Companies in liquidation
A model for the assessment of the value of used machinery

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Abstract: - The current economic crisis is creating serious global effects on the real economy, especially in terms of solvency and economic stability of many companies, forced to interrupt their activities and to initiate bankruptcy proceedings. In this case, the assessment of the value of the industrial machinery that can be reused is a problem that often arises. In the literature different approaches to estimate plant and industrial machinery are illustrated. Each method includes several specification and, in practice, only in exceptional cases, there are consistent data for comparison. The major problem consists in the identification and the valuation of the level of depreciation which intervenes in the definition of the value of used industrial machinery. In the present work an algorithm to determine in a rational manner the depreciation of used industrial machinery has developed. The procedure has its theoretical basis in the analysis of formal deductions of the value of new machinery. The model defined in this research considers the factors that contribute to decrease the original value of the machinery. Empirical formulas have been developed to estimate the market value of used industrial machinery on the basis of quantitative and qualitative analysis of depreciation functions. The interpretation and schematization of the results have led to the definition of value-time curves for the three main depreciation factors (age, income decay, obsolescence). The result is a flexible model for the evaluation of different types of machinery and a simply procedure, with a reduced number of variables to be taken into consideration. The paper must be attributed in equal parts to the three authors.

Key-Words: - estimation model, value of used industrial machinery, depreciation factors, companies in liquidation.

1 Introduction

The current economic crisis is drawing attention to the need to employ, in any sector (e.g. in the real estate market [1,2,3], in the urban planning [4], in the environmental resource management [5]), assessment tools that allow to manage the investment risk. The effects of the crisis are emerging especially in the manufacturing sector, where many companies, as a result of the collapse in demand for goods and services and of the credit crunch practiced by banks, are bankrupt and are currently in the process of liquidation.

This work defines a procedure for estimating the depreciation of industrial machinery. This problem often arises in the case of companies undergoing liquidation where there is machinery that can be reused. The depreciation value of this machinery therefore needs to be applied.

In practice, this problem is solved with empirical procedures for defining the depreciation coefficients, which leads to the presence of subjectivity margins related to the competence, experience and sensitivity of the evaluator. The proposed model involves the use of very little input data, generally available, as well as the quantitative and qualitative analysis of the effects generated by the passing of time on the machinery, which lead to the depreciation upon which the value of the used machinery is based.

The paper is structured as follows. Paragraph 2 deals with the issue of calculating depreciation and the procedures that are can be used in different concrete situations to estimate the market value of machinery. In paragraph 3, the possible degradation factors are classified into intrinsic and extrinsic, since they contribute and measure the decrease of the original value of the machinery. Paragraph 4 defines the algebraic expressions for the calculation of the reduction in value arising from intrinsic factors, whereas the expressions of the decrease generated by the extrinsic factors are discussed in section 5. In paragraph 6, the various algebraic relations are summed to obtain the functions of depreciation. On the basis of a working hypothesis and depending on the type of machinery, a depreciation model for estimating the value of new machinery is discussed in paragraph 7. Paragraph 8 briefly outlines the conclusions of the work.

2 Terms of the problem

Whatever the reason generating the evaluation of used industrial machinery may be, the final judgment is the synthesis of the logical process which, in monetary terms, is effected by the passing of time. While, on the one hand, it is easy to recognize the cause of these effects, namely the loss of value of the asset according to age, on the other hand, it is difficult to measure the extent of the loss.

In the literature different approaches to estimate plant and industrial machinery are illustrated. In fact, the methodologies proposed recall the procedures explained by International Valuation Standard Council (IVSC) for real estate evaluation: the sales comparison approach (market approach), the cost approach (depreciated replacement cost) and income capitalization approach. The first two methods are generally preferred by valuers: data required for the evaluation allow to obtain an estimate more justifiable and defendable than the result of income capitalization approach [6]. Furthermore, each method includes several specification. Direct match method, comparable match method and percent of cost method are some market approaches. Methods of cost approach include percentage of delivered equipment cost estimate, capacity ratio estimate and cost indexing [7,8]. The normal income method (capitalization of earning method) and discounted future earning method are two different types of income capitalisation approach [9].

