GOSPODARKA SUROWCAMI MINERALNYMI

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Depreciation of fixed assets and efficiency of investment and operation of a mining plant

Key words

Mining, hard coal mining, depreciation methods, income tax, project evaluation

Abstract

Due to the application of a determined depreciation procedure for fixed assets, an investor obtains a cash flow which influences the Net Cash Flow – NCF. This fact affects considerably the economic efficiency of an investment project under analysis. The article analyses the effect of the depreciation procedure upon fixed assets (linear method, degressive method as well as procedures applied in West Europe) upon cash flows, income tax encumbrance and efficiency of an investment project. Then, there is also investigated a possibility of self-financing of investments with the means coming from amortization deductions. A pertinent analysis was performed taking as example an investment project aimed at providing some mining flats with machines and devices.

Introduction

The depreciation procedure is applied in booking operations so as to reflect the effect of time upon the value of fixed assets. Deducted book values not only cause a fall in the value of fixed assets, but they are also considered as tax deductible costs while calculating the corporate profit, income tax and another taxes [eg estate taxes]. The other aspect of depreciation is particularly important in the feasibility study of investment projects in the mining sector, since the taxation does affect the cash flow value, and therefore, also the

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selection of the most effective of alternative projects. Each capital component, either produced or acquired under the project and subject to depreciation, is subject to amortization in compliance with a schedule which, in turn, arises from the adopted depreciation procedure. The applied depreciation procedure influences the intensity of the cash flow generated in an investment project.

Henceforth, we can say about two main aspects related to depreciation management in the context of the investment project.

— selection of the depreciation method,

— its reflection in the changes in cash flows, which results from the application of a given depreciation schedule.

Both the aspects aforementioned are subject to investigation herein and with reference to investment projects in the mining sector.

Worldwide, the extractive industry uses various depreciation procedures for fixed assets. In each country this item is regulated with pertinent legislation, which to a large extent depends to the opinions and compromises reached by and between political forces represented in the parliament. (in the case of parliamentary democracy). Such legislation can, generally speaking, be more liberal or repressive towards businessmen, and of course, they can be modified according to which of the political forces and business circles are most influential in the given country. Naturally, it must influence the evaluation of efficiency of investment projects under performance through the following factors:

— legally permissible depreciation methods for fixed assets,

— tax system and rates.

The evaluation of a project which truly reflects the problem of future depreciation procedure as well and tax effect are still of significance, mainly from the viewpoint of selection of the depreciation method so that one may maximize the post-taxation effects generated by the company as a result of the investment project under performance.

Taking into consideration the present condition of the extractive industry, and especially, the hard coal sector, a large number of mining plants should urgently effect a series of revamping or development investments. However, according to previous analyses (Franik 2000; Farys 1996), in many cases today's financial and economic position of such plants prevents them from having access to effective sources of outside capital; besides, even if such a capital were within an investor's reach, its cost is relatively high; and if such capital should be utilised for financing investment expenses, in most cases the efficiency of the mining project will be affected. Therefore, one of the best solutions which could guarantee efficient investments in a mining plant is the use of company assets for financing a project. For this purpose, the investor should first of all make use of means coming from depreciation deductions, since this is a sure and relatively 'cheap' source of capital.

So, as to determine the effect of the depreciation method for fixed assets upon net cash flows and investment efficiency, there has been performed appropriate research taking as example an investment project which concerned the replacement of fundamental machinery working in the flats of a hard coal mine which is still in operation. This is a revamping type investment, since the hitherto equipment is exchanged for a more efficient one. This investment is set in a 16 year time horizon, concurrent with the period in which the resources of the bed will be depleted and the plant will be decommissioned.

1. Depreciation methods for fixed assets applied in the mining sector in Poland and worldwide

As mentioned before, the mining sector worldwide makes use of a large number of depreciation methods for fixed assets and their modifications. In Poland, in the time of economic transformations, the legislation pertinent to the depreciation methods for the beginning value of assets has become more liberal. The autonomy of the business entity regards to a large extent also the management of fixed assets, including selection of the method and rate of their depreciation in order to reach the economic target. In this field, the basic limitation is, however, legislation which restricts the top level of depreciation rates whose application allows to include the depreciation costs in the tax deductible expenses, which influences the income tax assessment (in compliance with the Ordinance of the Minister of Finances in the matter of depreciation of fixed assets).

