

**The Master Research Paper**

**Capital Market”?**

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## Abstract<sup>12</sup>

This paper examines the issue of market efficiency in Ukrainian privatization auctions, showing that these auctions are not efficient. There is persistent “overbidding” for objects that are underestimated by the state. A theoretical explanation for this result is offered.

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<sup>1</sup> The help of Dr. Lance Eric Brannman during the writing the paper is highly appreciated. At the same time he bears no responsibility for the final product. I also would like to thank Dr. Gardner and Dr. Waller for their useful comments on the first draft.

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## **Introduction**

State ownership was considered equivalent to people's ownership during the socialistic era. The common idea that everybody has some share in the state property made sale transmission of property to private owners impossible. It was inappropriate because it would be considered as stealing the property from the genuine owners, namely, all citizens of Ukraine. The mass privatization program was developed to provide a distribution of property equitable to all citizens of Ukraine. Hence, "justification for mass privatization is largely political"<sup>i</sup>. Mass privatization makes everyone an owner and gives them a sense of private ownership. This sense is of quite big importance for a country where certain things were excluded from private ownership sphere during decades<sup>ii</sup>.

However, discussion of the goals of mass privatization is not a subject of this paper. The paper stresses consideration of certain type of economic transactions, specifically, transactions of an open sale of privatized property through mass privatization auctions that are a part of the mass privatization program. The auctions have a quite interesting design, and the behavior of bidders under such unusual conditions is also interesting.

In the first few sections we present a concise description of the privatization procedure. A short description of the data is presented. Simple theoretical expectations of the behavior of bidders and efficiency of auction prices are discussed. The data do not conform to the predictions. Some attempts to explain the discrepancy will be made.

### **Privatization Environment and Privatization Securities.**

Mass privatization is based on converting specially issued privatization property certificates and compensation certificates into shares of stocks of privatized enterprises.

The state gave each citizen of Ukraine a privatization property certificate. Each certificate gave its owner the right to obtain a share of state property for free<sup>iii</sup>. Each privatization property certificate has a face value, which is constant over all certificates. Due to the law "On Privatization of State Property"<sup>iv</sup> the sum of the face values of all privatization property certificates should be equal to the total assessed value of all enterprises to be privatized for those certificates. Thus, the amount of property offered for sale for privatization property certificates should be enough to get every certificate invested.

State owned enterprises to be privatized are converted into joint stock companies. Then the stocks of those joint stock companies are sold to physical or juridical persons for privatization

property certificates, compensation certificates, and/or money, on a competitive or noncompetitive basis.

A company's initial equity capital is defined by the government to equal the assessed value of the property belonging to the enterprise. This assessed value was estimated by the technique described in [1]. This technique is based on bookkeeping values of equipment, turnover capital and other assets and liabilities items of the enterprises' balance sheets. Roughly, the value of a firm is calculated as a sum of all bookkeeping records for assets minus the sum of bookkeeping records for debts of the firm. The prices used for bookkeeping records of equipment, buildings, etc. usually come from old (Soviet) times when those enterprises were created and began to operate. Thus, the estimated property value does not take into account recent changes in prices, current and future profitability of the enterprise, expected variation in profits flows from the enterprises. Assessed values have very little in common with market values or with replacement values of the firms. But likely the used assessment procedure is the only one possible to be implemented quickly for a big number of objects in need for a rapid big-scale privatization of state property.

A market valuation of the privatized property may be obtained via an auction, or sale of shares on the stock exchange.

Privatization property certificates are personally registered securities. They cannot be legally sold. The certificates can be given to a trust or invested into an investment company in an exchange for investment certificates of the investment company. There have been cases where financial intermediaries purchased large quantities of privatization property certificates for cash.

Compensation certificates were issued as compensation for bank deposits that were lost because of the hyperinflation in the early 1990's. The certificates were distributed proportionally to the amounts of the former deposits and therefore their distribution was uneven among people. Compensation certificates are legally allowed to be traded.

The public may use privatization property and compensation certificates in three ways. First, workers may invest their certificates in the enterprise for which they work. This is called "franchise underwriting". In such a case the worker gets shares with total assessed value equal to the face value of one certificate. The worker also gets an additional option to buy extra shares in a quantity equal to a half of the quantity already received per a privatization property certificate. These extra shares are paid by cash or by compensation certificates due to their face values. Second, a person may use their certificates by participating directly in a certificate auction. Third, certificates may be given to a

financial intermediary. The intermediary will invest its collected certificates in privatized enterprises through an auction or tender. Compensation and privatization certificates are used for these investments, irrespective of whether they were legally or illegally obtained.

Most people exploit the first or the third possibility. As a result, the main participants of the auctions for privatization property certificates are financial intermediaries. Their share is about 88.46% for the first 35 auctions for privatization property certificates, all auctions for which we have complete data.

Contrary to auctions for privatization property certificates, people may submit claims for shares with any quantity of compensation certificates. Thus, there is no necessity for a private person to hire a financial intermediary in order to get shares of a particular enterprise. Hence, only 53.24% of invested compensation certificates arrive from financial intermediaries. Nevertheless, a study of Ukrainian mass - privatization auctions is a study of the behavior of financial intermediaries and big private investors, rather than a study of huge quantities of small individual investors.

The auctions for both compensation and privatization property certificates are conducted monthly through the Auction Centers Network that is a special national organization created for this purpose. The network has its regional branches in every district of Ukraine and, thus, allows physical and juridical persons to participate easily in auctions. It also distributes information about objects to be sold at the auctions and about the auctions themselves, collects certificates of the participants, calculates the auction results.

The auctions for privatization property certificates can be either regional in scope or apply to the entire country. Only 4.16% of total number of privatization property certificates submitted for participation in the auctions were assigned to the regional auctions. The paper limits its consideration to the only national wide auctions for privatization property certificates.

The auctions for the compensation certificates are only of national wide type.

### **Auctions Conductance and Calculation of Results Procedures.**

Auctions based on privatization property certificates and compensation certificates are very similar. At first we will describe the conduct of auctions for the privatization property certificates and then we will move to the discrepancies in the conduct of auctions for compensation certificates from the procedure already described.

Privatization property certificate auctions are conducted in three stages. First, the government

decides which firms will be privatized at a particular auction. Often there are several hundreds of firms to choose at a single auction. The first stage takes roughly one month, during which time information on the privatized enterprises, including short financial indicators, is published. Everybody interested can get an initial knowledge about investment opportunities of the coming auction.

