivity

Abstract

The paper investigates the growing concentration of coal production in the Polish mining sector in the years 1993—2005 in collieries belonging to the Coal Corporation S.A. revealing improvement of productivity both in terms of overall productivity and productivity of underground operations.

Introduction

In 2003, in an attempt to improve the productivity of the coal mining sector in Poland, the relevant authorities decided that five Coal Mining Companies existing since 1993 should go into liquidation:

- Bytomska Spółka Węglowa (Bytomska Coal Company),
- Gliwicka Spółka Węglowa (Gliwicka Coal Company),
- Nadwiślańska Spółka Węglowa (Nadwiślańska Coal Company),
- Rudzka Spółka Węglowa (Rudzka Coal Company),
- Rybnicka Spółka Węglowa (Rybnicka Coal Company).

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Instead the Kompania Węglowa S.A. (Coal Corporation) was set up, which grouped several mines and, as such, became one of the largest mining companies in Europe, accounting for nearly 50% of coal production in Poland. It is worthwhile to mention, for clarity, that before the Coal Corporation S.A. was established, the previous coal companies Bytomska Spółka Węglowa and Rudzka Spółka Węglowa formed the capital groups. Such capital groups, comprising previously listed mining companies, were formed to separate collieries in which the production level was stable from collieries or their sections which were being closed, in order to make their financial situation more transparent as state subsidies were granted to assist mine closures. In the consequence, however, the organizational structure became more complex and repeated names of producing collieries and those being closed could obscure the analyses of the mining sector in Poland.

The period 1993—2005 marked very hard times for the mining sector in Poland. On one hand, the collieries bore the costs of structural transformations in the country and of adopting the market economy principles. Maintaining fixed prices of coal for many months in the conditions of three- or two-digit inflation rates helped to fight the inflation, at the same time, however, it caused major financial problems for mining companies which have not been fully overcome yet. On the other hand, a campaign was launched to deprecate the role of coal as an energy carrier, concentrating on environmental, though not always justified, arguments. Hence attempts were made to replace coal by other, usually more expensive, minerals whilst the development of energy-saving technologies led to the further reduction in the demand for coal, both in Poland and abroad. At the same vast amounts of cheap coal, produced in more favourable conditions, were available on the international coal markets, which made the coal exports less profitable.

All these considerations prompted the Polish authorities to make the decision to progressively limit coal production in Polish collieries, and hence to reduce the number of miners. Some mines or mine sections, where coal production was not considered cost-effective, were to be closed. These closure programs, undertaken before 1998, were aimed to improve the economic condition of mines, most of them being in financial trouble.

The present study covers the part of the coal mining sector taken over by the Kompania Węglowa S.A. (Coal Corporation) in 2003. Accordingly, in the considered time period the number of mines decreased from 42 to 17 whilst the production level fell down from 84.1 million ton in 1993 to about 52.6 million ton in 2005, which means the reduction of 37%. At the same time the number of operated longwalls fell from 251.1 down to 73.6, which means a 3.5 — fold reduction. The reduction of the number of operated longwalls led to the growing concentration of coal production and despite the decrease of production levels, the production concentration factor rose from 1 184 ton of average daily production from a single longwall in 1993 to 2931 tons in 2005, accounting for 147% increase.

At the same the employment structure in mines was modified. Instead of group redundancies, miners were offered a social package to encourage them to voluntarily leave the mines. During the period covered in this study about 130 thousand miners decided to leave the mines currently belonging to Kampania Węglowa S.A., which means the reduction

by 65%. Although production levels were lower, the overall productivity of coal production in that period increased by 66% and the productivity of underground operations improved by 77%.

1. Growing concentration of coal production

In literature on the subject concentration of coal production is understood as production level per a section of a mine. In Poland longwall faces are predominant, hence the concentration factor applied in this study shall be expressed as the daily production per one longwall.

