Indexes of effectiveness of antique internet auctions

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Abstract. Algorithms for calculating indicators of liquidity, the fall-increase of the financial efficiency of the auction, the duration of waiting for the sale of goods and the activity of traders, as well as some others, necessary for evaluating the work of Internet auctions of cultural values and forecasting indicators of the financial efficiency of participation in them, are described.

Keywords: antique internet auctions indexes of effectiveness cultural values silver coins
Introduction. Antique online auctions appeared in Ukraine at the beginning of the 21st century and over the past 15 years have gained wide recognition and trust among fans of antiquities and works of art; were filled with a wide range of all kinds of goods, the number of sales increased. Despite the difficult socio-economic conditions on the Ukrainian market and the sharp drop in the value of antique goods, related to the aggression of Russia, which we wrote about earlier [1], auctions maintained a positive development trend – they improved their work. Methods, become more operational and informationally open for consumers of their services. Among the most famous and active online auctions of cultural values in Ukraine, Violity, Art in, OLX should be singled out.

The services of antique online auctions are currently used by numerous groups of the population [2]. In particular, those who deal with the problem of assessing the damage caused by the Russian occupation to national and world culture, who want to sell inherited antiquities, Internet traders, collectors, fans of original art, historians, art critics, experts of cultural values, professional appraisers and economists.

Problem. Modern online auctions help anyone who wants to study the antiques market and the cultural traditions of different peoples, however, when it comes to making a decision about real participation in them, purely practical questions arise:
- Is it appropriate to sell antiquities in the conditions of a significant decline in the value of antiquities caused by Russian aggression?
- How to assess the liquidity of one or another type of antique items?
- Is it worth buying antique items at this time and can they act as an investment?
- Is it now possible to make money on a double auction, i.e., buying and selling artifacts at the same time during the auction?
- How to choose a time to participate in the auction?
- How to calculate an attractive starting price for potential buyers?
- Is it possible to be guided in your decisions by information on previous sales or presented in well-known catalogs?

The range of possible issues related to the work of auctions is quite wide and is not limited to the list presented above, however, they all relate to the possibility of promoting goods on the market for the purpose of making a profit [3]. Taking this into account, the problem lies in the need for further improvement of methods of financial analysis of data on the operation of modern Internet auctions, definition of the list of necessary objective parameters for their evaluation for their use by researchers and active bidders.

Despite the fact that there are no unequivocal and universal answers to the questions posed above, market processes can be modeled in the form of a set of the most likely solutions and based on the calculation of special indices, which must be substantiated with clear ideas about specific tasks and circumstances of bidding. By the term "index" in this work, we will understand the coefficient expressed in the ratio of individual indicators that describe the state of the market in quantitative or semi-quantitative scales. For example, the liquidity index, the fall-growth index of the financial efficiency of the auction, the index of the duration of waiting for the sale of goods, and the index of trader activity.

**Previous studies.** Algorithms for calculating such important indicators for market participants as the evaluation base, the level of information security of the product and the indicator of social and cultural value were described in works devoted to the analysis of the state of the market of cultural values published earlier [4, 5]. This set of information allows for independent and internally indisputable value prediction in tasks of assessing the damage of the owner or national culture. In particular, in recent publications, the dynamics of changes in the index of the evaluation base of works of art over the past ten years have been highlighted [1]. It was demonstrated that official data on the level of value indicators for cultural objects recorded in specialized catalogs should not be considered as permanent
information that describes the state of the market. It only records the presence of manifestations of the emotional factor [4] in the bidding process.

The way to solve the problem. The problem of indexing the market situation is solved with the help of mathematical modeling, which is based on the law of commodity science: "The more positive information about the product, the higher its quality and, accordingly, its value". According to this law, the predicted value of "C" is calculated according to the formula:

$$C = \alpha 2^N,$$

where: $\alpha$ is the assessment base, which is precisely determined by regression analysis of current market data; $N$ is the number of positive information about the product in bits, which is calculated by additive accumulation of answers to special criterion questions that remove uncertainty.

A complete description and theoretical confirmation of the formula is published in [4, 6, 7]. There is also an example of a predictive assessment of a cultural monument.

The sequence of actions that allows you to calculate a number of important indices for solving the above questions involves the following sequence of actions:

1. Creation of a working database on the availability of a particular type of goods on the market and their permanent value indicators, as well as accounting for their quality characteristics. By constant indicators, we understand value indicators fixed for a certain time, which do not correspond to the final sales indicators, as well as the initial ones.