During the second stage, which also takes a month, claims<sup>3</sup> from physical persons and financial intermediaries are submitted to local branches of the Auction Centers Network and corresponding amounts of the privatization property certificates are collected. Claims can be submitted in any working day of the month and usually a lot of claims are coming in the last few days. Investors make decisions without knowing how many claims have been submitted.

The collected claims are processed and the results of the auction are sanctioned and publicly announced during the third stage. The third stage usually takes several weeks.

The main result of the auction is the price of a share, i.e. the number of shares awarded per privatization property certificate. Shares offered for privatization property certificates have an initial price equal to their face value<sup>4</sup>. The shares cannot be purchased for a price below this initial price<sup>5</sup>. It is the "reserve price" of the company's shares at the auction. The auction price is determined by the amount of the certificates that are submitted for stocks offered for a sale during the auction. If more than the "reserve price" number of certificates are submitted, the auction price is the "reserve price" multiplied by the ratio<sup>6</sup> of all submitted certificates to the quantity needed to buy a share at its face value (more precisely, it is a rounded value of the product of the "reserve price" and the ratio). Otherwise the auction price of a stock equals its "reserve price".

Two types of claims may be submitted by bidders<sup>7</sup> at a privatization property certificate auction:

- 1) Claims of type "A" - can be submitted by only financial intermediaries. A bidder indicates the highest price which he is willing to pay for shares. If the auction price is higher then this

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<sup>3</sup> Claim is just a formal application to get stocks of some enterprise at the auction in exchange on privatization securities.

<sup>4</sup> The face value is gotten by dividing of value of property assessed due to the standard procedure by number of stocks. Therefore, the sum of face values of all issued stocks is equal to the amount of equity capital of joint stock company created from the privatized enterprise. "Reserve price" (the minimal price of a stock in auctions for privatization property certificates) is equal to the face value of the stock.

<sup>5</sup> Note, that every certificate also bears some face value and, thus, it is impossible to buy more than some certain number of stocks for one privatization property certificate.

<sup>6</sup> We will call the ratio "winning bid/ appraisal ratio" due to the terminology of usual auctions.

<sup>7</sup> As it was noted by Professor Gardner "bidding is not quite exact here. Tender of certificates is likely more relevant". The author agrees but now the generally accepted term is "bidding". That is why we will call this "bidding" and participants of the auction will be called "bidders".

price limit then the claim is not satisfied and the certificates can be used for buying stocks of other privatized enterprises in following auctions.

- 2) Claims of type "B" - can be submitted by both physical persons and financial intermediaries. These claims are satisfied no matter how high is the auction price. Thus, the bidders will get stocks for any auction price.

There are only two important differences between auctions for privatization property certificates and auctions for compensation certificates. First, only claims of type B are allowed in compensation certificate auctions. Thus, there is no possibility to put any restriction on price. Second, there is no reserve price at an auction for compensation certificates. All shares are sold and distributed evenly among the submitted certificates no matter how small number of certificates was submitted.

Usually, there is an enormous number of winning bidders for any object at both types of auctions. Almost all bidders are "winning" for the auctions for the privatization certificates and, just all are "winning" for the auctions for compensation certificates. In both types of auctions, the amount of shares received by winning bidders is negatively related to the total quantity of winning bids for the particular object. More precisely, the object offered for a sale is divided among all winning bidders proportionally to the quantity of submitted certificates. This last statement seems to reflect the essence of procedure quite accurately.

If we take into account the inability of individuals to submit claims with a price constraint in auctions for privatization certificates, and how small is the percentage<sup>8</sup> of all submitted privatization property certificates with a price constraint, then we should conclude that auctions of both types have to be very similar by the outcomes, at least, if we consider the objects that attract more

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<sup>8</sup> ***For all auctions for privatization property certificates:***

Approximately 30% of all submitted certificates have price constraint. Approximately 19 % of all satisfied certificates have price constraint. Only about 46 % of all submitted certificates with price constraint were not satisfied.

***For our 57 observations of matched pairs of auction and stock market prices (namely, the data used for the test at the next section):***

There were about 8275547 certificates submitted to these objects that is 28 % of all certificates submitted for participation in auctions:

Approximately 33% of all submitted certificates have price constraints. Approximately 20% of all satisfied certificates have price constraint. Only about 48% of all submitted certificates with price constraint were not satisfied.

The numbers above are calculated from information in database provided by Price Waterhouse (see section "Data" of the main text).



certificates than necessary to buy offered stocks for their reserve prices at the auctions for privatization property certificates.

### **Data**

Auction data come from several sources. Price Waterhouse kindly provided us with an electronic database of information on privatized enterprises and the results privatization and compensation certificate auctions. The database includes information on more than 6000 enterprises that passed through privatization auctions for both or either privatization property and compensation certificates. This information was published in the Ukrainian Investment Newspaper and was publicly available.

Stock market prices were provided by PFTS<sup>9</sup>, the Ukrainian over-the-counter trade system. It is currently the biggest stock market in Ukraine. It operates similarly to the US over-the-counter trade system, NASDAQ. There are less than two hundred stocks listed for trading in the system. From those stocks only about 80 have been traded.

The cases when there were no increase in an auction price during auctions for privatization property certificates were excluded from consideration. “Winners Bid/Appraisal Ratio” for such cases is equal to one and some part of stocks to be sold during the auction remains unsold. The property is sold for the reserve price to those bidders who have submitted their certificates for shares of these enterprises. Thus, the “Winners Bid/Appraisal Ratio” is one no matter how low is the stock exchange value of the property. Auction for privatization property certificates does not give here market evaluation of the property. That is why there is no reasons to consider the correspondence between the auction and the stock exchange valuations of the property.

Thus, a successful comparison between the results of privatization certificate auctions and stock market prices could be made for only 47 enterprises. Some enterprises participated in the auctions more than once, so the total number of pairs of auction and stock market prices is 57.

Similarly, we come out with 33 observations for the auctions for compensation certificates.

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Note that if all submitted certificates with some price constraints would be not satisfied than the auction prices will be changed in general by only about 30%. So, much bigger share of submitted certificates should bear price constraint in order to influence substantially the resulting auction price.