Table 1 and its graphic interpretation (Fig. 1) show the daily production level per one statistical longwall in the section of the mining sector taken over by the Kampania Węglowa S.A. in 2003. It is readily apparent that the daily production levels would grow from 1184 tons in 1993 to 2935 tons in 2002, this constant growth was incidentally interrupted in 1998 due to a drastic reduction of production levels imposed under the governmental program. Organizational changes and setting up of the Kampania Węglowa

Average daily output from longwall face (overall) [Mg/d] TABLE 1
TABELA 1
Średnie dobowe wydobyć ze ściany (ogółem) [Mg/d]

Ycars	Bytomska Sp.W. S.A./ /Gr. Kapitałowa	Rudzka Sp.W. S.A./ /Gr. Kapitałowa	Gliwicka Sp.W. S.A.	Nadwiślańska Sp. W. S.A.	Rybnicka Sp. W. S.A.	KW S.A.	Together Coal Comp. (Capital groups /KW S.A.)
1993	829.6	1 087.5	1 147.0	1 611.1	1 245.1		1 184.3
1994	1 003.9	1 240.1	1 395.7	1 908.5	1 555.4		1 400.9
1995	1 067.1	1 425.3	1 662.2	2 160.6	1 726.7		1 579.7
1996	1 226.7	1 703.8	1 929.6	2 223.8	1 892.1		1 791.7
1997	1 287.6	1 983.3	2 022.0	2 434.8	2 116.2		1 969.8
1998	1 190.9	2 132.8	1 921.4	2 409.6	2 228.6		1 970.7
1999	1 309.1	2 164.1	2 414.6	2 769.5	2 788.7		2 320.8
2000	1 612.8	2 493.8	2 568.0	2 857.1	3 030.6		2 535.9
2001	1 828.2	2 471.0	2 819.8	3 184.4	3 375.2		2 760.6
2002	1 842.8	2 644.4	3 150.8	3 393.7	3 431.7		2 925.4
2003						2 749.0	2 749.0
2004						2 885.0	2 885.0
2005						2 931.0	2 931.0

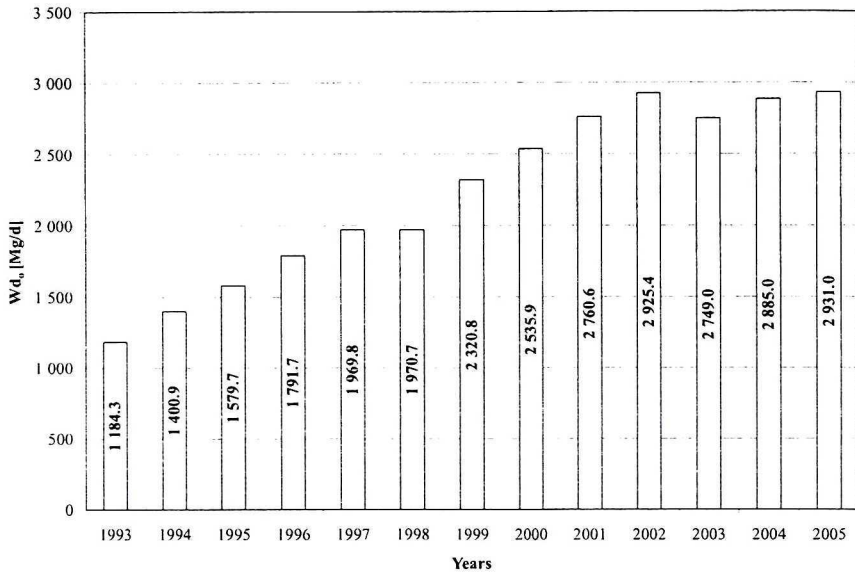


Fig. 1. Average daily output from longwall face (overall) of the mincs belonging to Kompania Węglowa S.A.

Rys. 1. Średnie dobowe wydobyćcie ze ściany (ogółem) w kopalniach przyporządkowanych Kompanii Węglowej S.A.

S.A. (Coal Corporation) in February 2003 coincided with the decrease of the average daily production to 2749 tons.

In 2004 the value of this parameter approached the level achieved in 2003, in 2005 it slightly exceeded the level 2931 of the daily output from all longwalls. Throughout the whole investigated period the production concentration level increased by 1747 tons of daily output altogether, which is a 147% increase with respect to the baseline data. It has to be mentioned, however, that this level was achieved whilst the policy of reduced coal production was adopted in the whole coal mining sector.