Apart from the depreciation methods generally applied in Poland, viz. linear and degressive methods, in some countries yet another procedures are used. The fundamental features of the five most important deprecation methods subject to analysis hereinafter are as follows:

1. Linear method (MLN).

   This is the simplest and most common method applied in the Polish mining industry. The difference between the beginning and the ending value of a fixed asset is subject to depreciation in equal annual amounts in the time of operation of the asset said, according to the relation:

$$A_r(t) = (Q_p - Q_k) \cdot \frac{1}{T} \tag{1}$$

   where:

   $A_r(t)$ — annual depreciation in a year t,

   Q_p — (gross) beginning value of a fixed asset which constitutes the base of depreciation,

   Q_k — ending (liquidation) value of the fixed asset,

   T — economical period of operation; here, the inverse period of operation determines the level of depreciation rate for the given fixed asset.

2. Degressive method (MDG).

   This method, instead, enables one to recover a higher value of a fixed asset in its first years of operation. In the years to come, the depreciation is calculated on the (net) current value; that is why in the United States this procedure is often referred to as 'the decreasing base deprecation'. In Poland is applied its modification – when the annual depreciation value calculated with the degressive method becomes equal to that calculated with the linear method, then the latter is applied. This will enable one to shorten the depreciation time for a fixed asset (accelerated method). In this procedure, the depreciation rate is multiplied by a number from 1 to 2 or even by 3 in the regions with high rate of structural unemployment. The annual depreciation rate is found from the relation:

$$A_r(t)=\left(Q_p-\sum_{x=1}^{t-1}A_r(x)\right)\cdot\frac{R}{T} \tag{2}$$

Taking into consideration the following condition:

$$\left(Q_p-\sum_{x=1}^{T-1}A_r(x)\right)\geq Q_k \tag{3}$$

where:

$A_r(x)$ — annual depreciation in previous years,
R — conversion factor used in the degressive method.

3. Method of sums of year digits (SOYD).

In this method, different depreciation rates are applied. For the given year, the rate is calculated from the quotient in which the numerator is the number of the remaining years of operation of the fixed asset, and the denominator is the sum of all digits from the numerators. As a result, we obtain depreciation rates decreasing with time. Therefore, this is also a degressive method. The annual depreciation value can be found from the relation:

$$A_r(t)=\left[\frac{(T+1-t)}{T(T+1)/2}\right](Q_p-Q_k) \tag{4}$$

4. Production units method (MJP).

The annual depreciation value calculated with this method is proportional to the year output. The depreciation rate is calculated by dividing the yearly output by the aggregate output viz. in the entire period of operation of the given fixed asset. Usually, as time goes by, the respective assets become less efficient due to wear. If the yearly output is constant in the entire period of operation, the depreciation value determined this way is equal to the value calculated with the linear method. Instead, in the production units method, the depreciation value can be determined from the relation:

$$A_r(t) = (Q_p - Q_k) \cdot \frac{W_r(t)}{\sum_{x=1}^{T} W_r(x)} \tag{5}$$

where:

$W_r(t)$ — output volume in year t.

5. Modified Accelerated Cost Recovery System (MACRS).
   Although the US mining sector applies selectively all the said depreciation methods (fore example, in Canada almost exclusively the degressive method) (Hajdasiński 1993), the American tax regulations permit the Modified Accelerated Cost Recovery System – MACRS. The system ranks all assets (real estates excluded) into classes whose depreciation periods are 3, 5, 7, 10, 15 and 20 years. Thus, such classes can exhibit a poor relation to the expected period of economical operation (Brigham, Gapenski 2000; Johnson 2000). This is a method of 200% decreasing balance (multiplying coefficient is 2), with a possibility of adopting the linear method. However, due to the application of the so-called half-a-year convention, (in the first year the depreciation value equals to the half of the amount computed with the degressive method), the actual depreciation period for a fixed asset is also one year longer than the period which results from the inverse of the basic depreciation rate.

2. Effect of the depreciation method upon the value of cash flows for an investment project related to the longwall equipment

In order to determine the effect of the method applied for depreciating fixed assets upon the volume of cash flows generated by an investment project, as an example was taken a project under performance in a hard coal mining plant which is still in operation. The scope of the investment project said postulates a systematical replacement of the equipment in longwalls and section haulage routes until the mine decommissioning. The machinery under analysis comprises: a combined cutter loader, mechanized supports as well as longwall, push plate and band conveyors.

The overall cost of such an extraction industry machinery is 29 404 thousand zloty [PLN].

The assumed net daily output is 9336.6 t/day, and has been hitherto won from 6 longwalls. A revamping of the stock of machines under the project under consideration, due to the application of more efficient machines, will allow to reduce the number of longwalls to three, and the average output will amount to 3112.2 t/day.