<sup>9</sup> The stock market prices were taken as “Last Sales Prices” as of 03/06/98 in PFTS.

## "Market Efficiency"<sup>10</sup> for Privatization Auctions.

There are three standard types of "market efficiency"<sup>iv</sup> for capital market. All of them are based on the same idea that can be formulated in the next way:

"A capital market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices. Formally, the market is said to be efficient with respect to some information set,  $\phi$ , if security prices would be unaffected by revealing that information to all participants. Moreover, efficiency with respect to an information set,  $\phi$ , implies that it is impossible to make economic profits by trading on the basis of  $\phi$ ."<sup>vi</sup>

The types of efficiency are differentiated by the information that consist  $\phi$ . Weak hypothesis states that only information on previous prices of the asset should be included into the current price of the asset. Semistrong efficiency means that all publicly announced information should be reflected in the current price of the asset. Strong efficiency means that not only public information but also insiders' private information is reflected by the price of the asset.

It is not easy to apply these notions of "market efficiency" to Ukrainian privatization auctions. Usually there is no history of asset prices. It is unreasonable to expect that insiders information can be transmitted to outsiders during sealed-bid privatization auctions. But the basic idea of "efficiency" seems to be applicable.

The reserve value of the property is estimated by the government using a method that does not even pretend to be accurate. The imperfections should be corrected through competitive methods of sale of the stocks. One of them is the sale through auctions. The larger the increase in price during the auction, measured by the Winning Bid/Appraisal Ratio, the larger the auction market valuation of the property compared to the initial estimation based on bookkeeping records.

The auction price of a stock is one-shot phenomenon. The shares, after privatization, are usually traded on a stock market. The stock market attaches prices to the shares after privatization auctions and these prices are the future prices of stocks for an auction market. It is clear from the definition above that the auction market can be called efficient with respect to some informational set if there is no systematic possibility to get superior profits on the base of predictions made from this informational set. Usual scheme to get money from the participation in privatization auctions involves selling stocks received from the auctions in a stock market. We will consider the efficiency with the

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<sup>10</sup> Everywhere we will be talking of "market efficiency" we will intend "pricing market efficiency", not any other

respect of the informational set that consists from the stock prices in auctions and stock exchange.<sup>11</sup>

Hence, it is more appropriate to see how correctly auction prices predict future stock market prices and eliminate in such a way a possibility for the systematic improvement in profits.<sup>12</sup> So, our notion of market efficiency will focus on the ability of certificate auction prices to predict future share prices.

The definition of market efficiency given by Figlewsky (1978) is quite useful for this consideration. He says:

"It is not possible to separate the impact of elementary information such as news releases, crop reports, etc., from the subjective evaluation of this information by the participants in the market. Thus rather than dealing with differences in "information," it will be more convenient to work with differences in forecasting ability – bearing in mind that access to elementary information is a major determinant of forecasting ability. The operational definition of an efficient market, then, is one in which the market price at any time (plus normal profits) is the best, that is minimum variance, estimate of the future price, given the individual forecasts of all market participants."<sup>wii</sup>

This definition of efficiency is equivalent to the definition of efficiency given a little earlier. It has the positive feature that it can be more easily applied to the considered situation.

"Market efficiency" for privatization auctions means that the Winning Bid/Appraisal Ratio should be an unbiased estimator of the future surplus of stock price in the stock exchange over the face value of the stock. Namely, the relative prices of stocks during auctions expressed in certificates should be the same as relative prices of the stocks on a stock market. Graphically this means that relative prices of stocks in stock market plotted against the relative prices of stocks in certificates (that is prices of stocks in auctions market) should give a straight line with an angle in 45 degrees between x - axis and the line if both variables are measured in logarithms.

This is a testable hypothesis. But let us move from relative prices to the more convenient measures (one extra attempt to explain the situation is made in footnote<sup>13</sup>).

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notion of efficiency like "operational efficiency" or something other.

<sup>11</sup> The fact that the information used is price information makes this application of "efficiency" notion resembling

<sup>12</sup> Thus, we will use prices taken from different markets. Dr. Brannman attracted attention of the author to the sort of confusion that may arise because the efficiency notion was initially defined for one market. But the author decided that since the idea is clearly the same as that of usual textbook efficiency, so, the usage of the words "efficiency" and "efficient" seems to be appropriate in this context.

<sup>13</sup> Let us consider the situation in the words just so simple as possible.

Suppose there are two objects with initial assessment in 100 Ukrainian Hryvnias. Correspondingly the government will issue 200 certificates with the face value in 1 UAH and distribute them to 200 persons. Those certificates are assigned to be used for buying equity capitals of the first and the second privatized objects.

Initially the investor has a certificate. He converts this certificate into stocks by participating in a privatization auction. When the investor sells the stocks on the stock market he gets money for the stocks. This money is considered the market value of certificate. If the relative prices of stocks on auction market and on stock market are the same then the market value of certificates should be the same no matter in which object (that is in which kind of stocks) the certificate was invested during privatization auction. Of course, in reality there will be deviations in the market values of certificate bidden for different objects. But the deviations should not have any regular pattern. There should be no significant systematic bias in market value of certificate with respect to the increase in price of stocks during the auction that is Winning Bid/Appraisal Ratio.

The opportunity cost of certificates is the possibility to invest them into any other firms being privatized at a single auction or other auctions. Thus, we assume a possibility of substitution for objects not only within one particular auction but also between different auctions for the same type of privatization securities.

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Equity capitals of the first enterprise and the second enterprises are splitted among 1000 stocks for each. Thus, the “reserve price” (face value) of the stocks of the first company is 0.1 hryvnias or 0.1 of the certificate. Respectively, the face value of one stock (“reserve price” for auctions for privatization property certificates) of second company is 0.1 hryvnias or 0.1 of certificate. We will consider below an auction where the sale of stocks below their face value is allowed and, so, there will be no “reserve price”. Also, suppose that the stock exchange valuation of the objects is 150 hryvnias for the first and 300 hryvnias for the second.

The stock market price of one stock of the first enterprise should be 150 hryvnias divided by total quantity of the stocks 1000. The stock market price of one stock of the first enterprise should be 0.15 hryvnias. Respectively, stock market price of one stock of the second enterprise should be 0.30 hryvnias. Thus, the relative valuation of the first stock compared to the second is 2 to 1.