Table 2 and its graphic interpretation provided in Fig. 2 show the daily output per a statistical longwall mined with caving. It is apparent that the value of this parameter tends to grow progressively, from the beginning of the investigated period up till 2002, except the year 1998 in which the production level was stagnant. In 2003 this parameter fell down in relation to its value in the previous year and in 2004 its value was similar to that reported in 2002. Last year the daily output amounted to 2974 tons, which means a 131% increase in relation to 1993. An increase in the value of this parameter for longwalls with caving is slightly less for the total number of longwalls. In those two cases the growing tendency is interrupted at the same moment and for the same reason.

Fig. 3 shows the average daily output from longwalls with hydraulic filling in the subsequent years. The graphic interpretation is provided in Fig. 3. In the case of longwalls with backfilling, the general growing tendency is observed, though the parameter increase

TABLE 2

Average daily output from longwall face (with caving) [Mg/d]

TABELA 2

Średnie dobowe wydobyć ze ściany (z zawałem) [Mg/d]

Years	Bytomska Sp.W. S.A./ /Gr. Kapitałowa	Rudzka Sp.W. S.A./ /Gr. Kapitałowa	Gliwicka Sp.W. S.A.	Nadwiślańska Sp. W. S.A.	Rybnicka Sp. W. S.A.	KW S.A.	Together Coal Comp. (Capital groups /KW S.A.)
1993	989.6	1 308.1	1 203.2	1 628.8	1 298.9		1 286.8
1994	1 180.0	1 490.0	1 402.2	1 935.3	1 648.7		1 516.4
1995	1 240.8	1 677.6	1 678.5	2 192.2	1 777.1		1 691.1
1996	1 332.1	1 950.1	1 933.1	2 255.4	1 922.3		1 877.8
1997	1 391.0	2 166.7	2 022.0	2 434.8	2 147.6		2 030.2
1998	1 301.4	2 296.6	1 921.4	2 409.6	2 265.5		2 028.6
1999	1 427.3	2 209.5	2 414.6	2 769.5	2 798.6		2 353.3
2000	1 754.9	2 548.4	2 568.0	2 857.1	3 030.6		2 572.3
2001	1 906.7	2 458.1	2 819.8	3 184.4	3 375.2		2 772.3
2002	1 898.5	2 710.3	3 150.8	3 393.7	3 431.7		2 948.6
2003						2 852.6	2 852.6
2004						2 939.0	2 939.0
2005						2 974.3	2 974.3

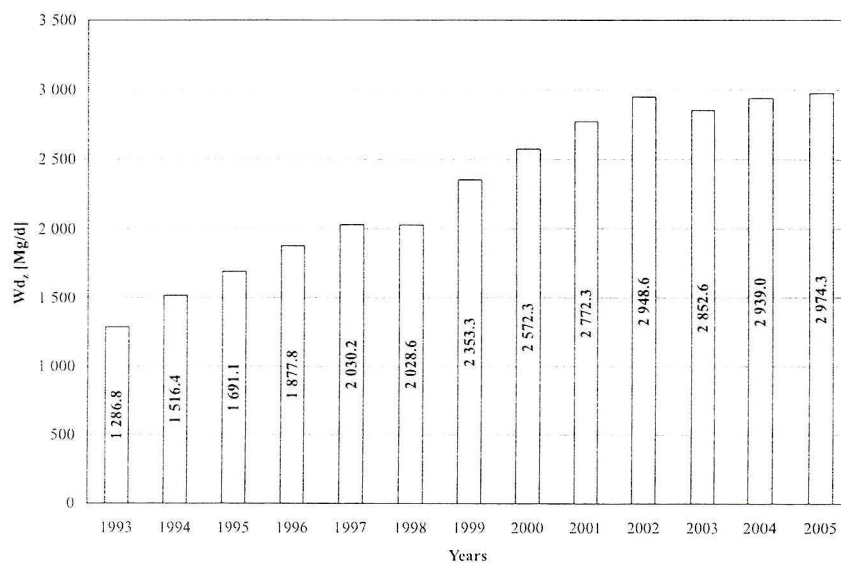


Fig. 2. Average daily output from longwall face (with caving) of the mines belonging to Kompania Węglowa S.A.