In practice, only in exceptional cases, there are consistent data for comparison. In general, there is no market for used industrial machinery, with there, therefore, being a lack of basic data that makes it possible to directly estimate the present value. Since there are no direct references, if the machinery is still on the market the current value can be estimated using the transformation value, which is calculated as the difference between the estimated value of the new machinery, still on the market, and the costs (simple revision, replacement of parts, etc.) to restore the machine to the same conditions as a new one.

The machinery may no longer be produced. In this case, it may be possible to manufacture a similar one, although with construction techniques different to those which had been used in the production of the machinery to be evaluated. In this case, the determination of the present value passes through the estimation of the depreciated reconstruction costs, considered as the difference between the cost to realize, at the time of the estimate, machinery similar to that in use, and the costs to confer to the latter the conditions of the machine to be rebuilt.

More simply, the estimated cost of the reconstruction could be avoided by comparing it with a machinery currently available on the market, with similar features and functions, even if more technologically advanced, to the one being evaluated. In this case can be used the value of subrogation: to obtain the current value of the machinery, the price of the one on the market should be noted, with the difference due to technological innovation and physical attrition between the two pieces being subtracted.

The estimate therefore takes place in two phases. The first is the process of determining the replacement value of the used piece of machinery through the identification and detection of the market price of 1) the same machine if it is still on the market, or 2) a machine on the market with similar features and functions, even if more technologically advanced. In the second stage, the original value is reduced. In the first case, this reduction must correspond to the cost of physically restoring the piece of machinery being evaluated. While, in the second case the reduction must be equal to the cost of technologically and physically restoring it. Since it is neither easy nor physically possible to evaluate the costs to restore the piece of used machinery to the characteristics of a similar piece currently available on the market, the estimate is resolved with the determination of depreciation by coefficients to be applied to the value of a new one.

3 Depreciation factors

In general terms, the depreciation is generated by a plurality of factors, which exert an impact on the value of an asset whose measure depends essentially on its characteristics. The passage of time leads to an inevitable reduction in the value of an asset, due to the fact that it becomes near the end of its *operating* life. This concept should be distinguished from the useful *economic* life, that is the period during which it is expected that the asset will be used as the representative of the less expensive solution than the use for which it is intended (National Bureau of Standards). On the other hand, an asset no longer new, undergoes a depreciation respect to another identical in characteristics but of new production, because the use in time and therefore the inevitable wear compromises the functionality. The need of having to ensure competitive performance respect to new assets will require ever higher maintenance costs; in the absence of these interventions, there would be a gradual performance degradation.

In the indirect estimate, depreciation is usually quantified with coefficients applied to the value of new machinery. The evaluator determines an overall coefficient, or more coefficients, through the evaluation of the effects of the passing of time and income decay factors on the machinery [10]. These factors can be classified into two groups: intrinsic, those directly related to the type of machinery and the function that it has; extrinsic, those derived from the boundary conditions, such as usage conditions and maintenance of the machinery, with market phenomena also leading to changes in value. Both the first and second result in deductions, sometimes added, to the value of a new piece.

Intrinsic Factors. The intrinsic factors generate reductions in value due to age and income decay. Depreciation due to age is the inevitable consequence of the fact that a piece of machinery, regardless of its economic benefits, in comparison with a corresponding new piece has a shorter efficiency life span. The reduction must therefore correspond to the difference in value between two pieces of machinery that have identical characteristics of productivity and equal operating costs, but a different useful life [11]. The reduction due to income decay is, however, the effect of the lesser utility of an asset already in use compared to the corresponding new piece of machinery, due to increasing operating costs, along with a more and more frequent need for extraordinary maintenance [12]. The reduction must also take into account the costs in the event of machinery failure and related slowdowns or stoppages required to carry out repairs [13,14].

It is therefore evident that a more accurate and expensive maintenance produces, on the one hand, a growth of the deduction for income decay, whereas, on the other hand, makes it possible to prolong the efficiency of the machine with the consequent reduction of the deduction due to age [15].

The way the machinery is used and the quality of maintenance are significantly influential on the sum of the two deductions. Thus, these variables can be considered in the calculation of the ordinary type of deduction for income decay. This also includes the assumption of income decay between the intrinsic factors of degradation.