If the auction market is an efficient one then the auction price of a stock should be an unbiased estimator of the future price of the stock. The future price of the stock for an auction market is the price of the stock on stock market. Thus, we should get the same relative valuation of the prices of two types of stocks for privatization auction and stock exchange. It means that the auction price of one stock of the first enterprise should be 0.066666 of privatization certificate. Auction price of one stock of the second enterprise should be 0.133333 of one privatization certificate. In that case we come out with the same relative price of one stock of the first company compared to the price of one stock of the second company in any market. Then each investor is indifferent between alternative investments of certificate into the first or the second object.

Under such scheme the market value of certificate is 2.25 Ukrainian Hryvnya. “Winning Bid/Appraisal Ratio” for the first object is 0.666667. “Winning Bid/Appraisal Ratio” for the second object is 1.333333.

The considerations presented above are illustrated by the next table:

	First Enterprise	Second Enterprise
Assessed value of property (Equity Capital) in UAH	100	100
Quantity of stocks	1000	1000
Face Value of one stock (“reserve price” for auctions for privatization property certificates)	0.1	0.1
Stock exchange value of the enterprise (in UAH)	150	300
Stock Market price of one stock (in UAH)	0.15	0.30
Auction price (in UAH/in certificates) for the case if the auction market is an “efficient” one.	0.06667 UAH / 0.06667 certificate	0.13333 UAH / 0.13333 certificate

Claiming that the market values of certificates are the same and independent of the Winning Bid/Appraisal Ratios is equivalent to previous statement that the Winning Bid/Appraisal Ratio is an unbiased estimator of the ratio of the stock market price over the state’s estimated value of the property. This is a second testable hypothesis and, if verified, indicates that the auction market is efficient. In other words it means that there should be no systematic possibility to get superior profits through different choices among objects offered for a sale.

The market value of an invested certificate is plotted against Winning Bid/Appraisal Ratios in Figure 1. Here, those discussed at the section “Data”, 57 successful matches of stock market prices and prices at the auctions for privatization property certificates are used. Both variables are measured in logs.

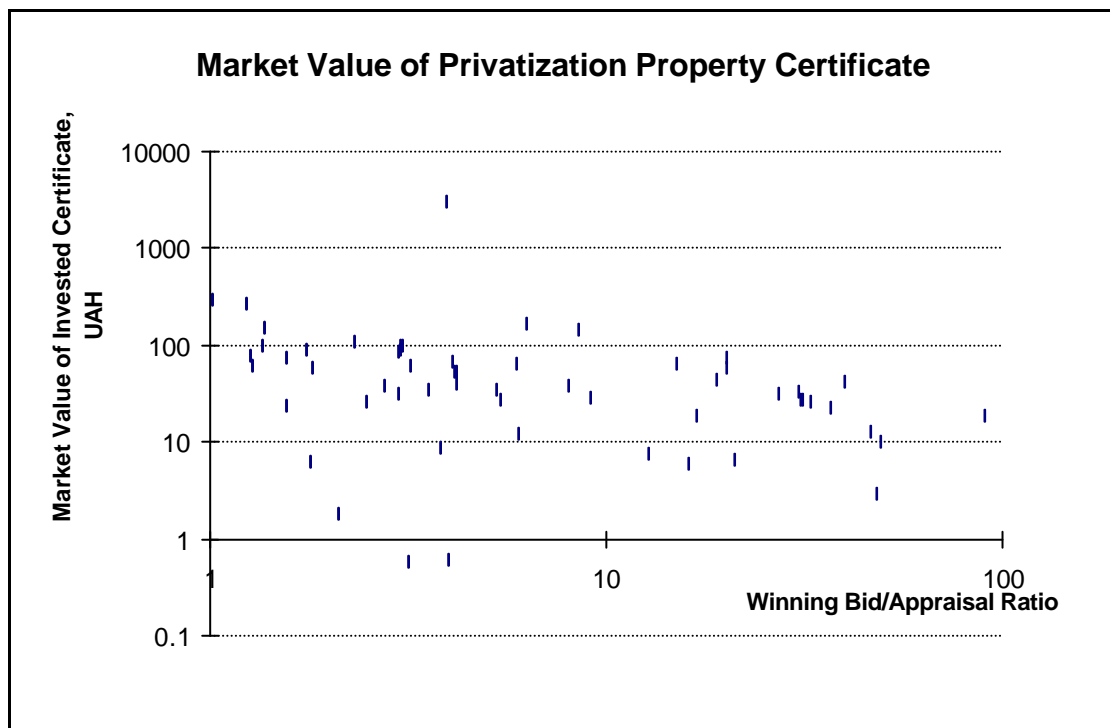


Figure 1.

The market value of a certificate should not depend on the Winning-Bid/Appraisal Ratio if the auction market is efficient. However, Figure 1 shows that there is a negative and statistically significant dependence<sup>14</sup> on the 5% level between those variables.

<sup>14</sup> Below we present full “Eviews” output. Here: RETC is a market value of compensation certificate across different objects; RATIO is a “Winning Bid/Appraisal Ratio”

LS // Dependent Variable is LOG(RETC)  
Date: 05/05/98 Time: 20:14

The same dependence for auctions for compensation certificates is presented on figure 2. It is also negative<sup>15</sup> and statistically significant on 5% level contrary to our theoretical expectations.

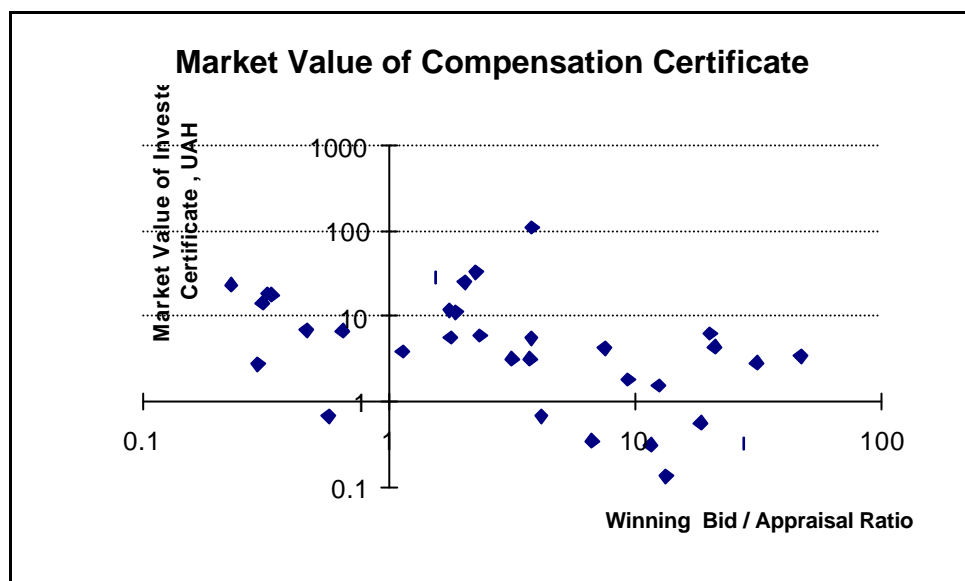


Figure 2.