In relation to the 16 year period of operation of both the mine and of respective machines which arises from their depreciation periods – such machines will have to be replaced not a single time. The level of depreciation rates, allowed by the tax legislation and the resulting periods of operation of the facilities under analysis are as follows:

— longwall combined cutter and loaders 25%, time of use: 4 years,
— longwall supports 20%, time of use: 5 years,
— push-plate conveyors 50%, time of use: 2 years,
— band conveyors 25%, time of use: 4 years.

The said depreciation methods for fixed assets were used to determine the depreciation flow in all the period of operation of the project.

Fig. 1 presents an exemplary time related course for the depreciation value for a set of mechanized support in a single longwall, calculated with the rules typical for the said depreciation methods. In the production unit methods (also known as natural method) in order to differentiate the depreciation rates, there has been assumed a fall in the performance of fixed assets in the last two years of their operation; instead, in MACRS, the depreciation rates were typical for this method, but taking into consideration as well the normative period of use of a fixed asset. In the calculations, the zero ending value of fixed assets was postulated.

So as to assess the depreciation flow and cash flows generated by the project, it was necessary to prepare first a schedule of replacement of machines and devices under analysis in the entire investment project time.

This procedure allowed to find the total investment expenditure in the successive years of the period under analysis which was the sum of costs of purchase and assembly of respective parts of machinery in conformity with the adopted depreciation method. In the cash flow analysis it was assumed that the hitherto longwall infrastructure would be successively

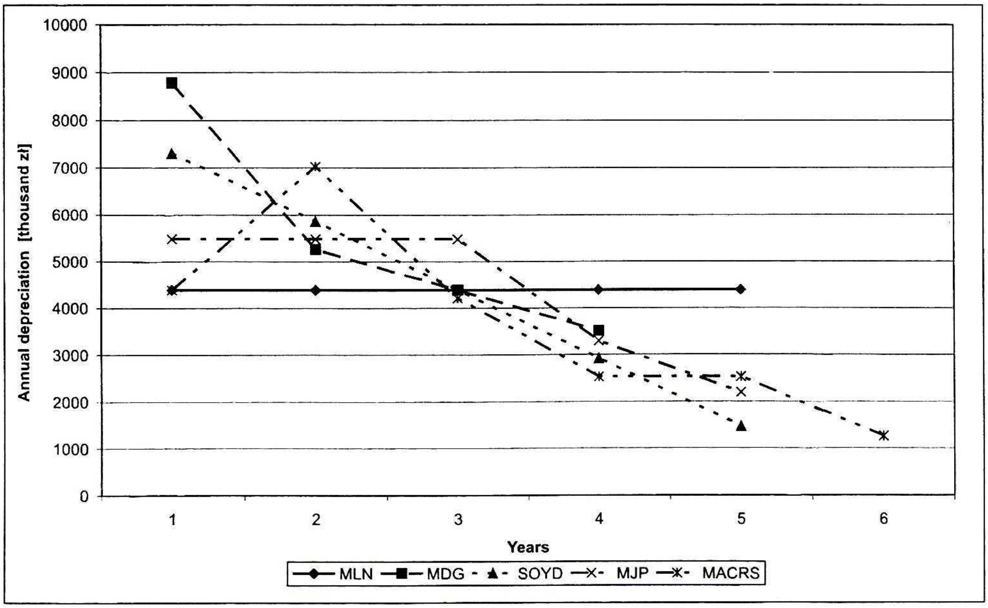

Fig. 1. Annual depreciation value for a longwall support according to the calculation methods used

Rys. 1. Wysokość amortyzacji rocznej obudowy ścianowej określonej według zastosowanych metod jej obliczania decommissioned in the first four years of the calculation period, and its undepreciated value would be as follows:

— in year 1 – 32 447.1 thousand zł,
— in year 2 – 27 347.3 thousand zł,
— in year 3 – 17 147.6 thousand zł,
— in year 4 – 10 199.7 thousand zł.

The said values supplement the amounts of depreciation by way of purchasing and amortizing new machines and devices, which means that they are in part used for financing the investment expenditures under the project herein referred to. In case of an opportunity of using financial means from the amortization of the facilities which are still in operation (for example, in the case of a development project crowned with new production potential), a partial financing of the project under analysis would have to be financed with outside capital, for example with an investment credit. This results from a shift – occurring on the time axis – of the flow of means recovered in the amortization process till the investment expenditures are spent

Fig. 2 presents the course for the flow of investment expenditures and depreciation calculated according to the methods described, in the successive years of the calculation period.