2. Sorting of the original information base in a row from the smallest value indicators to the largest in order to study the regularities of their distribution.

3. Analysis of the identified patterns, as well as calculation of auction efficiency indices in the field of trade in the described type of cultural monuments.

In this article we will demonstrate the results of determining the efficiency of the auction using the example
of the analysis of the distribution of value indicators for silver coins presented at the Violiti auction in the period from 12/27/2023 to 01/3/2024. The average purchase price of silver in Ukraine during this period was 25 hryvnias per gram [8].

Table 1 shows a fragment of the primary database of values for the silver coins, ordered from the smallest to the largest denomination, that were put up for public sale at the mentioned auction. The table also shows the indicators of the purchase price of silver in accordance with the weight of each coin. The total number of coins used to form the primary database was 203. Coins were chosen randomly.

<table>
<thead>
<tr>
<th>№</th>
<th>A photo of the coin, a brief description and a link to the source of the information</th>
<th>Price in hryvnias</th>
<th>Weight in grams</th>
<th>The value of silver in a coin in hryvnias</th>
<th>Calculated cost in hryvnias</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Greece. Patrai (Peloponnes) City - Damasias. Silver. 146-132 AD. Triobol</td>
<td>34</td>
<td>2,4</td>
<td>60</td>
<td>548,75</td>
</tr>
<tr>
<td></td>
<td><a href="https://violity.com/ua/108041037-greciya-patrai-peloponnes-gorod--damasias-serebro-146-132-g-d-n-e-triobol">https://violity.com/ua/108041037-greciya-patrai-peloponnes-gorod--damasias-serebro-146-132-g-d-n-e-triobol</a></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pound 1987 (25 years of the World Wildlife Fund), Silver 0.925, 28.4 g, Jersey</td>
<td>61</td>
<td>28.4</td>
<td>710</td>
<td>556,41</td>
</tr>
</tbody>
</table>
Graph 1 describes the distribution of value indicators for silver coins sorted from the cheapest to the most expensive. The graph illustrates a characteristic feature of the distribution of value indicators on the market - a large number of goods offered for sale at low prices and a limited number of expensive goods. Roughly, the graph shows the distribution of financial capabilities of potential buyers - a large number of buyers with limited financial capabilities and a small number of buyers with high capabilities. Accordingly, a large number of coins exhibited at a small value confirms the validity of this conclusion.
Analyzing graph 1, it can be determined that among potential buyers, 23% are ready to pay up to 1,000 hryvnias for a silver coin (red arrow on the graph); for a coin up to 5,000 hryvnias, another 54% of auction participants are ready to pay (green arrow). 10,000 hryvnias are willing to pay 20 percent of potential buyers (blue arrow on graph 1). Finally, only 3% of potential buyers can pay for expensive coins, the value of which is higher than 10,000 hryvnias.

The given graph allows to analyze the growth or fall of indicators of the purchasing power of citizens with different levels of real income in real time, which means that it helps to make decisions about the feasibility of carrying out relevant trade operations in general.

If you sort the coins described in the source data base by the value of the silver from which they are made, then the distribution graph will have the same form as presented above, which indicates the impracticality of using this type of data for conducting separate studies.

Using the law of commodity science, let’s check the compliance with this law of the distribution of value indicators presented in graph 1. To do this, we logarithmize the value indicators described by the ordinate axis in graph 1, based on the base "2". The result of this operation is presented in graph 2.
Graph 2

Distribution of value indicators logarithmized to the base "2" for antique silver coins (ordinate axis). Coin numbers from the first to the last are placed along the abscissa axis. The red vertical lines define separate sections of the graph (I, II and III), which are described by different growth functions.

The graph clearly shows that during the trading period, which is limited to 30 calendar days, the imaginary valuable coin put up for sale must go through several stages of increase in value. The first stage - the area marked "I", which corresponds to the interval from the first to the twenty-ninth number in the original base - is a rapid increase in value from the initial indicator, which is specially underestimated by the seller in order to attract the largest audience of potential buyers.

The second stage (section "II") - linear growth, which fully corresponds to the law of commodity science formulated above.

