Determining the Moral Depreciation Function of Railway Vehicles in Market Economy Conditions: A Review

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Abstract

In this paper we have studied the necessity of determining the moral consumption (obsolescence) of wagons and locomotives in the conditions of market economy. In this case it has resulted that moral consumption should be determined by comparing the actual value of cash flows related to the operation of the object to be evaluated and the new analog object, for their term service. For this purpose we have determined the factors that affect the obsolescence of locomotives for freight transport. In the paper mathematical models has been employed and combined to arise to an equation able to determine the moral depreciation.

Keywords: *Market economy relations, moral consumption of railway rolling stock, appraised object, analog object, cash flows*

1. Introduction

Today, with the development of market relations, an increasingly important issue in Albania has become the evaluation of properties. This assessment is necessary for the following topics:

- Ensure the functioning of the secondary property market;
- Create and modify the structure of business entities (creation of business entities from the contributions of the founders, formation of such companies on the basis of existing enterprises and so on;
- Achieve accounting reliability, including an adequate definition of financial results;
- Approximate price information;
- Property insurance;
- Through private property is possible to gain the benefit of the loan and other purposes.

Currently, rail transport in Albania is in the process of structural reforms. The concept involves the creation of its basic structures. To create its basic structures, a revaluation of all its assets is required. In the process of the structure of the further railway transport reform, the issue of property valuation will not lose its importance.

It should be noted that today in the book value of fixed railway assets, we must take into account that what exists in accounting, is very different (several times) from the real market value. This reduces the reliability of accounting and distorts the magnitude of the costs and financial results of rail transport and the negative impact on tariff policy. Accounting standards in such situations require the revaluation of fixed assets [2].

In a market economy, entities are required to ensure that their current carrying amount is consistent with their fair market value, which must be achieved through periodic, occasional revaluations.

We add here that most of the active fixed assets of the railway consist that of the railway vehicle park. All railway vehicles in Albania are used. For example, the locomotive fleet consists of 25 units (in 2006), all of which are diesel-electric DC locomotives produced in the interval of 70-90 of the 20th century. Locomotives of this series have a number of constructive flaws and many of the technical characteristics are much smaller than those in modern models, which are produced today.

The presence of old locomotives and wagons makes it necessary to accurately determine the depreciation function in relation to the current similar facilities on the market [3]. In particular, it is necessary to take into account the fact that wagons and locomotives operate in a single technological process and the change of their technical-constructive characteristics can significantly affect their use.

To precisely determine a real state of the deterioration of technical-economic indicators we must develop a calculation method determining the functional deterioration of railway rolling stock. To achieve such a thing we have defined the steps we need to follow, which are as follows:

- Finding out the causes of damage to vehicles;
- The impact of technical parameters of rolling stock on their market value today;
- Construction of economic and mathematical models to determine the depreciation function of rolling stock.

2. Functional Depreciation of Railway Vehicles

Functional depreciation of an asset - is a loss in the value of the asset compared to the value of a similar new asset due to the total or partial loss of the original functional (consumer) characteristics of the object being evaluated [3].
According to the literature this functional depreciation is divided; in moral and technological depreciation.

Technological depreciation occurs when we have a radical change in the process, part of which is the object being valued [4]. Such depreciation affects the service of the facility in principle. The service of the facility can in principle be determined on the basis of an analysis of the useful services performed by the facility when the facility itself changes its functions.

According to the literature the causes of obsolescence are of two types, as follows;

Obsolescence of the first type - is associated with the arrival of objects with lower cost compared to the object that is valued, and that performs the same function. This could lead to a reduction in the new analogue cost or a corresponding reduction in operating costs. Therefore, in these cases there is a moral deterioration, caused by excessive investment costs, and moral consumption causes excessive operating costs.

Aging of the second type; occurs when the analog valuation object has a higher productivity.

The obsolescence of the first type is related to the technical-scientific progress in the industries that produce objects such as those that are valued. This progress has to do with reducing the production costs of the facility and the costs during the operating time which are achieved through increased labor productivity, more efficient use of assets, the use of cheap raw materials, to improve the production process and so on.

The obsolescence of the second type is caused by the impact of scientific and technological progress directly on the object being evaluated, which has to do with the improvement of the construction and the improvement of the performance of the objects during the use objects of similar purpose.

From what we said above we must emphasize that the obsolescence of an object is not an absolute value, and as such it can only be determined by the comparative method. The comparative method is about comparing an object that is evaluated with an analog object.

The obsolescence of the first type as an independent indicator is determined when evaluated by the method of approximation of the cost of reconstruction [3].

To determine the magnitude of the depreciation of the functional capacity of rolling stock, it is necessary to take into account that Wagons and Locomotives together form a system of bodies, the elements of which have a mutual influence. If we change the technical characteristics of rolling stock, as a result we will have changes in the operating performance of the system. For example, if we increase the speed of the locomotive through constructive changes, consequently, we will also have increased the speed of movement in that area. As a result of increasing the speed of movement we will have increase the output capacity of the railway line by reducing the wagon turnover. Increasing the carrying capacity not only improves their performance, but also increases the weight of trains. As a result we will have increased productivity of locomotives.