It is important to take into account the possible future use of the piece of machinery when estimating its present value [16,17]. It may be possible that the piece of machinery was conceived to be used exclusively at the site of the initial installation, or that it may be materially and economically convenient to transfer it to another site. In the first case, and when the company is undergoing liquidation, it is logical that the machinery has no value except that corresponding to its disposal [18]. The machine can even assume a negative value when the owner is forced to dispose of it (disassembly and transport) [19]. In the case of a change in management, it may be possible to reuse the machinery on site. In this case, the possibility of physically moving the machine and the depreciated value of a new piece, obtained by applying the deductions for depreciation consequent to the different factors of degradation, plus the value of the economies resulting from savings of purchase and installation time of a new piece of machinery are irrelevant. Dismantling, transportation and assembly costs are not taken into account.

In the event of the machinery being reused within the same company, it can also occur, due to obsolescence caused by an incorrect technical organization and operation of the plant or following modifications and transformations of the production programs, that a further deduction must be made to the value of a new piece, due to the fact that the machinery does not produce as much as was paid for it, due to the changed organization and production conditions.

Extrinsic factors. For the definition of the present value of a piece of machinery, the evaluator should also consider the depreciation generated by extrinsic factors [20,21]. The technological and functional obsolescence of the machinery can accelerate depreciation [22]. The corresponding deduction is due to being “outdated”. This occurs whenever technological progress brings onto the market a new technical solution capable of ensuring a greater production and/or lower operating costs compared to the technical solution in use [23], thus the replacement of the piece of machinery being used with a new one becomes economically convenient.

Extrinsic factors also include the usage status and degree of maintenance, lack of market demand for that particular type of machinery, any specifications and operations that do not comply with the legislation in terms of reliability, safety and accident prevention, due to changes in the laws or the introduction of new national provisions that are necessary for retrofitting. The disappearance and unavailability of the machinery manufacturer or spare parts, are other factors that may cause considerable un-usability of the machinery or the reduction of its residual life.

Another extrinsic factor stems from a particular behaviour of the application that can be called "suspicious buyer", always present and to an extent that is usually independent of the type of machinery. This factor, which has a reductive impact on the value, comes into play immediately after the commissioning of the new machinery and then quickly disappears. This factor can be identified in the distrust of those who must choose between buying a new piece of machinery or a piece that has been used little. The latter, which has almost identical characteristics to a new piece of machinery, is assigned a lower value caused by the depreciation measurement due to all the other degradation factors. The distrust of the buyer is partly offset by a greater appreciation of the machinery in the post-installation period, due to immediately having the machinery, which has already been tested and is fully operational. All the extrinsic factors as well as the intrinsic factors result in lowering coefficients of the value of a new piece of machinery. The magnitude of these coefficients should however be defined on a case by case basis.

4 Deductions from the intrinsic factors

Compared to the effects of extrinsic factors, the effects of the intrinsic factors can be easily isolated and formally analyzed. The forms of calculation of the individual corrections have already been expressed in analytical terms in current literature. Various authors have proposed algebraic expressions with deductions for age and income decay [24,25,4]. The original formulation of the mathematical relationship for the estimation of the deduction for age is described without changes in the following paragraph. The deduction for income decay is developed with reference to a more general case. In fact, the value of the additional monthly maintenance costs of the machinery is assumed to increase over time.

Deduction due to age. The expression proposed for the measuring of the deduction due to age is Eq. 1.

$$\Delta C_1 = (Co - Cv)\cdot\frac{(1+i)^n - 1}{(1+i)^v - 1}\ , \qquad (1)$$

where:
Co = initial capital or new value of the machinery,
Cv = salvage value at the end of its useful life,
i = interest rate,
v = number of years of life in efficiency from purchase,
n = difference in years between the date of evaluation and the date of putting into operation of the machinery, assumed in normal operating mode (use and maintenance).

The value of n is to be considered equal to a virtual age of the machine when, instead of in normal use and maintenance, the machine is subject to interruptions, to methods of use and quality of maintenance that result in an extension or reduction of the normal life in efficiency. In these cases, the state of use of the machine does not reflect the actual operating time. The virtual age is then calculated as the difference between the duration that the machine would have had under normal operating conditions (v) and the number of years of probable useful life attributable to the used machine (u). Once the values of i, Cv, Co and v, have been assigned to the analytical expression above, an exponential function of n is obtained.