Rys. 2. Średnie dobowe wydobyć ze ściany (z zawałem) w kopalniach przyporządkowanych Kompanii Węglowej S.A.

TABLE 3

Average daily output from longwall face (with hydraulic backfilling) [Mg/d]

TABELA 3

Średnie dobowe wydobywanie ze ścian (z podsadzką hydrauliczną) [Mg/d]

Years	Bytomska Sp.W. S.A./ /Gr. Kapitałowa	Rudzka Sp.W. S.A./ /Gr. Kapitałowa	Gliwicka Sp.W. S.A.	Nadwiślańska Sp. W. S.A.	Rybnicka Sp. W. S.A.	KW S.A.	Together Coal Comp. (Capital groups /KW S.A.)
1993	532.3	511.2	0.0	605.5	717.2		591.8
1994	674.8	587.0	0.0	608.4	649.5		630.7
1995	765.2	634.3	0.0	877.7	1 055.1		824.4
1996	985.4	568.5	0.0	610.1	1 086.3		808.4
1997	965.5	781.2	0.0	0.0	1 315.0		1 031.2
1998	886.1	1 028.1	0.0	0.0	1 301.3		1 074.2
1999	781.2	1 557.9	0.0	0.0	1 974.3		1 456.8
2000	1 023.1	1 574.1	0.0	0.0	0.0		1 297.2
2001	1 408.8	2 666.2	0.0	0.0	0.0		2 062.2
2002	1 438.7	1 318.6	0.0	0.0	0.0		1 375.0
2003						1 372.6	1 372.6
2004						1 449.5	1 449.5

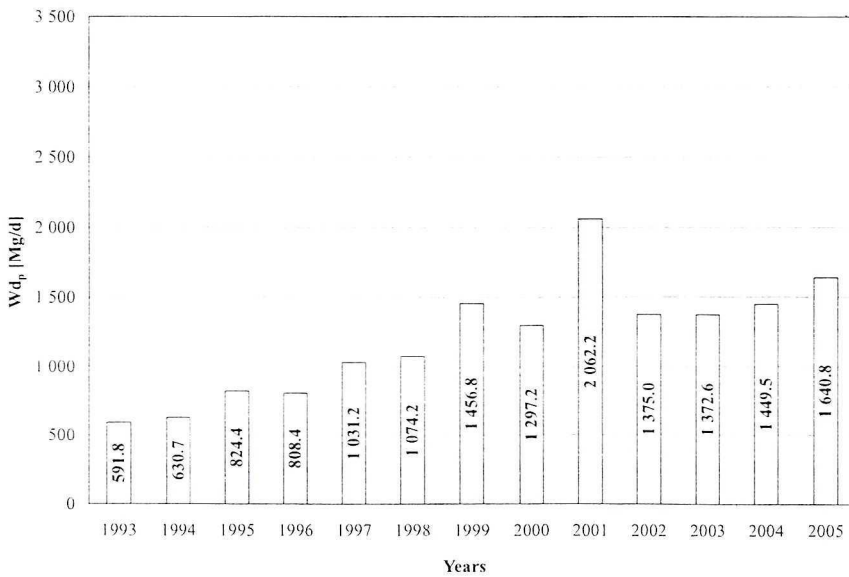


Fig. 3. Average daily output from longwall face (with hydraulic backfilling) of the mines belonging to Kompania Węglowa S.A.

Rys. 3. Średnie dobowe wydobywanie ze ścian (z podsadzką hydrauliczną) w kopalniach przyporządkowanych Kompanii Węglowej S.A.

follows a slightly haphazard pattern. One has to bear in mind that when this roof control strategy is adopted, new elements are added and the process becomes more failure-prone, which explains the fluctuations of the parameter values. On account of higher costs of coal production in longwalls with backfilling, this method was adopted only when absolutely necessary, which might be an additional reason behind the fluctuations of the concentration factor.

Throughout the whole analysed period the average daily production would increase from 590 to 1640 tons, which implies a increase by 177%. In 2001 the production level approached 2062 and it is reasonable to suppose that longwall mining operations at that time proceeded in most favourable conditions. Although the fastest increase of this parameter was reported for longwalls with backfilling, it still remained on a lower level than other key parameters. For example, in 2005 it was lower by 44% from the production levels achieved for the remaining longwalls.