In this case are regarded only depreciation flows obtained as a result of depreciation of fixed assets generated in the process of an investment project. Respective methods applied

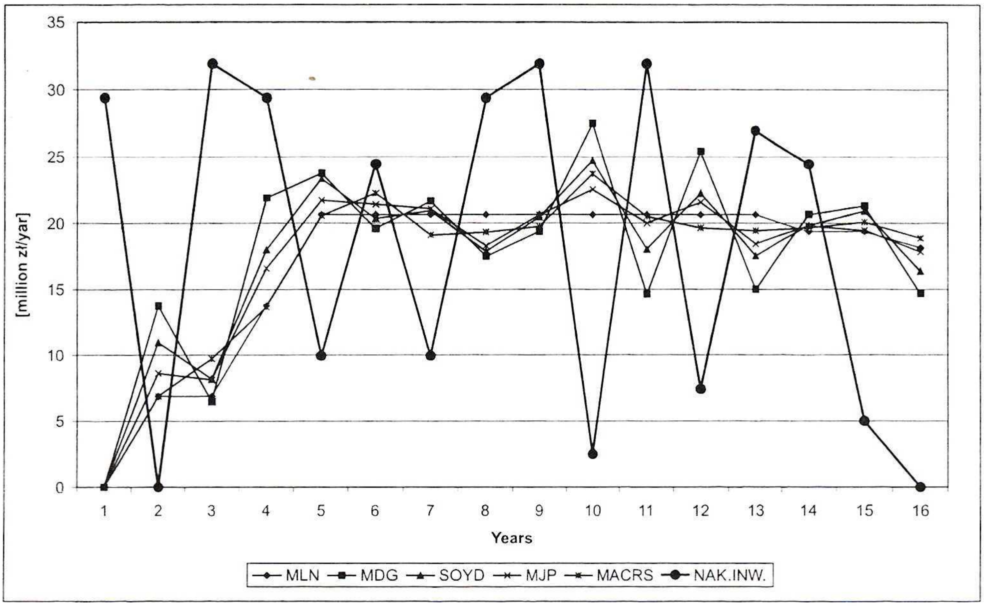

Fig. 2. Flows of investment expenditures and annual depreciation according to the procedure of its determination

Rys. 2. Strumienie nakładów inwestycyjnych i amortyzacji rocznej w zależności od sposobu jej określania for calculating the depreciation value give a level of amounts differentiated in time. Most significant modifications to the intensity of depreciaton flows occur in the case of the degressive method (version used in Poland); instead, the lowest ones occur for the linear method. That is why the use of the determined depreciation method can cause a faster or slower return of the capital invested, which undoubtedly affects the project efficiency. This is shown in Fig. 3, which presents the accumulative flows of investment expenditures and depreciation.

The relation occurring between the investment expenditures and the depreciation value in the given year determines the demand for the capital for financing an investment project.

The return of the capital invested is the fastest for MDG, followed by: SOYD, MJP (with the assumptions made for the fall in the machinery performance), MACRS and MLN. This is also reflected in the overall value of the unamortised fixed assets (net value) after a 16 year time of the mine operation, viz. at its decommissioning. The depreciation method is characterised by the fastest return of capital have the lowest level of the unamortised value of fixed assets. Those values are as follows:

— in method MLN – 24.436 million zł,
— in method MDG – 11.416 million zł,
— in method SYD – 14.843 million zł,
— in method MJP – 18.473 million zł,
— in method MACRS – 21.360 million zł.