Deduction due to income decay. This deduction is set equal to the sum of the largest annual spending on maintenance or the sum of the lower annual profits resulting from the use of the used machinery compared to an equivalent new piece. The sum should be referred to the probable years of efficiency of the used piece of machinery. In effect, the income decay is related to physical attrition and manifests itself, on the one hand, through the progressive increase of maintenance costs and, on the other, with the increasing reduction in the production capacity of the machinery. In relation to the expression of these variables, it is worth distinguishing: type *a)* machinery subject to normal wear and type *b)* machinery characterized by an accelerated physical attrition (in the case of machinery with components subject to rapid wear and frequent replacement).

Denoting with ΔX the amount of expenditure on the maintenance of a new piece of machinery (first year) and assuming for the subsequent years an exponential growth of ΔX, the amount of greater annual expenditure or lesser annual profit due to the use of used machinery can be calculated with the Eq. 2.

$$\Delta X\cdot\left[(1+p)^{v-u}\right] - \Delta X\ . \qquad (2)$$

For type *a)* machinery, the percentage p of increase in expenditure may be considered constant, while for type *b)* machinery, subject to an accelerated physical attrition a function of the percentage p increasing over time can be assumed, as shown in Fig. 1.

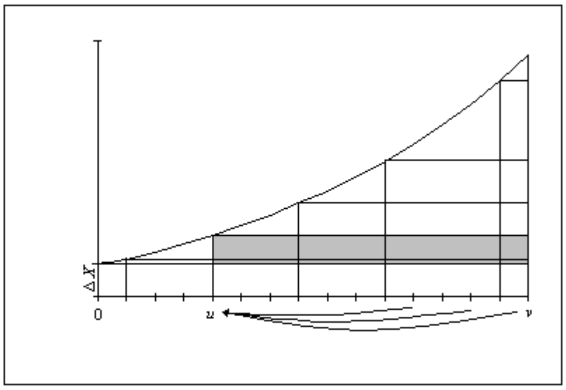

Fig. 1 Greater annual expenditure or lesser annual profit due to income decay.

In any case, the deduction for income decay takes the form of Eq. 3, described qualitatively in Fig. 2.

$$\Delta C_2 = \Delta X \cdot \left[(1+p)^{v-1} - 1\right] \cdot \frac{(1+i)^u - 1}{i} \cdot \frac{1}{(1+i)^u} \qquad (3)$$

In Fig. 2, the curve (a) and the curve (b) respectively indicate the case of type *a)* and type *b)* machinery.

Sum of the deductions due to intrinsic factors. Trying to add up the deductions for age and income decay, the curves in Fig. 3 are obtained.

Fig. 3 shows that in cases where, due to physical attrition, the production capacity of the machinery is greatly reduced or in other words the use of the machinery involves a high and progressive increase of the maintenance costs, the k year life, even if the machinery has not yet reached the end of the term of efficiency, its value is null or equal to the residual value.

These observations lead to a calculation procedure of the depreciation generated by the intrinsic factors, alternative to those described above, but more rapid and simple. The procedure is based on the amount of deductions for age and income decay. In particular graphs, such as those described in Fig. 3, constructed on the basis of many different combinations of the values assigned to the variables in play, it is possible, with good approximation, to hypothesize a linear depreciation depending on the age of the piece of machinery. The depreciated value may then be defined by the Eq. 4.

$$Vn = Co - \frac{Co - Cv}{v^*} \cdot n \ , \qquad (4)$$

where: n represents the actual age, expressed in years, of the machinery; if it is a piece of machinery subject to abnormal physical attrition (type *a*), v^* is a time to be taken as equal to the number of years of probable duration of the efficiency of a new piece of machinery ($v^* = v$); when the use of the machinery requires a considerable and progressive increase in the maintenance costs, or the machinery manifests an increasing reduction in production capacity (type *b*), the time to be allocated v^* is equal to the same v reduced by 10-15% ($v^* = 0.90$ *to* $0.85\ v$).

