FUNCTIONAL MODEL FOR DETERMINING THE OPTIMAL DURATION OF USE OF FIXED ASSETS

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Abstract

The purpose of this paper was to present a functional model for determining the duration of use of fixed assets based on the relationship between the average fixed cost of depreciation of the fixed medium and the opportunity cost determined by the market of the respective product. The objectives of the paper included: 1. determining the correlation between the duration of use, the total distance travelled and the price of fixed assets; 2. determining the optimal duration of use of the fixed assets based on the relationship between the average fixed cost and the opportunity cost. In order to determine the optimal duration of use, the minimum marginal cost of depreciation was calculated as the ratio of the difference between the prices between moments n and n + 1 and the length or kilometres travelled in the range n and n + 1. Also, the marginal opportunity cost for the remaining transport capacity to be used was determined starting from the hypothesis that the market assigns a price to a usable capacity and to a capacity too old to be used, the price is nil. As a result, we identified the average price for the maximum duration or distance of use. The marginal opportunity cost was determined as the ratio between the price at one point and the remaining difference to be used by kilometres or old. The remaining difference to be used was calculated as the difference between the maximum duration that can be used and the time at time i or the maximum distance travelled and the distance travelled at price i. The average cost with the depreciation of the fixed means analysed is determined by the distance travelled and its age. The proposed model allows to determine an optimal duration of use of the fixed means according to their age and the transport distance. This model can be easily adapted to other types of fixed assets and the quality of the results is given by the existence of a significant number of data on their selling prices.

Key words: optimum use, investments, opportunity cost

Increasing the lifespan of fixed assets is a particularly current challenge, especially in the conditions of accelerated environmental degradation (Krezo S. *et al*, 2016; Tscheikner-Gratl F. *et al*, 2015; Twerefou DK. *et al*, 2015). In contrast, this desire may lead to higher costs for companies due to increased repair costs (Guiraud P, Moulinier F., 2008; Robati M., McCarthy TJ., 2018). As a result, scientific research seeks solutions to maximize the life span of fixed assets while increasing the economic performance of companies (Budde M., Minner S., 2015; Yard S., 2000; Pascual R. *et al*, 2016)

MATERIAL AND METHOD

The purpose of this paper was to present a functional model for determining the duration of use of fixed assets based on the relationship between the average fixed cost of depreciation of the fixed medium and the opportunity cost determined by the market of the respective product.

The objectives of the paper included: 1. determining the correlation between the duration of use, the total distance travelled and the price of fixed assets; 2. determining the optimal duration of use of the fixed assets based on the relationship between the average fixed cost and the opportunity cost.

In order to determine the optimal duration of use, the minimum marginal cost of depreciation was calculated as the ratio of the difference between the prices (P) between the moments n and n + 1 and the seniority (D) or kilometres (P) travelled in the interval n and n + 1 after calculation relation:

$C_m=(P_n-P_{n+1})/(D_n-D_{n+1})$ or

$C_m=(P_n-P_{n+1})/(R_n-R_{n+1})$.

Also, the marginal opportunity cost for the remaining transport capacity to be used was determined. This process started from the hypothesis that the market assigns value (price) to a usable capacity and to a capacity too old to be used, the price is null. As a result, we identified the average price for the maximum duration or distance of use.

The marginal opportunity cost was determined as the ratio between the price at one point (Pi) and the remaining difference to be used by kilometres or by age. The remaining difference to be used was

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calculated as the difference between the maximum usable duration (Dmax) and the time at time i (Di) or the maximum distance travelled (Rmax) and the distance travelled at price i (Ri) after the calculation relation:

$C_o=P_i/(D_{max} – D_i)$ or

$C_o=P_i/(R_{max} – R_i)$.

The research methodology consists of conducting a case study within an economic unit active in agriculture. The information used was obtained from the commercial databases, online AUTOVIT.RO (www.autovit.ro., 2019), AutoScout24.ro (www.autoscout24.ro, 2019) and MOBILE.DE (www.mobile.de, 2019). From these were extracted data on a means of transport freight - utility vehicle with a specific brand (which will not be specified in order not to cause image damage), 136 HP, payload: 2,801 - 3.5 t. including prices according to the length and number of kilometres travelled until the announcement was posted.

Data processing was performed in Microsoft Office and SPSS with the Pearson correlation coefficient, the regression coefficient and the ANOVA matrix determined.

RESULTS AND DISCUSSIONS

The determination of the correlation between the duration of use, the total distance travelled and the price of the fixed means indicated a Pearson coefficient of -0.673, which suggests a reduction of the price according to the increase of the distance travelled by the means of transport for which the research is carried out.