Sample(adjusted): 1 57

Included observations: 57 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.172099	0.335117	12.44967	0.0000
LOG(RATIO)	-0.343388	0.152958	-2.244975	0.0288

R-squared	0.083943	Mean dependent var	3.540616
Adjusted R-squared	0.067287	S.D. dependent var	1.423996
S.E. of regression	1.375253	Akaike info criterion	0.671733
Sum squared resid	104.0227	Schwarz criterion	0.743419
Log likelihood	-98.02390	F-statistic	5.039915
Durbin-Watson stat	2.633286	Prob(F-statistic)	0.028811

<sup>15</sup> Below we present full “Eviews” output. Here: RET\_CC is a market value of compensation certificate across different objects; AUCR is a “Winning Bid/Appraisal Ratio”

LS // Dependent Variable is LOG(RET\_CC)

Date: 05/05/98 Time: 20:29

Sample(adjusted): 1 33

Included observations: 33 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.958716	0.298735	6.556712	0.0000
LOG(AUCR)	-0.499595	0.158625	-3.149528	0.0036

R-squared	0.242415	Mean dependent var	1.401628
Adjusted R-squared	0.217977	S.D. dependent var	1.563852
S.E. of regression	1.382946	Akaike info criterion	0.707124
Sum squared resid	59.28875	Schwarz criterion	0.797822
Log likelihood	-56.49252	F-statistic	9.919527
Durbin-Watson stat	1.724783	Prob(F-statistic)	0.003607

There is a positive correlation<sup>16</sup> between the ratio of stock price in the stock exchange to assessed value of stock and Winning Bid/Appraisal Ratio. Figures 3 and 4 show that the more an object is underestimated by the state compared to its stock market valuation, the higher will be the Winning Bid/Appraisal Ratio.

Greater underestimation of the property by the initial assessment makes the property more attractive for bidders in privatization auctions and, finally, the quantity of submitted bids is so big that the market value of property received per a certificate becomes less than that for the less attractive objects (the objects that are less overestimated by the initial assessment).

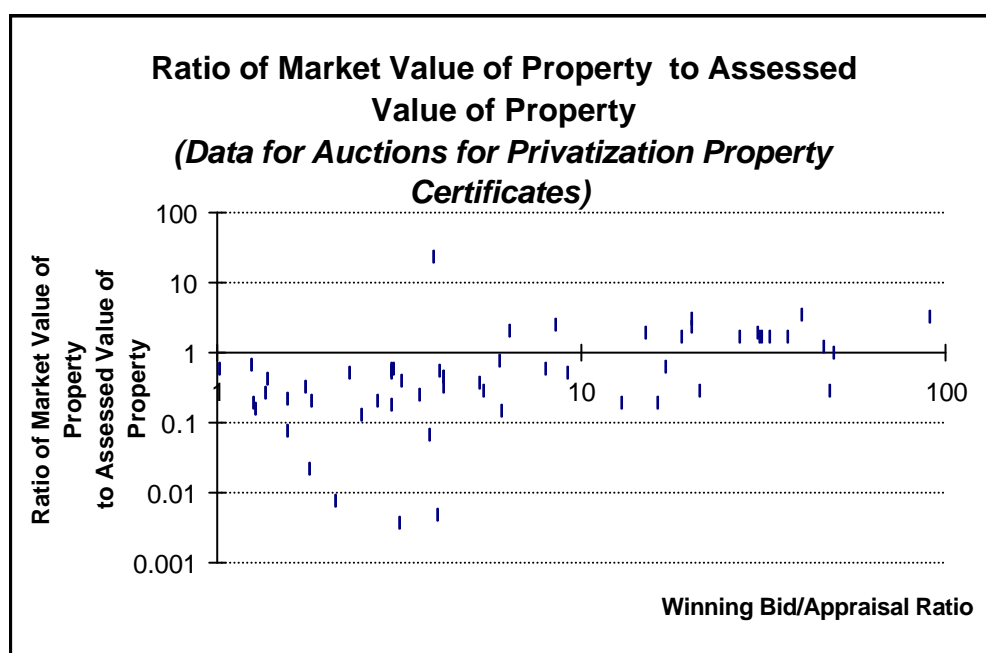


Figure 3.

<sup>16</sup> Let us denote “market value of certificate” as  $y$ , “Winning Bid/Appraisal Ratio” as  $x$ , and “Ratio of market value of property to assessed value of property” as  $z$ . Then to check the correspondence between the relative prices of objects in auctions and in stock exchange means to check the equality of coefficient  $\alpha_2$  to one in the next regression:

$$\ln(z) = a_{10} + a_2 * \ln(x) \quad (f.1)$$

If  $\alpha_2=1$  then some percent change in  $x$  leads to the same percent change in  $z$ . This is equivalent to equality of relative prices in both markets. Let us subtract  $\ln(x)$  from both sides of equation (f.1). Then we get:

$$\ln(z/x) = a_{10} + (a_2 - 1) * \ln(x) \quad (f.2)$$

It is easy to see that  $(z/x) * \text{face value of certificate} = y$ . The results of the regressions of type (f.2) are presented in footnotes 13, 14. The coefficients of regressions of type (f.1) can be easily derived from the information presented at the footnotes. There are no reasons to run additional regressions to check the positive correlation between the ratio of stock price in the stock exchange to assessed value of stock and Winning Bid/Appraisal Ratio. Anybody interested in statistical tests is invited to add one to the slopes of regressions' equations in footnotes 13, 14. The results will be the coefficients of regressions of type (f.1). They are deviated from one by more than two standard deviations and, therefore, they are different from one on the 5% level of significance.