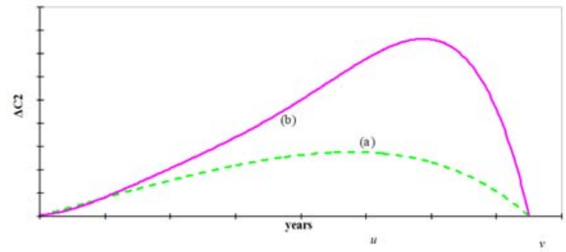

Fig. 2 Deduction due to income decay

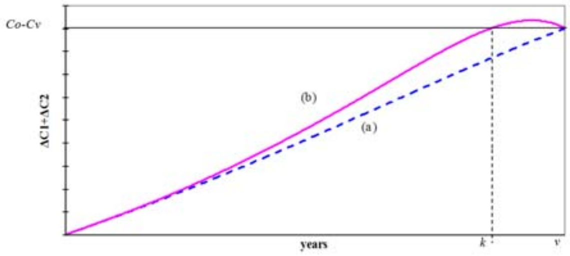

Fig. 3 Sum of the deductions due to age, income decay

5 Deductions from the extrinsic factors

The deductions relating to the extrinsic factors, unlike what has been said for the deductions generated by intrinsic factors, are not easily schematized due to being associated to contingent situations and are therefore variable from case to case. Any attempt to give an analytical explanation is most of the time neither possible nor justifiable.

For factors such as the lack of demand or distrust of the buyer, the only way to quantify the effects is the attribution of empirical coefficients that represent the measurement. The amount of the deduction due to non-compliance of the technical characteristics and operating of the machinery in compliance with safety and reliability regulations can be assumed to be equal to the cost of restoring the machinery.

The deduction relating to a state of non-ordinary use and maintenance of the machinery can be calculated by assigning a different virtual age, more or less, than the actual operating time. Even the deduction for loss and/or unavailability of the manufacturer or spare parts, resulting in a reduction in the remaining life, can be translated into a correction of the real age of the piece of machinery.

Deduction due to being outdated. The analysis in this section completes and integrates many aspects of the estimation of the deduction due to being outdated already considered in the cited literature.

The application of the function that describes this deduction, however, requires numerous data, which in practice are not always available. The analysis is developed by virtually replacing the outdated piece of machinery with a new one capable of offering a higher profit, then comparing the revenues and costs of replacing it. The hypothesis is therefore that within a plant there is a faulty piece or outdated piece of machinery *A* that could be replaced with a new one *A'*.

Below these symbols will be used:

$C'o$ = the cost of a new piece of machinery *A'*;

Co = the cost of a new piece of the faulty or outdated piece of machinery *A*;

v' = the probable lifespan of the new piece of machinery *A'* under new conditions;

v = the probable service life of the old or outdated piece of machinery under new conditions;

$u = v-n$ further probable duration of the efficiency of the outdated piece of machinery from the moment of the estimate;

$C'v$ = the salvage value of the new piece of machinery *A'* in the year v', the last of its useful life;

Cv = the salvage value of the old piece of machinery *A* in the year v, the last of its useful life.

In order for the comparison to be meaningful, the piece of machinery *A'* must not be new at the time of replacement, but old enough to be missing only u years after its decommissioning, where u is equal to the probable efficiency of the machine to be replaced. This therefore, anticipates the purchase of a piece of machinery *A'* already in use with a virtual age $v'-u$. The cost of the replacement (Cr) is a result of the difference between the cost of a new piece and the deductions due to age and income decay, calculated in terms of v' and u (Eq. 5):

$$Cr = C'_o - \left(\Delta C'_1 + \Delta C'_2\right) . \tag{5}$$

In this relation, both the amount of any proceeds from the sale of the old piece of machinery *A* as well as the difference, at the end of year u, between the value of the disposal of the new piece of machinery and the same value of the outdated piece, both discounted to relevance. The formula is in Eq. 6:

$$Cs = \left[Co - \left(\Delta C_1 + \Delta C_2 + Sp\right)\right] + \left[\frac{C'v - Cv}{\left(1+i\right)^u}\right] . \tag{6}$$

Sp represents the cost of the premature disposal of the outdated machinery and the losses associated with the stopping of production during the replacement phase. The replacement of the piece of machinery *A* with the new piece *A'* involves a lower expenditure and/or an increased revenue, therefore an annual profit U for the u years of remaining efficiency of the outdated piece. The present value of the annuity U is the benefit of the replacement (Eq. 7):

$$U \cdot \frac{\left(1+i\right)^u - 1}{i} \cdot \frac{1}{\left(1+i\right)^u} . \tag{7}$$

The accumulation of annuity U reduced by the costs that the replacement involves is the deduction due to being outdated. Eq. 8 synthesizes this difference.

$$\Delta C_3 = U \cdot \frac{\left(1+i\right)^u - 1}{i} \cdot \frac{1}{\left(1+i\right)^u} - \left(Cr - Cs\right) . \tag{8}$$