Table 4 shows the number of operated longwalls in particular mining companies, capital groups and, finally, in Kampania Węglowa S.A. throughout the whole investigated period. The graphic representation is provided in Fig. 4, revealing that the number of operated longwalls would decrease each year. This tendency was more marked in the years 1993—1998, and starting from 1990 the number of operated longwalls was being reduced more slowly. During that period the number of longwalls fell down from 251.1 in 1993 to 73.6 in 2005, which marks the 3.5-fold decrease. That was the major factor enhancing the concentration of coal production despite progressive limitations imposed on production levels by the mining sector in recent years.

The programs outlined in this chapter were undertaken with an aim to reduce the costs of coal production. Better concentration enabled the collieries to get more coal from a smaller number of longwalls, hence the requirements for mining equipment were lower. Accordingly, the unit cost of coal production would be reduced. Another major reduction of production costs was associated with the reduction of the number of productive developments and hence the number of longwalls to be operated.

Each year the length of the working face was reduced and so was the number of longwalls with caving and longwalls with backfilling (hydraulic or rock filling), where the production costs are the highest. That is why in 1999 the dry (rock) filling method was abandoned altogether though in 1993 there were still 1386 m of such longwalls, accounting for 2.6% of the mining activities. Similarly, the hydraulic filling method was applied only when absolutely necessary, in recent years that would mean less than three longwalls on the average whilst in 1993 the total length of longwalls with hydraulic filling would amount to 6929 m, accounting for over 13% of mining operations.

Owing to the growing concentration of coal production, the number of miners employed underground could be reduced too, which further improved the mine performance as the unit costs of production per a man was decreased. Productivity indicators shall be addressed in more detail in the following chapter.

TABLE 4

Number of operated longwalls [num.]

TABELA 4

Ilość ścian czynnych [szt]

Years	Bytomska Sp.W. S.A./ /Gr. Kapitałowa	Rudzka Sp.W. S.A./ /Gr. Kapitałowa	Gliwicka Sp.W. S.A.	Nadwiślańska Sp. W. S.A.	Rybnicka Sp. W. S.A.	KW S.A.	Together Coal Comp. (Capital groups /KW S.A.)
1993	51.0	51.2	46.6	50.7	51.6		251.1
1994	51.7	47.3	43.4	43.6	40.3		226.3
1995	46.2	41.8	36.8	37.1	37.7		199.6
1996	35.5	34.9	29.2	36.4	33.5		169.5
1997	32.2	25.7	27.0	34.0	30.1		149.0
1998	26.6	20.1	24.1	27.2	26.1		124.1
1999	19.6	20.9	19.9	24.9	21.5		106.8
2000	19.1	18.9	20.9	23.4	20.7		103.0
2001	17.1	18.5	19.5	21.0	18.3		94.4
2002	16.2	18.3	17.9	19.7	18.6		90.7
2003						85.5	85.5
2004						76.5	76.5
2005						73.6	73.6

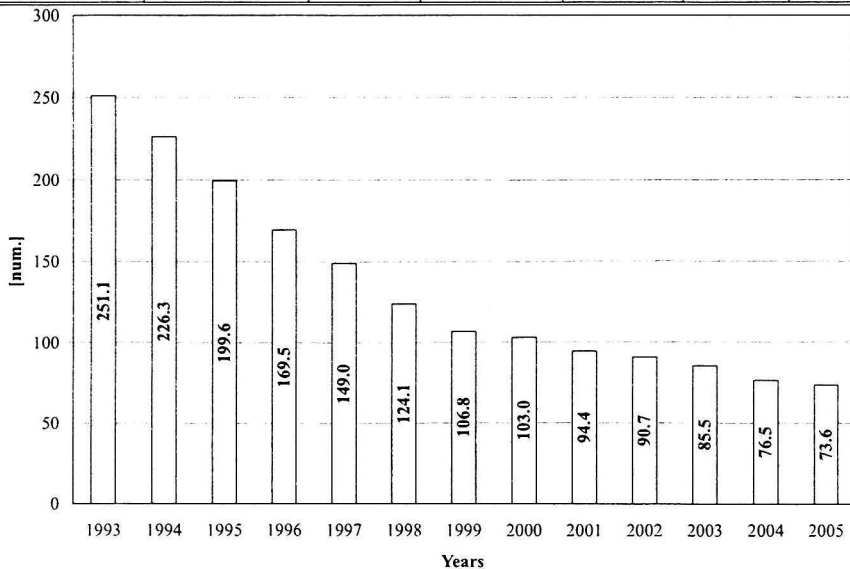


Fig. 4. Number of operated longwalls of the mines belonging to Kompania Węglowa S.A.