Table 1

The correlation between the number of km travelled and the price

		No. Km	Price (euro)
No. Km	Pearson Correlation	1	-.673**
	Sig. (2-tailed)		.000
	N	178	178
Price (euro)	Pearson Correlation	-.673**	1
	Sig. (2-tailed)	.000	
	N	178	178
**. Correlation is significant at the 0.01 level (2-tailed).			

The correlation between the number of km travelled and the price is statistically ensured for an error of 1% for a sample of 178 values.

Table 2

The correlation between age and price

		Price (euro)	Years old
Price (euro)	Pearson Correlation	1	-.846**
	Sig. (2-tailed)		.000
	N	178	178
Years old	Pearson Correlation	-.846**	1
	Sig. (2-tailed)	.000	
	N	178	178
**. Correlation is significant at the 0.01 level (2-tailed).			

The correlation between age and price (tab. 2) records Pearson coefficient values of -0.846 for the same error, showing that the price decreases depending on the length of use.

Table 3

The correlation between the value of the depreciation and the price

		Depreciation (euro/km)	Price (euro)
Depreciation (euro/km)	Pearson Correlation	1	.713**
	Sig. (2-tailed)		.000
	N	178	178
Price (euro)	Pearson Correlation	.713**	1
	Sig. (2-tailed)	.000	
	N	178	178
**. Correlation is significant at the 0.01 level (2-tailed).			

The correlation between the value of the depreciation and the price (table 3) is positive and has a value of the Pearson coefficient of 0.713, statistically assured for the same error of 1%. These values confirm the hypothesis that the depreciation is determined by the distance travelled by the means of transport and its age.

Therefore, the regression relation between the values of the average depreciation with the useful life and the number of kilometres travelled has been determined.

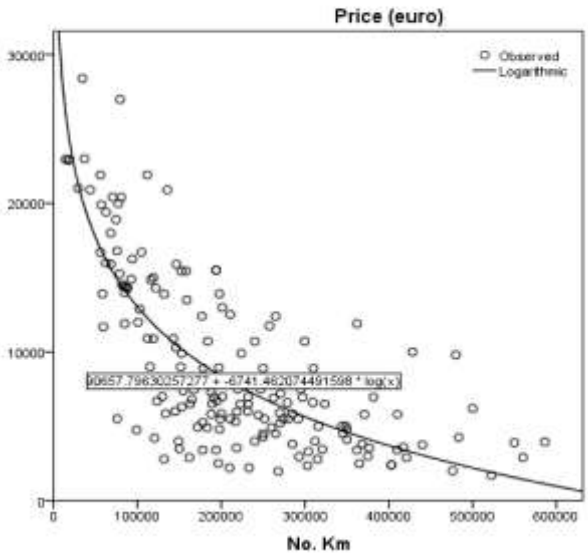

Figure 1 **The regression relation between the total distance travelled and the price**

The regression relation between the total distance travelled and the price (fig. 1) indicates that by using the depreciation determined cost decreases logarithmically with the distance travelled. Model Summary: R = 0.786, R Square = 0.617, Adjusted R Square = 0.615, Std. Error of the Estimate = 3624.796, ANOVA: Sum of Squares = 3726125750, df = 1, Mean Square = 3726125750, F = 283.59, Sig. = 0.000. The independent variable is No. Km.

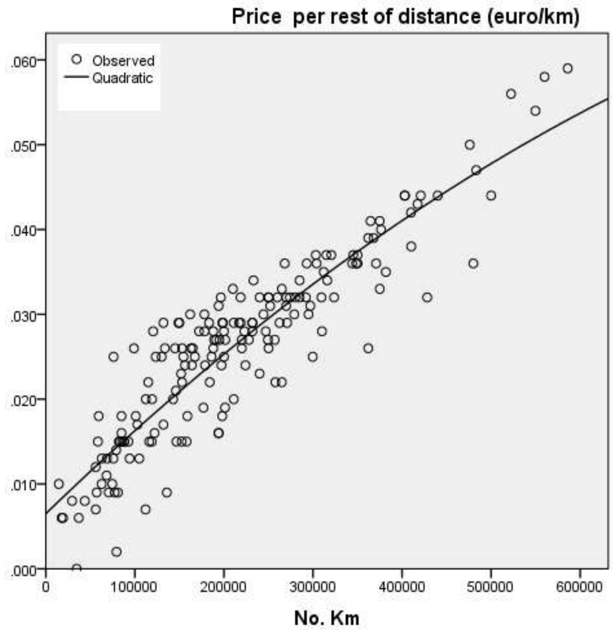

Figure 2 **The regression relation between the total distance travelled and the price for the remaining distance for use**

The regression relation between the total distance travelled and the price for the remaining distance for use (fig. 2) indicates that through use the cost determined by depreciation increases quadratically with the reduction of the remaining distance for use. Model Summary: R = 0.91, R Square = 0.828, Adjusted R Square = 0.826, Std. Error of the Estimate = 0.005. ANOVA: Sum of Squares = 0.017, df = 2, Mean Square = 0.009, F = 422.022, Sig. = 0.000. The independent variable is No. Km.