In the case in which the development of this expression gives a positive result, the outdatedness of the machine is determined. The replacement is therefore convenient and the value of the outdated machinery is in Eq. 9.

$$V_n = Co - \left(\Delta C_1 + \Delta C_2 + \Delta C_3\right) . \tag{9}$$

In the simplified assumption in which the value of the new piece of machinery, capable of offering a higher profit than the machinery already in use is equal to the value of the outdated piece ($C=C'$) and the recovery value of the latter is equal to that of the new piece of machinery, in the case in which both pieces have no salvage value, the above expression is reduced as Eq. 10 shows:

$$\Delta C_3 = \frac{U \cdot \frac{\left(1+i\right)^u - 1}{i} \cdot \frac{1}{\left(1+i\right)^u} - Sp}{2} . \tag{10}$$

The proposed calculation has practical limits in its application due to the lack of data as well as a certain behaviour in the managing of companies, which hardly ever leads to taking initiatives for the replacement of obsolete machinery. The same system, however, makes it possible to measure the effect of the deduction due to being outdated on the current value of the machinery and then to have the data that is required for the estimation of its total depreciation. The most useful amount of U is related to the technological level of the machinery and with the event of being outdated due to technological and functional obsolescence, known or predictable. With reference to the technological level, the machinery may be classified as type *c)* machinery with mechanical components and type *d)* machinery with electronic components.

Type *c)* machinery includes traditional ones, with it being possible to recognize technological progress as a slow and discontinuous phenomenon.

Type *d)* machinery includes those heavily influenced by rapid and continuous evolution of technology over time. In the first case, the value of *U*, obtained from the comparison of only two pieces of machinery (old and new) is constant over time. In the second case, the value of *U* that is derived from the comparison between the old machinery and the number of new pieces that over time replace it is assumed to increase over time.

Fig. 4 and Fig. 5 show the deductions due to being outdated, respectively, in the cases of types *c)* and *d)* machinery. It is worth noting that, for type *d)* machinery, the most useful *U* is an increasing function of the time variable. It is assumed with a linear increase.

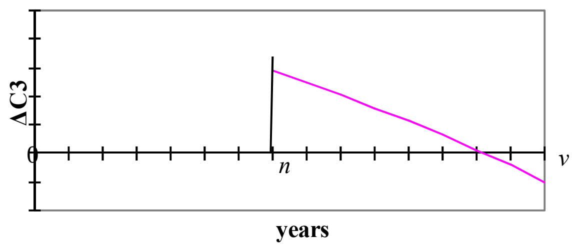

Fig. 4 Deduction due to being outdated for type *c)* machinery

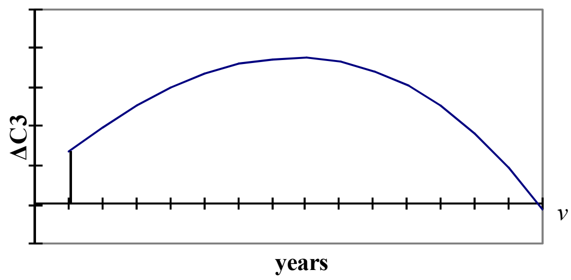

Fig. 5 Deduction due to being outdated for type d) machinery

6 Sum of the deductions due to age, income decay and being outdated

For the purposes of estimating the total depreciation, the classification of the machinery with respect to the technological level is combined with the classification made by the deduction from income decay and produces the following reference classes as represented in Table 1.

type	physical attrition	type	obsolete machinery	type	technological level
a	normal	a-c		c	more mechanical component
		a-d			
b	accelerated	b-c		d	more electronic components
		b-d			

Table 1 Reference classes for machinery estimation

For type *c)* machinery, if it is assumed that in year *n*, a piece of machinery is put on the market that can offer, compared to the piece of machinery already in use, a more useful *U*, the curve of total depreciation assumes the trend shown in Fig. 6.

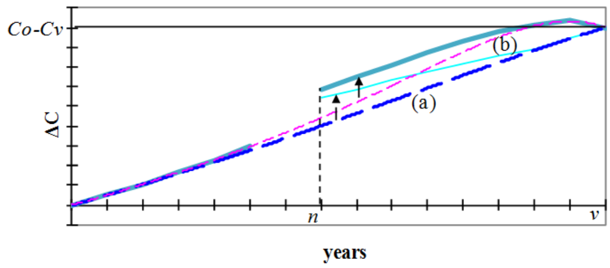

Fig. 6 Curve of total depreciation for type *c)* machinery

For type *d)* machinery, being outdated, known or predictable, results in a depreciation which added to the deduction due to age and income decay is qualitatively shown in Fig. 7.