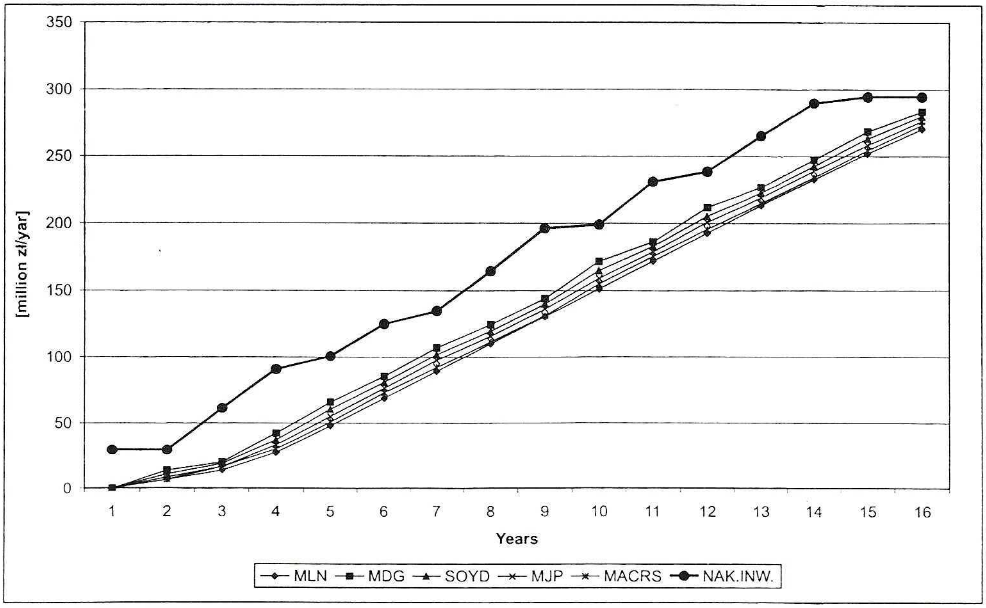

Fig. 3. Accumulative flows of current investment expenditures and annual depreciation according to the procedure of their determination

Rys. 3. Skumulowane strumienie bieżących nakładów inwestycyjnych i amortyzacji rocznej w zależności od sposobu jej określania

The said amounts also constitute the value of the total demand for investment capital in case 'current depreciation' is not used for financing the investment project; however, for each depreciation method used not only amounts are, but also their intensity in time are different from each other. This way one can determine the demand for outside capital in compliance with the depreciation schedule adopted for fixed assets. In the case under analysis, when 'current depreciation' is used, an investment project can be financed without outside financing sources by making use only of depreciation deductions.

The accumulative flows of investment projects and depreciation as shown in Fig. 3 are expressed in present values for the given year. The present value of those cash flows and the demand for capital resulting from their difference are shown in Fig. 4. For this purpose, present values of cash flows were discounted (at a rate of 10%) as of the beginning of the period under analysis, viz. when the decision on the realization of an investment project was made.

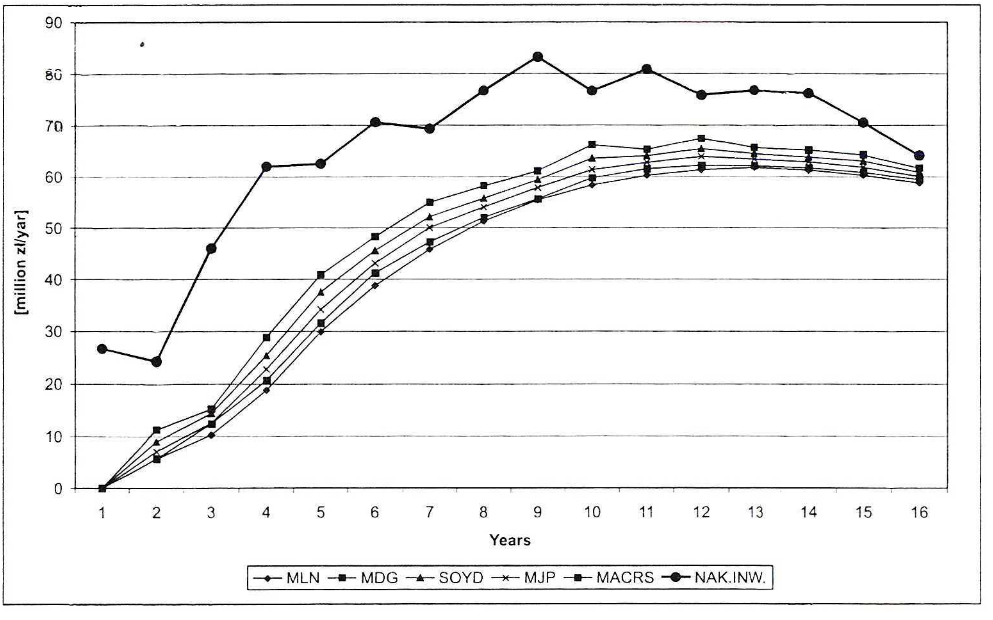

Fig. 4. Accumulative flows of updated investment expenditures and annual depreciation according to the procedure of their determination

Rys. 4. Skumulowane strumienie zaktualizowanych nakładów inwestycyjnych i amortyzacji rocznej w zależności od sposobu jej określania

3. Depreciation versus efficiency of an investment project and post-taxation effects of its implementation

The acceptance of a depreciation method for fixed assets is of importance for the assessment of an investment project, and successively, for its implementation. Each method is characterised with a time variable intensity of cash flow generated by the project, which in turn influences the efficiency of the project and economic results attained after its implementation.