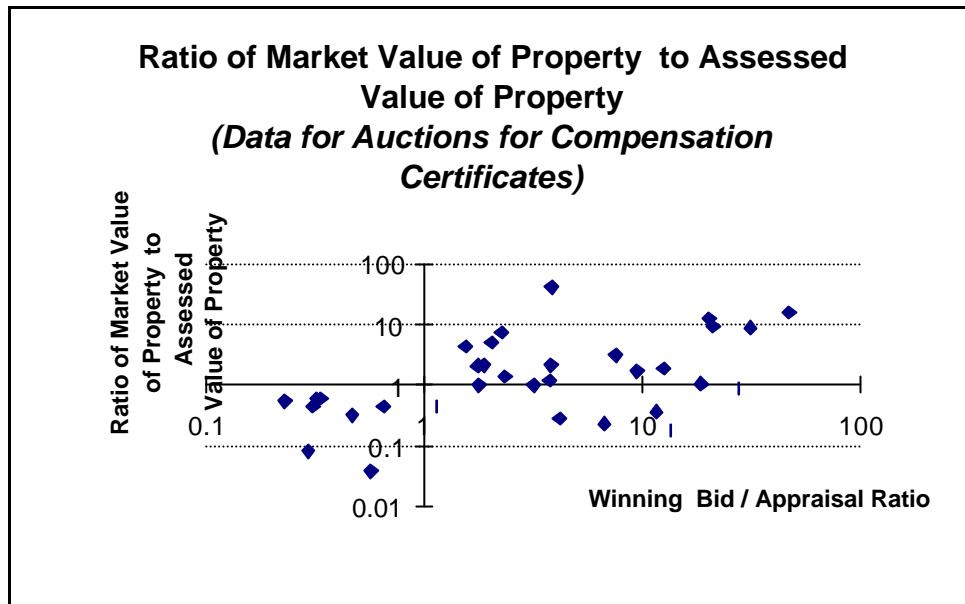


Figure 4.

Primarily it was supposed that the quantity of submitted bids will correct the mistakes in the initial estimation of the privatized property. We see from the empirical investigation presented above that the quantity of certificates submitted for some property cures the mistakes in initial estimation so intensively that it finally creates new reverse imperfections. The more property is underestimated by the initial assessment, the less market value of such a property will be received per submitted certificate. Let us call this phenomenon “overbidding”.

Reality contradicts the assumption that auction market is efficient. Bidders who bid for extremely attractive objects, on average, lose their money. They receive less than those who will choose property of initially less underestimated by the state compared to the most underestimated objects. So, this is like “winners curse”. If someone has chosen something that seems to be the most valuable then he will be in inferior position to a more cautious bidder.

There are likely two ways to explain this phenomenon. The first is to assume that privatization auctions fit a “common values” auction environment.<sup>17</sup> The second explanation is based on the fact that decrease in the market value of an invested certificate with an increase in auction price can be compensated by the decrease in risk of such investment or liquidity of the acquired property. We will try to consider these two possible explanation of the phenomenon in the next two sections.

Due to the usual "winners curse" hypothesis, the winning bidder loses because he overestimates the real value of the object that he wins (and the reason why he wins is because he overestimates the true value). In our situation the bidders have the same system of preferences



among the offered objects. They fail to discount their expectations enough to incorporate that fact efficiently into their forecasts, and this failure leads to the irrational decisions of bidders and biased market value of certificate across different objects.

### **An Application of Common Value Hypothesis to the Privatization Auctions.**

The common value hypothesis for some object means that the object has a value roughly equal for all bidders. In other words, if we have a lot of objects then the valuations of the objects by different bidders are positively correlated<sup>viii</sup>.

It seems reasonable to assume that shares in a particular company have the same true and unknown value which is common for all investors. Differences in share valuations occur because of the differences in forecasts of the true value. The differences in forecasts are caused by the differences in information and ability and methods to convey that information into the forecasts.

For our situation we can state that some certain amount of stocks will have the same true value for any bidder if the bidder buys those stocks only to get a stream of dividends in future or for resale on a stock market.

Each certificate invested in a privatized enterprise is converted into a certain number of shares in the enterprise. Suppose that the estimates of the amount of money that will be received on one certificate bidden for any object from proposed is also approximately the same for any bidder before the auction. Bidders have the same valuations of property proposed for a sale and fail to discount enough the expected share of the property received for one certificate from the auction. Then, different bidders will give to the objects similar rankings due to the expected market values of certificates bidden for the objects<sup>18</sup>. Therefore, they have the similar system of the preferences across all objects offered for a sale. If they will bid correspondingly to the rankings then the most attractive objects will get too many bids and the market value of the certificates invested into the

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<sup>17</sup> The "common value" hypothesis is a basic assumption for standard explanation of "winners curse".

<sup>18</sup> Often the participants of the auction markets are concerned only with determination of the future value of the property. There were proposed several hundreds of objects for each auction. Most of them are not worth bidding for at all. The usual task for investors is to distinguish the objects worth to be invested. They fail to study correspondence between the results of the auctions and the trade sessions in the stock market and they do not pay a lot of attention to the possible increase in the prices of stocks during the auctions.

The other side of the story is that the price of one certificate in shadow market is small enough and even the increase in price of stocks during auctions rarely discount the market value of certificate below its price in shadow market (see Oksanych (1997)). That is if bidders are concerned more with the positive profits than with the profits margin then they will not pay too much attention to the increase in prices of stocks during auctions. We also suspect that this paper is very likely to be the first serious research on the problem of correspondence of relative auction and stock market prices.

objects will be less than those for the less attractive objects (that is objects that have lower rankings by the bidders).

Let us to describe the situation in formal terms. Suppose there is an auction of the type that was described above. The number of objects offered for a sale is  $n$ . All objects were initially estimated by the same value. There is a large number of  $m$  identical bidders. Suppose that each bidder gets only one certificate and, thus, total quantity of certificates is equal to the quantity of bidders.