Rys. 4. Ilość ścian czynnych w kopalniach przyporządkowanych Kompanii Węglowej S.A.

2. Productivity

The overall productivity in the coal mining sector is typically expressed as the ratio of daily production of commercial coal to the total number of employees, measured in [kg/employee-shift] or [Mg/employee-shift] and productivity of underground operations is expressed as the ratio of daily production of coal to the number of mines employed underground, measured in [kg/man-shift] or [Mg/man-shift].

Table 5 shows the overall productivity achieved by particular mining companies, capital groups and the Kampania Węglowa S.A. (Coal Corporation) throughout the whole investigated period. The graphic representation is given in Fig. 5.

A growing tendency is apparent throughout the whole period, yet productivity tends to decrease in 1998 (in relation to the previous year), which is a consequence of a drastic limit on coal production not accompanied by the adequate reduction of labour force. In 2003 and 2004 productivity in the mines belonging to the Kompania Węglowa S.A. (Coal Corporation) proved to be lower than in 2002. That was most probably the result of organizational changes associated with the establishing of Kompania Węglowa S.A. in 2003, which comprised mining companies, capital groups as well as other organizational units

TABLE 5

Overall productivity [kg/employec-shift]

TABELA 5

Średnioroczna wydajność ogólna w węglu handlowym [kg/pdn]

Years	Bytomska Sp.W. S.A./ /Gr. Kapitałowa	Rudzka Sp.W. S.A./ /Gr. Kapitałowa	Gliwicka Sp.W. S.A.	Nadwiślańska Sp. W. S.A.	Rybnicka Sp. W. S.A.	KW S.A.	Together Coal Comp. (Capital groups /KW S.A.)
1993	2 261	1 912	2 444	2 313	2 310		2 256
1994	2 062	2 305	2 309	2 604	2 479		2 369
1995	2 261	2 591	2 444	2 658	2 605		2 519
1996	2 349	2 796	2 576	2 842	2 786		2 679
1997	2 440	2 944	2 723	3 148	2 947		2 857
1998	2 285	2 714	2 563	2 504	2 854		2 577
1999	2 674	2 973	2 956	3 179	3 232		3 024
2000	2 998	3 144	3 226	3 262	3 434		3 231
2001	3 336	3 223	3 500	3 778	3 705		3 536
2002	3 556	3 447	3 808	3 855	3 488		3 650
2003						3 475	3 475
2004						3 573	3 573
2005						3 759	3 759

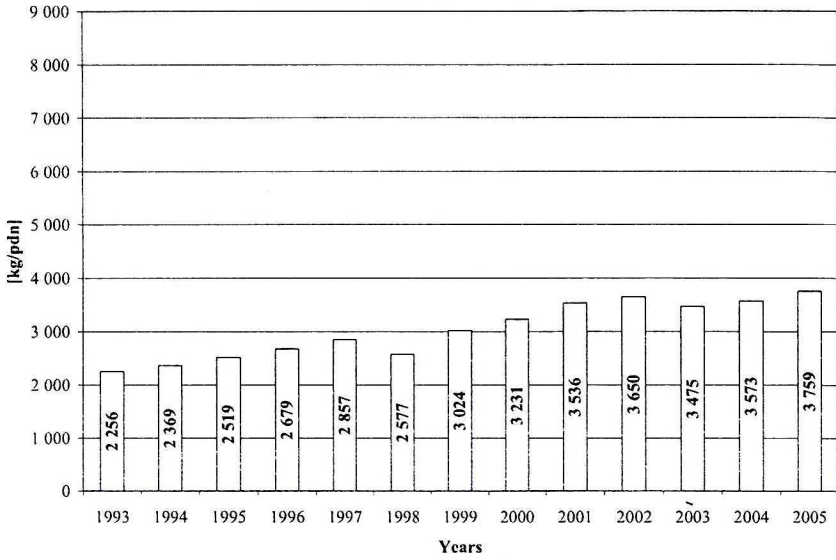


Fig. 5. Overall productivity in the mines belonging to Kompania Węglowa S.A.