The evaluation results for the efficiency of the investment project under performance expressed in NPV calculated for certain assumptions and various depreciation methods allow to indicate a method with which the investor could maximize the efficiency rate, viz. optimize the decision.

Fig. 5 shows the evaluation results for a project under performance by making use of NPV calculated for a real discount rate of 8%.

The results obtained show that the effect of the applied method for amortizing fixed assets upon the project efficiency is not considerable, although the NPV values are different in each calculation scheme. Relative differences in NPV values between the optimum and the worst variant do not exceed 1.5%. The lowest efficiency is found for MACRS, and this must be influenced by an extended period of depreciation of a fixed asset which is the case in this method. Here, the efficiency value is 93.7 million zł. Instead, the best results are found for the degressive method – here NPV is as high as 95.1 million zł; this method is followed by the linear method, which must be somewhat surprising since in this method the recovery of the invested capital is the slowest.

Another as useful evaluation criterion for a project may be: project's ability to generate profit and savings on taxes. In this case, we have different preferences in the matter of the selection of the depreciation method. The total net profit generated by the project together

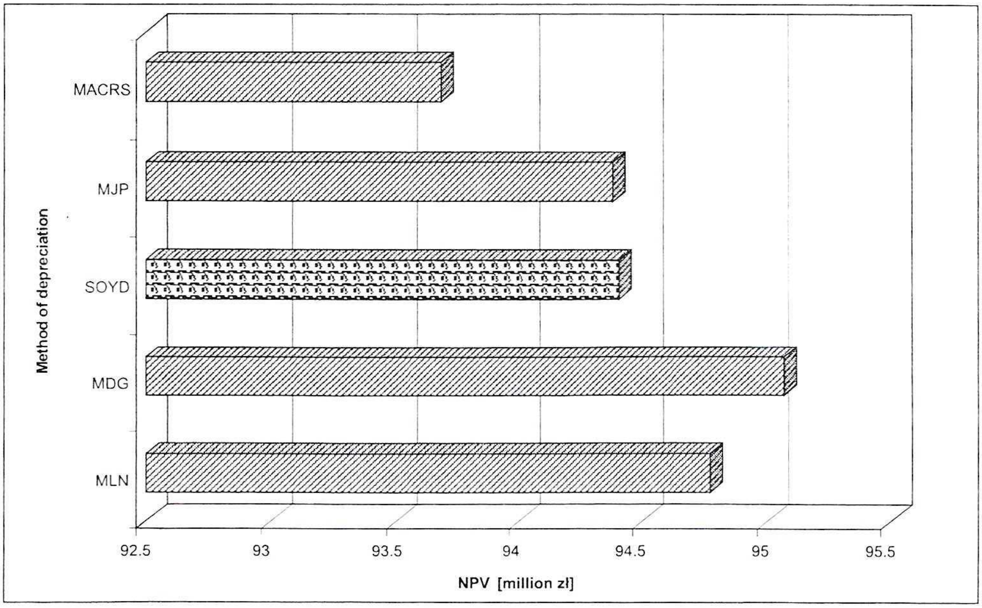

Fig. 5. Dependence between Project NPV and the procedure for depreciation fixed assets

Rys. 5. Zależność NPV projektu od sposobu amortyzowania środków trwałych with the determined depreciation method oscillates from 19.2 million zł for MDG to do 27.6 million zł for MLN; therefore, the best solution is the linear method – in this case, the profit exceeds by more than 43% the one obtained for the worst method [degression]. A high level of profit is generated also by the variant with MACRS. Generally, it can be stated that the net profit level is very low (for example, in comparison to the income tax amount), but the main reason is the fact that the calculation periods includes the mine decommissioning as well. A fall in coal extraction in this period appreciably influences an increase in proper expenses and a negative value of profit. Fig. 6 shows the course for the total net profit according to the way of depreciation fixed assets.

The level of total income tax, typical for the given variant of depreciation fixed assets, oscillates between 96.6 million zł for MDG to 101.7 million zł for MACRS.

From the investor's viewpoint, taking into consideration the income tax assessment, the best solution would be the degressive method [decreasing values method]. Income tax values in relation to the adopted procedure of depreciation is shown in Fig. 7.