Suppose that each object offered for sale during the privatization auction has some independent common value distribution with a mean  $\mu_i$  and variance  $\sigma_i^2$  that are unknown to bidders. Thus, each participant (bidder) receives a single particular value  $v_{ij}$  chosen randomly from such a distribution for each object offered for a sale during the auction. ( $v_{ij}$  is a subjective estimate of market value of stocks received per one certificate bidden for  $i^{\text{th}}$  object.) Here index  $i$  denotes the object and index  $j$  denotes the bidder. We will also assume that the future stock market prices of the objects are proportional to the means of common value distributions. Thus, the objects initially more underestimated by the state will have higher means of the common value distributions.

Then each bidder will bid for some object correspondingly to the set of the values he has received. He will invest his certificate into the object with the highest subjective valuation  $v_{ij}$ .

The probability that the  $k^{\text{th}}$  object will get the highest valuation may be easily calculated. Suppose, a bidder's valuation of the  $k^{\text{th}}$  object is drawn randomly from the distribution with  $\mu_k$  and variance  $\sigma_k^2$ . Then some other  $j^{\text{th}}$  object will not be preferred to the  $k^{\text{th}}$  object only when the corresponding value  $v_{ij}$  will be less or equal to  $v_{kj}$ . Hence the probability of the situation when the  $k^{\text{th}}$  object will get the highest valuation and, thereafter, will be chosen for bidding is<sup>19</sup>:

$$P(k^{\text{th}} \text{ object is the best}) = p_k = \int_{-\infty}^{+\infty} f_k(v_k, \mathbf{m}, \mathbf{d}_k^2) * \left( \prod_{\substack{i=1 \\ i \neq k}}^n F_i(v_k, \mathbf{m}, \mathbf{s}_i^2) \right) dv_k \quad (1)$$

where

$f_k$  – probability density function of  $k^{\text{th}}$  common value distribution;

$F_i$  – cumulative distribution function of  $i^{\text{th}}$  distribution which depends on the parameters of distribution mean  $\mu_i$  and variance  $\sigma_i^2$ ;

$n$  – number of objects proposed for an auction.

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On the whole the reasons for such behavior of bidders belong to the area of bounded rationality.

<sup>19</sup> Below we consider a situation from a point of view of one particular bidder and, so, index  $j$  will be omitted for simplicity.

$F_i$  is the probability of such an outcome when the valuation of  $k^{\text{th}}$  object is higher than the valuation of some  $i^{\text{th}}$  object. The product of such functions for all possible  $i$  except  $i=k$  will give us a probability that some particular value  $v_k$  drawn from  $k^{\text{th}}$  distribution will be bigger than the values drawn from all other distributions of common values. If we take an integral of the probability density function multiplied by the product of cumulative distributions for any possible value of  $v_k$ , then we will get a probability of the situation that  $k^{\text{th}}$  object will be preferred to any other of remaining objects.

The way (1) is gotten is illustrated by Figure (5) which shows a set of several symmetric density distributions. The area of the figure below the probability density function equals the probability of getting a value less than particular  $v_k$  (that is for  $i^{\text{th}}$  distribution the area is equal to  $F_i(v_k, \mu_k, \sigma_k^2)$ ). But, please, do not forget that  $v_k$  also was chosen randomly from  $k^{\text{th}}$  distribution. If we calculate the sum<sup>20</sup> of probabilities to get  $k^{\text{th}}$  object to be the best for any possible  $v_k$  then we get a probability that someone from our identical bidders will prefer the  $k^{\text{th}}$  object to any other object from  $(n-1)$  possible alternatives..

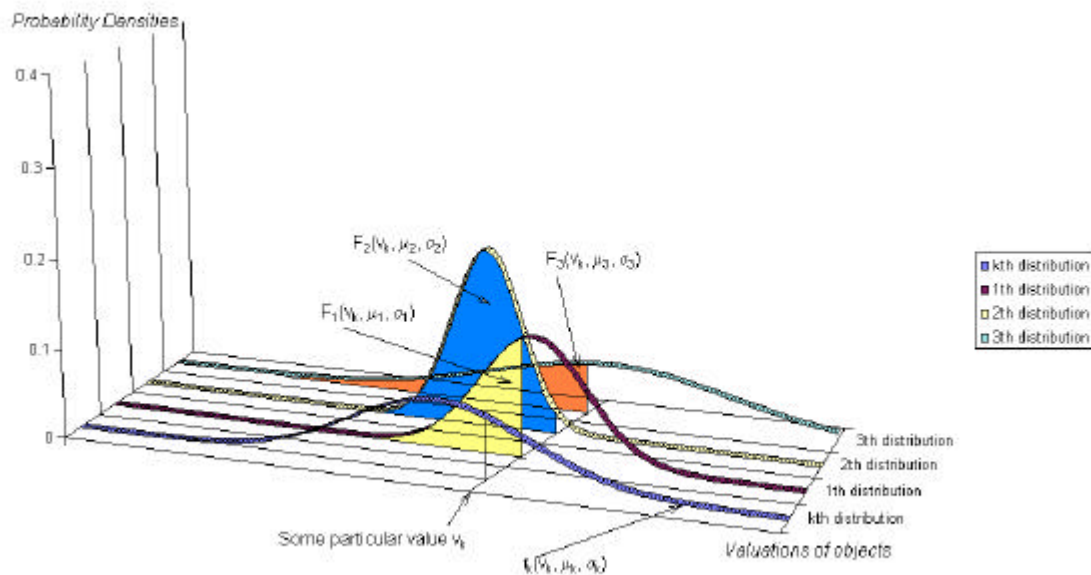


Figure 5

The sum of all probabilities of form (1) across all objects should be one. This means that finally the bidder has to use his certificates that is to bid for some object from possible  $n$ .

<sup>20</sup> That is an improper integral.

$$\sum_{k=1}^n p_k = 1 \quad (2)$$

The probability to bid for  $k^{\text{th}}$  object multiplied by the quantity of issued certificates will give us the quantity of submitted certificates for  $k^{\text{th}}$  object. Thus, the relative price of  $k^{\text{th}}$  object compared to some  $l^{\text{th}}$  object is equal to the ratio of corresponding probabilities.

Let us look what does it mean to get an efficient market in terms of our model.