Rys. 5. Średnioroczna wydajność ogólna w węglu handlowym w kopalniach przyporządkowanych Kompanii Węglowej S.A.

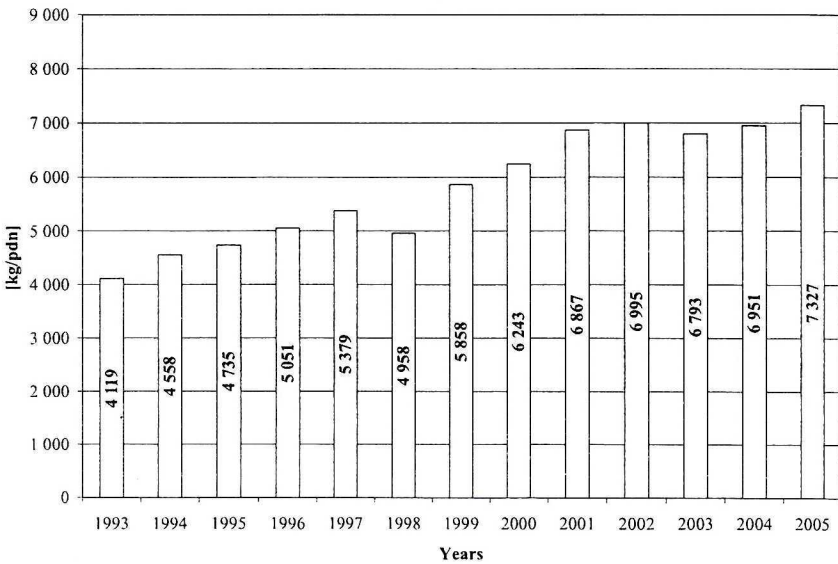


Fig. 6. Underground productivity in the mines belonging to Kompania Węglowa S.A.

Rys. 6. Średnioroczna wydajność dołowa w urobku węglowym w kopalniach przyporządkowanych Kompanii Węglowej S.A.

TABLE 6

Underground productivity [kg/man-shift]

TABELA 6

Średnioroczna wydajność dołowa w urobku węglowym [kg/rdn]

Ycars	Bytomska Sp.W. S.A./ /Gr. Kapitałowa	Rudzka Sp.W. S.A./ /Gr. Kapitałowa	Gliwicka Sp.W. S.A.	Nadwiślańska Sp. W. S.A.	Rybnicka Sp. W. S.A.	KW S.A.	Together Coal Comp. (Capital groups /KW S.A.)
1993	3 235	4 061	4 950	3 922	4 921		4 119
1994	3 647	4 526	5 556	4 277	5 235		4 558
1995	3 826	4 786	5 798	4 323	5 495		4 735
1996	3 952	5 046	6 128	4 679	5 923		5 051
1997	4 192	5 293	6 364	5 165	6 252		5 379
1998	3 894	5 087	6 257	4 180	6 182		4 958
1999	4 586	5 633	6 939	5 280	7 128		5 858
2000	4 907	5 859	7 882	5 484	7 422		6 243
2001	5 471	6 097	8 293	6 447	8 164		6 867
2002	5 861	6 358	8 534	6 507	7 806		6 995
2003						6 793	6 793
2004						6 951	6 951
2005						7 327	7 327

associated with the mining sector, leading to increased employment numbers in relation to the levels reported in previous years by mining companies and capital groups taken over by the Kompania Węglowa S.A. (Coal Corporation). In the investigated period the productivity indicator rose from 2256 [kg/employee-shift] in 1993 to 3759 [kg/employee-shift] in 2005, which means an increase by 66%. This result shall be treated as a major achievement as at that time drastic limits were still imposed on coal production.