Then the determination of the functional deterioration of locomotives can be determined by studying some of their main parameters, which are their attractive characteristics (attractive force in different modes, computational speed) and costs related to their maintenance and repair.

Since the above parameters give us a technical-user condition of the vehicle, then, its obsolescence value will be based on the method of comparing the effectiveness of using the object that is evaluated with another analog object.

In this case, if we seek to replace the existing assets with other analog instruments, then the cost of replacing the assessed vehicle, taking into account the obsolescence, will be equal to the purchase price of a new conditional valuation facility, in which the net income deducted from its operation over its full life cycle will be equal to the discounted net income. From the operation of such an amount of analog rolling stock, which is sufficient to perform the same amount of work. The cost of replacing the building that is estimated on account of moral consumption is determined by the relationship below, equation (1):

$$\sum_{t=1}^{T} \frac{DP_t^{ob}}{(1+E)^2} - 1 \cdot X - n_i^{ob} \cdot C_v = \sum_{t=1}^{T} \frac{DP_t^{aN}}{(1+E)^t} - M_i^{aN} \cdot C_l^{aN} - n_i^{aN} \cdot C_v \qquad (1)$$

Where :

DP_t^{ob} : flow (turnover) of gross income related to the use of the facility being valued, for the respective year of the life cycle;

T - life cycle duration (Useful life of the object being evaluated);

E - discount rate;

X - Cost of replacement of the building that is estimated in function of obsolescence;

n_i^{ob}- The necessary inventory of the wagon fleet to supplement the calculated traffic volume, referring to the attractive force of the locomotive being evaluated;

Cv - Average price of a freight wagon;

DP_t^{aN} - Gross cash flow (turnover) related to the use of the analog object;

M_i^{aN} - park inventory of analog locomotives needed to meet the projected volume of traffic.

C_l^{aN} - the price of a new analog locomotive excluding VAT;

n_i^{aN} - wagon fleet inventory needed to supplement the calculated volume of traffic with an analogue locomotive.

Gross income is defined by the formula expressed in equation (2) :

$$DP = (D - E) \cdot (1 - H_{NP}) + A \cdot H_{NP} \qquad (2)$$

Where

DP - gross income

D- Income without indirect taxes;

E - cost of operation without depreciation;

H_{NP}- Income tax rate;

A- Depreciation (monetary value of depreciation) for tax purposes.

Since both sides of equation (1) are written for the same traffic, then the revenue value is the same for both sides of the equation. After substitution (2) in equation (1) and the corresponding changes the formula for determining the moral cost (substitution due to obsolescence) takes the form of the equation (3):

$$X = M_i^{aN} \cdot C_l^{aN} + \sum_{t=1}^{T} \frac{(E_t^{aN} - E_t^{ob}) \cdot (1 - H_{NP}) + (A_t^{ob} - A_t^{aN}) \cdot H_{NP}}{(1+E)^t} + \left(n_i^{aN} - n_i^{ob}\right) \cdot C_v \qquad (3)$$

The calculation of the annual volume of traffic that the estimated locomotive can perform is determined based on the average (or standard) percentage of locomotives in the repair process and the calculated productivity, equation (4):

$$\sum \quad PL_{br} = 1 \cdot \left(1 - \varphi_l^{ob}\right) \cdot F_l^{ob} \cdot 365 \qquad (4)$$

Where :

PL_{br} annual turnover of gross goods calculated;

φ_l^{ob} average (or normative) percentage of series locomotives evaluated, defective;

F_l^{ob} The calculated productivity of the locomotive being evaluated.

The estimated production capacity of the locomotive that is estimated is determined by the formula given in equation (5):

$$F_l^{ob} = \frac{Q_{br}^{ob} * S_l^{ob}}{1+\beta} \qquad (5)$$

Where :

Q_{br}^{ob} gross calculated weight of the train for the locomotive being estimated;

S_l^{ob} average daily calculated distance traveled by the locomotive being evaluated;

β- the coefficient of kilometers traveled by the head of the train (taken equal to the average level for the object being evaluated and the analog one).

The gross estimated weight of the train is determined taking into account the size of the increase projected for average locomotive operating conditions. [5] For this the magnitude of the calculated increase is assumed to be equal for the locomotive being evaluated and for the analog locomotive. Thus, the calculated weight of trains for the locomotive being evaluated and for the analog locomotive will vary depending on the traction force in the long-term mode and the calculated speed.

The average daily kilometers traveled by the locomotive can be determined by equation (6):

$$S_l^{ob} = \frac{24\, V_{ll}^{ob}}{1+\frac{t_{m.xh}\, V_{ll}^{ob}}{2L}} \qquad (6)$$

Where:

V_{ll}^{ob} the computational speed of use for the object being evaluated;

$T_{m.xh}$ Average time for single locomotive, for filming (mainly in warehouse, time necessary for change of locomotive staff) - is taken at an average level equal to the object being evaluated and analog;

L- The length of the circulating part of the locomotive - is assumed to be equal to the average level for the object being evaluated and analog.