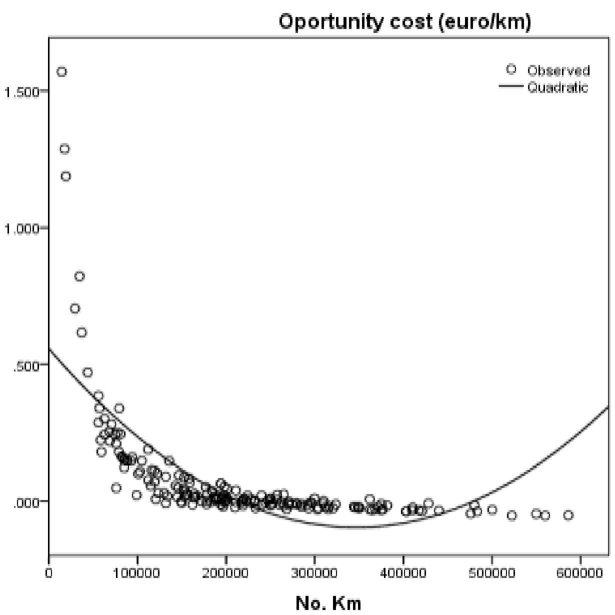

Figure 3 **The regression relation between the total distance travelled and the price**

The regression relation between the total distance travelled and the price (fig. 3) has a quadratic shape indicating a minimum cost: 0.007 euros / km at approx. 348,000 km. Model Summary: R = 0.734, R Square = 0.538, Adjusted R Square = 0.533, Std. Error of the Estimate = 0.144. ANOVA: Sum of Squares = 4.25, df = 2, Mean Square = 2.125, F = 102,038, Sig. = 0.000. The independent variable is No. Km.

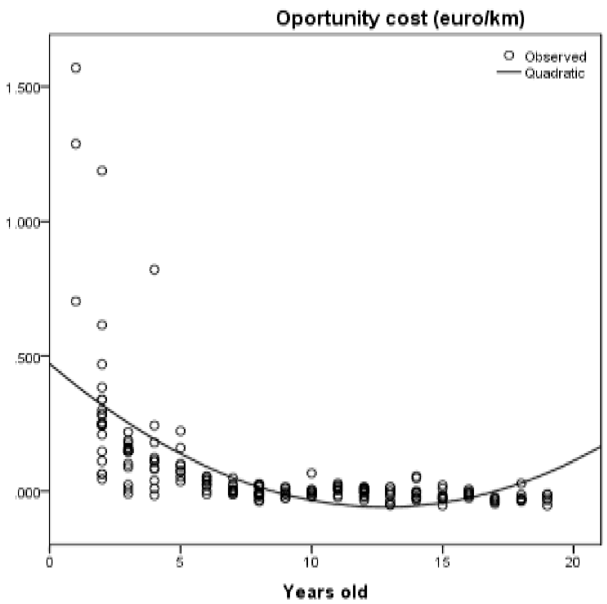

Figure 4 **The regression relation between the age of the fixed medium and the price**

The regression relation between the age of the fixed medium and the price (fig. 4) has a quadratic shape. Model Summary: R = 0.639, R Square = 0.409, Adjusted R Square = 0.402, Std. Error of the Estimate = 0.163. ANOVA: Sum of Squares = 3,228, df = 2, Mean Square = 1,614, F = 60,517, Sig. = .000. The independent variable is Years old. This indicates a minimum cost with depreciation of 0.007 euros / km at 12.4 years.

The proposed model allows to determine an optimum duration of use of the fixed means according to their age and / or the transport distance.

It can be easily adapted to other types of fixed assets and the quality of the results is given by the existence of a significant number of data regarding their prices.

The shortcomings of this research consist in the fact that all the calculations were made based on the information on the prices of the car offer. The existence of sufficient information about the sale price would ensure an additional level of rigor in this approach.

We specify that these results will be different from those that would be obtained by optimizing the internal costs of the users in which the costs of repairs are included (for example) but this model can provide benchmarks in order to make the opportunity decisions.

By using this model, the users of fixed assets can significantly reduce the operating costs and most likely the social and environmental costs.

CONCLUSIONS

The average cost with the depreciation of the fixed means analysed is determined by the distance travelled and its length.

The proposed model allows to determine an optimal duration of use of the fixed means according to their age and the transport distance.

This model can be easily adapted to other types of fixed assets and the quality of the results is given by the existence of a significant number of data regarding their prices.

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