Table 6 shows the underground productivity indicators expressed as daily coal production per man for particular mining companies, capital groups and the Kompania Węglowa S.A. (Coal Corporation) in the subsequent years of the investigated period. Graphic representation is provided in Fig. 6, revealing a constantly growing tendency, interrupted only in 1998 and slightly slower in 2003 and 2004. The explanation of this state of affairs is identical as in the case of overall productivity.

Accordingly, productivity of underground operations rose from 4119 [kg/man-shift] in 1993 to 7327 [kg/man-shift] in 2005, which means an increase by 77%. It is readily apparent that productivity of underground operations increases at a faster rate than the overall productivity. It is reasonable to suppose that existing social packages offered to those who chose to leave the mines prompted many employees to give up exhausting work underground.

Conclusions

As it was mentioned in the introductory section, the authors investigated the period 1993—2005 and that part of the mining sector in Poland that was first managed by the mining companies and capital groups and later taken over in 2003 by the Kompania Węglowa S.A. (Coal Corporation). It appears that the Kompania Węglowa S.A. (Coal Corporation) — a producer of over 50% of coal in Poland might be regarded as the representation of the Polish mining sector in the sense that achievements and problems faced by mines belonging to the Kompania Węglowa S.A. (Coal Corporation) are the same as those experienced by an average Polish colliery.

It is well apparent that the number of miners employed underground would be progressively reduced throughout the whole investigated period, which led to an improved productivity despite the limits of coal production imposed since 1998. Conversely, when productivity was improved, smaller number of miners could be employed to reach the predetermined production levels. A smaller number of miners employed underground prompted the reduction in the number of operated longwalls and galleries, leading in consequence to a growing concentration of coal production. Concentration of coal production and productivity are clearly interrelated and one parameter will control the other.

Concentration of coal production in recent years is much slower, both for longwalls with caving and longwalls mined using other techniques, which suggests that simple reserves are being exhausted and new technologies and more advanced equipment will be required. Simple reserves involve the limitation or abandonment of the least effective and very costly longwall mining with dry (rock) filling and application of the longwall mining with hydraulic filling only when absolutely necessary. Despite the growing concentration level (an increase by 77%), this parameter for longwalls with hydraulic filling would be 44% lower than for longwalls mined with caving.

In the light of the fact that under the governmental program mining companies in Poland were forced to reduce production levels, the reported increase in productivity of 66% in the investigated period and increase in productivity of underground operation by 77% should be regarded as major achievements. It is readily apparent that an improvement of productivity in this period is attributable to reduction in the number of personnel employed underground and on the surface. If no production limits were imposed, the values of this parameter would be still more favourable. It is reasonable to suppose that overall productivity would be easier to increase than productivity of underground operations as it would involve the reduction in the number of surface personnel. There might be still some reserves such as introduction of computers to assist surface personnel in conjunction with relevant organizational changes.

Results highlighted in this study seem worthwhile to mention, particularly in the light of the fact that working conditions underground are extremely difficult and mining companies that had financial troubles could not afford to buy more efficient mining equipment. One can hope that growing prices of other energy sources would cause an increase of the coal price, too, which should improve the profitability of coal production and exports, leading to the

removal of production limits or may be production levels will slightly increase. In this case productivity would improve soon. When the financial condition of the mining sector improves, modern and more efficient machines will replace the old and worn equipment, leading to a further increase of productivity of underground operations and the level of production concentration, whilst surface activities supported by advanced computer systems designed to suit the specificity of the mining sector shall help improve the overall productivity indices.

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STANISŁAW GŁODZIK, TADEUSZ WOŹNY

KONCENTRACJA WYDOBYCIA I WYDAJNOŚĆ PRACY W POLSKIM GÓRNICTWIE WĘGLA KAMIENNEGO W LATACH 1993—2005

Słowa kluczowe

Górnictwo węgla kamiennego, koncentracja wydobycia, wydajność pracy

Streszczenie

Artykuł ukazuje postępujący wzrost koncentracji wydobycia w polskim górnictwie węgla kamiennego w latach 1993—2005 w kopalniach należących aktualnie do Kompanii Węglowej S.A. oraz poprawę wydajności dołowej i ogólnej. Dane zamieszczone w niniejszym artykule wskazują na zależności istniejące między tymi wskaźnikami.