During the evaluation we assumed that the ratio of technical speed for the object being evaluated and that analog, is equal to the ratio of their calculated speeds. In this way the average technical speed (determined by statistical data) and is equal to the arithmetic mean of the calculated technical speed of the object being evaluated and the analog object. Then, the technical speed can be given through equation (7):

$$V_{tek}^{ob} = \frac{2V_{ll}^{ob}}{V_{ll}^{ob}+V_{ll}^{aN}} \cdot V_{tek} \qquad (7)$$

Where:

V_{tek}^{ob} the technical calculation speed of the object being evaluated;

V_{ll}^{ob} the computational speed of the object being evaluated (from the drawing diagram);

$V_{t.ll}^{aN}$ Computational speed of analog;

Vtec Factual technical speed (based on statistical data).

The zonal speed (of the line where the locomotives circulate) for the object that is evaluated is determined by the formula expressed in equation (8):

$$V_z^{ob} = \frac{1}{\frac{1}{V_{tex}^{ob}}+\frac{1}{V_f}-\frac{1}{V_{tek}}} \qquad (8)$$

Where:

V_z^{ob} the speed calculated for the given part for the object to be evaluated;

V_f actual speed for the given part (taken from statistics).

The production of the analog locomotive is determined in a similar way as we did for the locomotive being evaluated.

The inventory park for analog locomotives is determined by the formula given in equation (9):

$$M_I^{aN} = \frac{\sum \quad PL_{br}}{(1-\varphi_l^{aN})\cdot F_L^{aN}\cdot 365} \qquad (9)$$

Where:

φ_l^{aN} average (or normative) percentage of series locomotive defects - analog;

F_L^{aN} computational production of analog locomotive.

On the other hand, the inventory of the wagon park for the object to be evaluated is determined by the formula given in equation (10):

$$n_i^{ob} = \frac{\sum \quad PL_{br}}{(P_{din}^{p}+m)\cdot\frac{24\cdot 365}{\frac{1}{V_{ll}^{ob}}-\frac{1}{V_{ll}}+\frac{1}{S_v}}\cdot(1-\varphi_v)} \qquad (10)$$

Where:

P_{din}^{p} dynamic load of the working wagon park;

m - average weight of tare of wagons;

Sv - average kilometers traveled by wagons;

φv - percentage of defective wagons.

The park inventory for analog vehicles is determined in a similar way.

Operating costs (for the object being evaluated and the analog object) are determined by the cost norms. For this, clean train depreciation for locomotives and wagons has been removed from the train. Maintenance and repair costs are determined by a direct account of the average actual (or normative) costs for the respective series of locomotives for the period between overhauls. Relevant items of expenditure are excluded from expenditure rates. The rate of energy consumption (fuel for transport is set taking into account the energy consumption rates for the respective locomotives.

To calculate net depreciation it is appropriate to take as its initial value for the analog object its price without indirect taxes, and for the object being valued - its cost is replaced by that of moral consumption. Depreciation for tax purposes is determined by the residual value. For each year, it can be calculated from the formula given in equation (11):

$$X = \frac{M_i^{aN} C_l^{aN} + \sum_{t=1}^{T} \frac{\left(E_t^{aN} - E_t^{ob}\right)(1 - H_{np})}{(1+E)^t} + \left(n_i^{aN} - n_i^{ob}\right) C_v - C_l^{aN} H_{np} a \frac{(1+E)^T - (1-a)^T}{(E+a)(1+E)^T}}{1 - H_{np} a \frac{(1+E)^T - (1-a)^T}{(E+a)(1+E)^T}} \quad (11)$$

The absolute value of the obsolescence is defined as the difference between the price of an analog object and the cost of replacement, taking into account the obsolescence. The ratio of the amount of obsolescence to the price of an analog object shows the obsolescence coefficient.

3. Discussion and Conclusions

In this paper has been developed a model, given by formula (11), to determine the moral consumption of locomotives and freight wagons according to common depreciation theories used in economics.

The study referred to above, allows us to draw the following conclusions:

In the evaluation of railway rolling stock it is necessary to determine the moral consumption of the second type. The moral consumption of the first type serves for the choice of the analog object.

The obsolescence of wagons and locomotives should be determined by their dependencies.

The replacement cost due to moral consumption, is defined as the limit price of the new facility and is identical to the parameters of the facility being valued, in which the net present value of its use will be equal to the net present value of the Facility- analog which is enough to carry the same volume of traffic.

Factors influencing the value of moral consumption, in relation to the object of evaluation are divided into internal and external. For freight locomotives the main internal factors are traction force, calculation speed, specific energy consumption, maintenance and repair costs, average percentage of damaged locomotives. External factors are the road profile, the technical and zonal speed developed, the dynamic load of freight wagons, the average weight of wagons (tare), the percentage of damaged wagons, their average price, as well as the rate of return on investment in this industry.

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