In conclusion it can be said that when the said three evaluation criteria are considered, it is hard to say unambiguously which method of depreciation is the best for an investor. Undoubtedly, due to the degressive method, the investment efficiency is the highest and the return of the invested capital is the fastest, which is of importance for investment self-financing.

However, the application of this method does not guarantee the highest net profit amount in the investment under analysis.

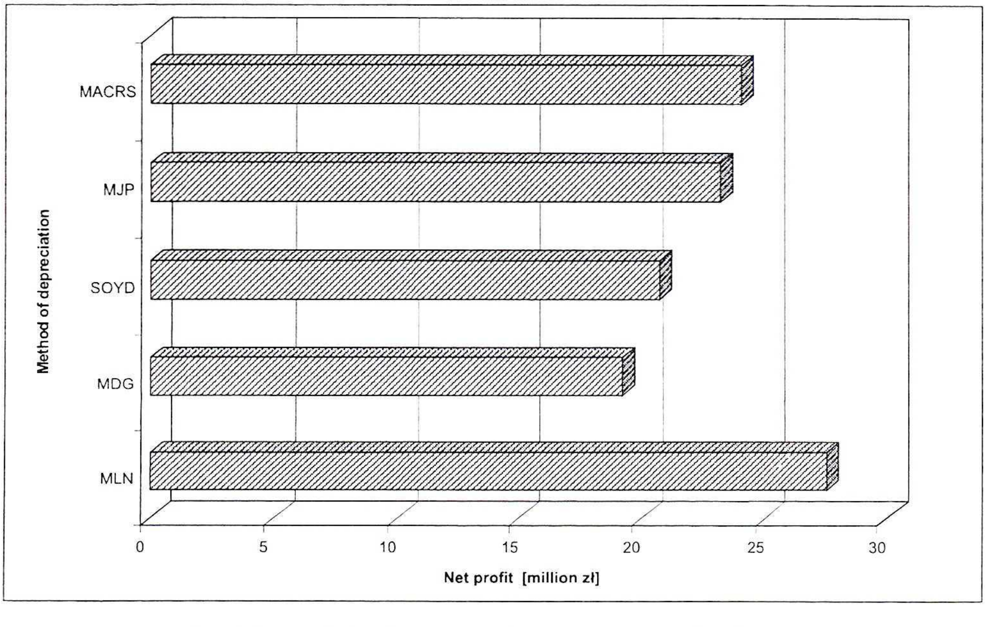

Fig. 6. Net profit level versus procedure of depreciation fixed assets

Rys. 6. Poziom zysku netto w zależność od sposobu amortyzowania środków trwałych

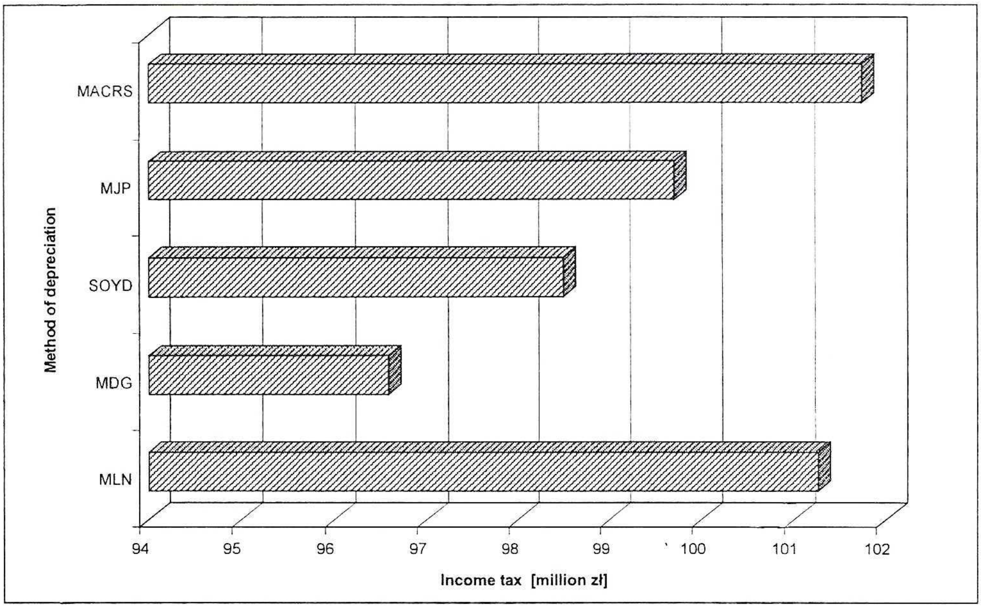

Fig. 7. Income tax amount versus procedure of depreciation fixed assets

Rys. 7. Wysokość podatku dochodowego w zależność od sposobu amortyzowania środków trwałych