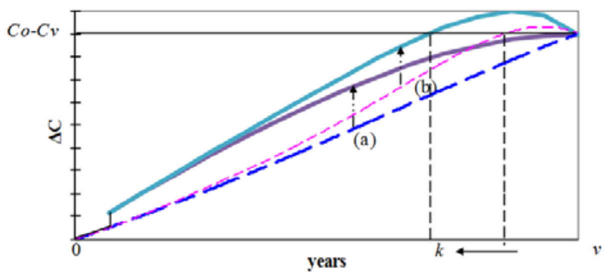

Fig. 7 Curve of total depreciation for type *d)* machinery

It is evident that if the deduction due to being outdated is greater than the new value already corrected by age and income decay, then the machinery will not have any appreciation in the market rather than that corresponding to the decay value. In the terms described by the curves of Fig. 7, this means that as a result of the deduction due to being outdated, the machine has a value equal to the residual at a time (year *k*) still far from the end of the useful life. In year *k*, therefore, obsolete machinery is appreciated by the residual market value (positive or null). For both the extrinsic factors as well as the intrinsic ones, the observation of the total depreciation which also includes the intervened technical and/or functional obsolescence of the machinery makes it possible to define a model that approximates the function of depreciated value to the real data. For machinery with both mechanical and electronic components, if being outdated is known or predictable, the estimate of the depreciated value becomes as Eq. 11 shows.

$$Vn = Co - \left[\frac{2\cdot(Co-Cv)}{v^*}\right]\cdot n - \left[\frac{(Co-Cv)}{v^*\cdot(v^*+1)}\right]\cdot n\cdot(n+1), \qquad (11)$$

where *v'* is:
= *v* for type *a-c* machinery,
= 90-95% of *v* for type *a-d* machinery,
= 80-85% of *v* for type *b-c* machinery,
= 70-55% of *v* for type *b-d* machinery.

The expression developed outlines a depreciation exposed to declining more rapidly during the first years of life, whose performance with good approximation follows the curves shown in Fig.6 and Fig 7.

7 Definition of the model

The model proposed is intended to estimate the present value of the machinery as an expression of the depreciation to be applied to the value of a new piece.

The basic assumptions of the model are:
1) there is a need for used machinery,
2) the estimation comes at a time that is not located close to the initial operating of the machinery,
3) the machinery are in use and maintained regularly.

The accuracy of the model is justified by the analysis carried out so far and will lead to errors that fall within the tolerances on the allocation of the dependent variables (*Co*, *Cv* and *v*).

The value of a new piece of machinery depreciated by the intrinsic factors of age and income decay is described by Eq. 4.

In the event of supervening technical and functional obsolescence of the machinery, the value of a new piece depreciated by both age and income decay as well as technical and functional obsolescence is described by Eq. 11.

The depreciated replacement value derived from the formulas described above has always meant that n appears less than *v**. On the contrary, the same value is to be taken equal to the residual value of *Cv*. In relation to the average useful life of machinery, equipment and facilities, the data for the estimation can be deduced from tables B-1 and B-2 set out in the Publication 946, "How To depreciate Property", Department of the Treasury Contents - Internal Revenue Service (2012) which refer to the MARCS classification (Modified Accelerated Cost Recovery System). This system has been used in the U.S. since 1986 for the calculation of the depreciation of movable and immovable property [26].

8 Conclusions

The simplified model for estimating the present value of industrial machinery in use, proposed in this paper has its theoretical basis in the analysis of formal deductions of the value of new machinery.

The interpretation and schematization of the results have led to the definition of value-time curves from which can be deduced by interpolation the value of the industrial machinery being assessed.

In addition to the simplicity of the application, the essential feature of the model is its flexibility when evaluating different types of machinery.

Another advantage is related to the reduced number of variables that the model defined takes into consideration, which are only attributable to the service life of the machinery and its residual value.

Thus, the arbitrary judgment of the estimation is also reduced, with it normally inherent in the coefficients of reduction of the original value of a new piece.

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