The third stage (section "III") describes the rapid increase in value associated with the emotional state of participants who enter into competitive relations wanting to purchase a coin. It is clear that the third section is not described by the law of commodity science and can be considered as a result of the action of emotional factors in
the environment of potential buyers. Here it should be noted right away that after the sale of goods under the influence of emotional factors, the value indicators fall into specialized catalogs, where they are described as "market value". However, the "market value" recorded in this way cannot be explained or reproduced through the use of mathematical modeling or comparative procedures and are therefore not suitable for use in valuation work.

Taking into account the total exposure period of the coin on the auction site (30 days), it is possible to calculate the amount of time required for the value of the coin to reach the level of the first qualitative point (intersection of the graph with the first red line - point 29 on the abscissa axis). Such a characteristic will correspond to the ideas about the commodity liquidity index - "L". To do this, the total number of points - 203 should be divided by 29, as a result of which we will get the value "7". Therefore, "7" is the number of days that is needed to clarify the issue of the possibility of selling any coin at auction.

If there are no potential buyers within the specified period, the coin is not an attractive product and most likely will not be sold, or will be sold at an extremely low price - below the purchase price of the silver from which it is made. The described indicator can be considered the index of liquidity "L", which should be calculated as follows: if "7" is "low level of liquidity", which should be characterized as an indicator of 0.5, according to the law of commodity science and is considered as a lack of useful information about the attractiveness of the product.

The liquidity index can also take a value of 0.25 from the level of the predicted value in the absence of potential buyers during 14 days of exposure of the product, which will correspond to the formulation "impossibility of selling the product in the auction mode" or a complete lack of useful information about it.

Another integral liquidity index "ΣL" can be calculated as an indicator of the number of auction participants divided by the number of coins offered for sale, expressed as a percentage:

\[ ΣL = \left( \frac{K}{M} \right) \times 100\% = \left( \frac{75}{203} \right) \times 100\% = 36.9\% \quad (2) \]
The result shows the low activity of the auction participants and the great lack of potential buyers. For the mathematical modeling of indicators of the predicted cost "C", we will describe the linear dependence of the indicators of the logarithmic value on the second interval, which is marked with the Roman numeral "II" on graph 2.

The linear regression equation will look like:

\[ C = 2^{0.02x} + 8.99 = 2^{0.02x} \times 2^{8.99} = 2^{0.02x} \times 508.86 \text{ or:} \]

\[ C = 508.86 \times 2^{0.02x} \]

(3)

where: \( x \) is the number of the coin in the database.

Graph 3 describes the simulated linear dependence of the predicted cost and the observed logarithmic cost indicators.

**Graph 3**

Distribution of value indicators logarithmized to the base "2" for antique silver coins (ordinate axis). Coin numbers from the first to the last are placed along the abscissa axis. The red dashed line describes the linear function that approximates the trend in interval "II". The correlation coefficient of the logarithmic value indicators in interval "II" according to K. Pearson is 0.99
It is clearly visible that the law of commodity science makes it possible to very precisely and reasonably forecast the value indicators in the section of the graph marked with the number "II", as well as to determine the estimated value of the evaluation base – the point of intersection of the ordinate axis with the linear trend determined on the basis of regression analysis. The "α" assessment base or the reasonable estimated starting value for the sale of coins at an auction in Ukraine will be 508.86 hryvnias. This indicator can also be considered as an important index, which is decisive in relation to indicators of changes in the values of the predicted value of antique coins in Ukraine over time – an indicator of the volatility of the coin market.

Therefore, it is advisable to forecast the value of silver coins based on the following equation:

\[ C = 508,86 \times 2^I, \quad (4) \]

where \( I \) – amount of positive information in bits.

The amount of information is easy to determine based on the accounting of useful information according to the protocol for the evaluation of cultural monuments [4], which allows to estimate the socio-cultural value index of the "K" coin, which was put up for auction.

When conducting regular studies of the state of the coin market, it is of great importance to study the nature of changes in the values of the mathematically determined assessment base over a year or two or three years. This makes it possible to study relative changes in the level of capitalization of the antique coin market and, by analogy with the Dow Jones stock index [9], the relevant indicators can serve as very informative special indices.

So, if the valuation base for antique silver coins at the end of 2021 (before the start of a full-scale war with Russia) was UAH 810.25, then the growth-decrease index of the level of capitalization "DJ" market at the beginning of 2024 can be determined as a percentage as follows:

\[ DJ = \left( \frac{810,25 - 508,86}{810,25} \right) \times 100 \% = 37,19 \% \quad (5) \]
Consequently, the market capitalization of antique silver coins in Ukraine decreased by 37.19 percent. Accordingly, the indicators of the projected cost have significantly decreased.