Summary

The decisions related to the selection of the depreciation method are one of the most important in the field of finance management in a mining plant. The application of a determined amortizing method for the assets generated in an investment project influences appreciably the result of the evaluation of an investment project. Nevertheless, this is not an unambiguous effect, since in the case under analysis it depends to a large extent on the adopted evaluation criterion. If only the NPV for a project is used, the differentiation in effects is not high. A comprehensive evaluation should also include other criteria so as to enable one to adopt the best decision. Only a multi-criteria evaluation can give an unambiguous reply to selecting the amortization method for assets. It must be remembered that in the evaluation of business processes divergent targets may appear. The investor goes by the profit maximization criterion, whereas while evaluating projects, the criterion of efficiency indices maximization is followed. From the viewpoint of macroeconomics (social purposes) as important is the criterion of maximizing the income tax, which is not advantageous for the business entity.

Today's economic and financial situation in conjunction with the circumstances in which the form of the mining sector is performed cause a series of problems related to gaining access to effective sources of financing investment projects, indispensable for mines in order to reach a return on production and its further financing. The lack of full self-financing and problems in gaining access to bank credits may constitute one of the factors hindering the progress of fundamental reform targets.

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REFERENCES

Brigham E.F., Gapenski L.C., 2000 – Zarządzanie finansami. PWE, Warszawa.
Farys K., 1996 – Zewnętrzne źródła finansowania. Penetrator – Wiadomości Gospodarcze nr 6.
Franik T., 2001 – Wpływ sposobu amortyzowania środków trwałych na efektywność górniczych inwestycji odtworzeniowych i ich finansowanie. Materiały konferencji „Przemysł wydobywczy 2001", Wydawnictwo SCRIPTUM s.c. Kraków.
Franik T., 2000 – Efektywność rozwojowych inwestycji górniczych finansowanych za pomocą kapitału obcego. Materiały Szkoły Ekonomiki i Zarządzania w Górnictwie, Ustroń.
Francis J.C., Taylor R.W., 1991 – Investments – analysis and menagement. McGraw-Hill Pub. Company, New York.
Harmgardt W., Tiedtke J., 1992 – Inwestycje i finansowanie. Die Akademie, Bad Harzburg.
Hajdasiński M., 1993 – Podstawy ekonomicznej oceny projektów górniczych. I Szkoła Gospodarki Surowcami Mineralnymi, CPPGSMiE, Kraków.
Johnson H.J., 2000 – Ocena projektów inwestycyjnych. Maksymalizacja wartości przedsiębiorstwa. Wyd. Liber, Warszawa.
Pluta W., 2000 – Budżetowanie kapitałów. PWE, Warszawa.
Schenck G.H.K., 1985 – Methods of investment analysis for the minerals industries. SME, New York.
Stremole F.J., 1980 – Economic evaluation and investment decision methods. Investment Evaluations Corporation, Golden.
Wahl S., 1983 – Investment appraisal and economic evoluation of mining enterprise. Trans. Tech. Publications, Houston.

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AMORTYZACJA ŚRODKÓW TRWAŁYCH A EFEKTYWNOŚĆ INWESTOWANIA I EKSPLOATACJI ZAKŁADU GÓRNICZEGO

Słowa kluczowe

Górnictwo, górnictwo węgla kamiennego, metody amortyzacji, podatek dochodowy, ocena projektów

Streszczenie

Dzięki zastosowaniu określonego sposobu amortyzowania aktywów trwałych, inwestor uzyskuje strumień pieniężny, który wpływa na rachunek przepływów gotówkowych netto (*Net Cach Flow* – NCF). Fakt ten w sposób istotny wpływa na ekonomiczną efektywność ocenianego projektu inwestycyjnego. W artykule analizowano wpływ sposobu amortyzowania środków trwałych (przy zastosowaniu metody liniowej, degresywnej oraz metod stosowanych w krajach zachodnich) na kształtowanie się w czasie strumieni pieniężnych, wielkości obciążeń podatkiem dochodowym oraz efektywność projektu inwestycyjnego. Rozpatrywano również możliwość samofinansowania inwestycji ze środków pochodzących z odpisów amortyzacyjnych. Analizę przeprowadzono na przykładzie projektu inwestycyjnego polegającego na wyposażeniu oddziałów wydobywczych w kopalni węgla kamiennego w maszyny i urządzenia.