It should be noted that such studies have been systematically conducted for works of painting over the past ten years, which was reported in an open publication [1]. They also testify to a significant reduction in the circulation of capital in this market.

Graph 4 shows the ratio of forecasted and observed cost indicators of the "II" interval in non-logarithmic form, that is, in real cost indicators.

Graph 4

Observed (row 1) and predicted (row 2) values of silver coins in interval "II". The number of silver coins in this interval is plotted along the abscissa axis. Along the ordinate is the value of coins in hryvnias. The vertical cones mark intervals that correspond to the amount of positive information in bits: correspondingly, 1, 2 and 3.

The correlation coefficient of value indicators in interval "II" according to K. Pearson is 0.99

The section of the graph of the distribution of value indicators marked as "III" can be a subject for studying the level of influence of the emotional factor during bidding. Thus, in Table 1, the estimated values are calculated for coins numbered 202 and 203.

It is clearly visible that the sellers have declared very
high prices, which are almost 9 times higher than the model prices. This indicates the presence of competition among potential buyers and the influence of additional undeclared useful information, which is described by at least two criteria: the rarity of the coin (circulation) and the level of its popularity. If we take this into account using the cultural values evaluation protocol [4], then we will have additional information about the socio-cultural significance of these coins: according to the "replicability" criterion – 4 exbits (unique); according to the criterion "level of popularity" – 2 exbits (high level of popularity). The aggregate indicator of socio-cultural value will be 8 exbits. By increasing the value of the predicted value, obtained using the regression equation, by 8 exbits, we will get new indicators of the predicted value of coins numbered 202 and 203. So, coin No. 202 will have a predicted value: 8306.36 \times 8 = 66450.88 \text{ UAH}. Coin No. 203 will have a projected value of 8422.31 \times 8 = 67378.48 \text{ UAH}.

Therefore, in the case of actual sale of these coins and fixing of price indicators in catalogs, there will be no rational explanation of the estimated value in the results of an independent examination. In these cases, it is appropriate to accept the predicted value, calculated on the basis of the regression equation, as the "theoretically justified liquidation value". It is also clear that expensive coins are the most profitable goods at auction, since the latter will have higher commissions.

In expert tasks related to value forecasting, it is advisable to use the indicator of "value growth potential" – "P", which is expressed as an indicator of the expected multiple of value growth, for example, coins 203:

$$P = \frac{C_d}{C_p} = \frac{75000}{67378.48} = 1.11,$$

where: $C_d$ – the declared value of the coin recorded on the auction site;

$C_p$ – predicted value, which is calculated as a result of mathematical modeling of the trend.

**Conclusions.** As a result of the analysis of the work of
the Violiti antique auction in terms of the sale of antique silver coins, it was established that solving a number of urgent problems of indexing the antique market, forecasting the value and feasibility of putting the product up for sale, it is advisable to use the following calculation indicators:

- **L is the liquidity index** — indicator, which is necessary to clarify the issue of the possibility of selling the goods at the auction, and takes the value of 1, 0.5 or 0.25.

- **ΣL is the general liquidity index**, determined by the ratio of the number of lots put up for sale to the number of potential buyers.

- **α is the evaluation base** — the estimated value of the starting value and the basis for forecasting the value according to the law of commodity science.

- **DJ — the fall-rise index of the market capitalization level** — an integrated indicator for evaluating the changes that occur with the circulation of capital at the auction during a certain period.

- **І — the amount of positive information about the product in bits** — the value that is calculated based on the accounting of useful information about the cultural monument using a special protocol [4, 7].

- **K — indicator of the socio-cultural value of the product** — the value that is calculated in exbits [4] and allows forecasting the value of specified objects by calculating its product with the evaluation base.

- **P — the index of the expected multiplicity of the increase in the price of the product** — an indicator that indicates the expectation of a significant increase in value during auction trade as a result of the appearance and action of an emotional factor in the environment of potential buyers.

The above-mentioned indices and their aggregates allow solving the questions posed at the beginning of this article and significantly increase the content of information about the auction trade of items that have cultural significance. Taking them into account allows you to visualize existing market trends and have relevant objective data for verifying the results of expert work and ensuring a high level of meaningful discussion between market participants.
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