It was stated in the previous section that the auction market is efficient if the relative prices of the objects in the auction are equal to the relative prices of the object after the auction, i.e. on the stock market. Relative prices of objects in an auction are given by the ratio of probabilities with which bidder will choose the objects for bidding. The relative prices of the objects in the stock market are equal to the ratio of the means of the common values distributions associated with those objects. Thus, the auction market can be considered as an “efficient one” if the next equation is satisfied for any  $l$  and  $k$  from possible  $n$  (that is across any pair of the objects offered for a sale):

$$\frac{p_k}{p_l} = \frac{\mathbf{m}_k}{\mathbf{m}_l} \quad (3)$$

This rule is easily derived from and is equivalent to the statement of the constant returns per a certificate across all objects offered for a sale:

$$\frac{\mathbf{m}_1}{p_1} = \frac{\mathbf{m}_2}{p_2} = \dots = \frac{\mathbf{m}_k}{p_k} = \frac{\mathbf{m}_l}{p_l} = \dots = \frac{\mathbf{m}_n}{p_n} \quad (4)$$

By simple rearranging we get:

$$\frac{p_2}{p_1} = \frac{\mathbf{m}_2}{\mathbf{m}_1}; \quad \frac{p_k}{p_1} = \frac{\mathbf{m}_k}{\mathbf{m}_1}; \quad \frac{p_k}{p_l} = \frac{\mathbf{m}_k}{\mathbf{m}_l}; \quad \text{and so on} \quad (5)$$

It is very unlikely to get a system of common values that will be able to provide validity of equation (3) for any pair from those common values. It should be a very specific type of distribution of common value. For example, let us take a derivative with respect to  $\mu_k$  from both sides of (3).

We get:

$$\frac{d}{d\mathbf{m}_k} \left( \frac{p_k}{p_l} \right) = \frac{1}{\mathbf{m}_l} \quad (6)$$

This means that a change in the mean of the  $k^{\text{th}}$  distribution should lead to proportional changes in the probability to bid for the  $k^{\text{th}}$  object compared to probability to bid for any other object in order to keep our auction market “efficient”. Let us mention that the probabilities in (6) are of the form that are given by (1). So, usually each of such probabilities is a function of parameters of all  $n$

distributions of common values. Left side of (6) can be written as:

$$\frac{d}{d\mu_k} \left( \frac{p_k}{p_l} \right) = \frac{p_k' * p_l - p_k * p_l'}{(p_l)^2} \quad (7)$$

where  $p_k'$ ,  $p_l'$  denote derivatives of  $p_k$ ,  $p_l$  with respect to  $\mu_k$ . Both of these derivatives are functions of parameters of all common value distributions including  $\mu_k$ . It would be quite a strange result if we would get finally just a number of  $1/\mu_l$  as a value of (7). Usually, we come out with the sophisticated non - linear function of many variables or just with complex mixture of integrals because every probability or a derivative of the probability is initially an integral. Hence, it is very unlikely to get efficient auction market if the decisions of bidders comply with the “common value” hypothesis.

But the main question for us is what will be the allocation of certificates among different objects if the decisions of bidders are based on “common value” distributions. A numerical simulation program was developed to answer this question, based on the assumption that each of the distributions from which bidders draw their value estimates is normally distributed (see appendix A for the text of the program). Thus, the system of such common values are described by the means and standard deviations of the distributions.

For example, let us consider one particular set of objects. We assume that their common values distributions have equal variances. Distribution of their means is given in Appendix C. The numerical values of the means and variances are given in Appendix B. It turns out that under this quite plausible distribution of means and equal variances we come out with decreasing function of the market value of the certificate with respect to the probability for the object to be invested (this is an analog of "Winning Bid/Appraisal Ratio" in this theoretical framework). Calculations made and their graphical representation is presented in Appendix B and Figure 6 below:

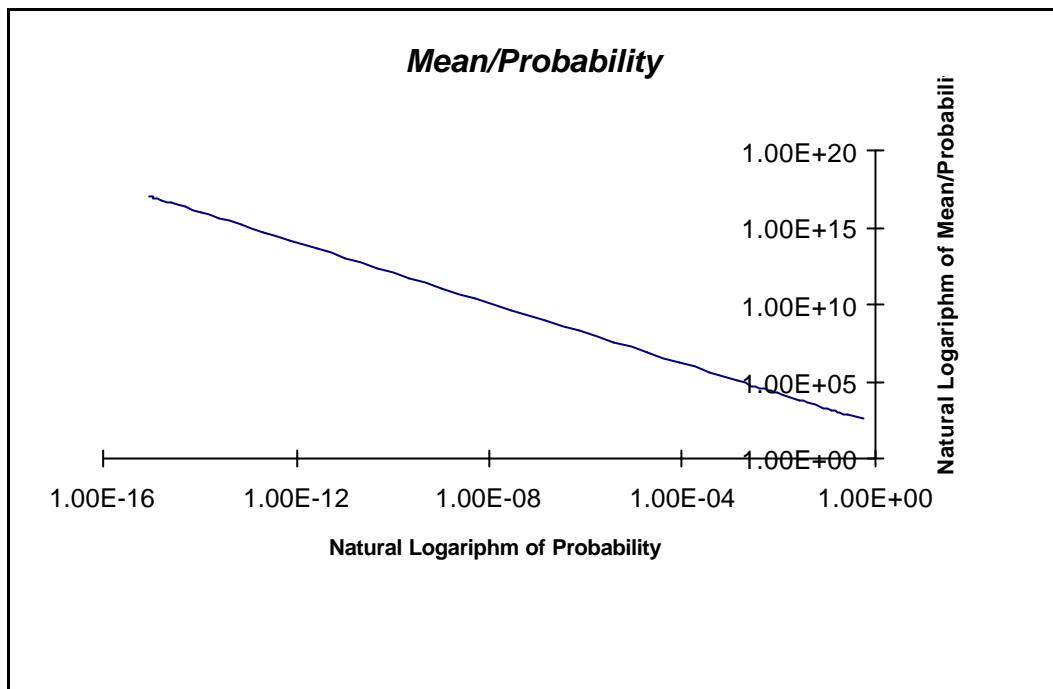


Figure 6

The decreasing shape of the dependence between the market value of the certificate with respect to the probability for the object to be invested was stable despite the changes in distribution of means or standard variances of common values distributions. We do not represent here all simulation experiments. Anyway, those experiments cannot exhaust all possible sets of distributions. That is why this result can hardly be considered as theoretically convincing, but it makes it possible to state reasonably that system of common values, if it is used as a base for decisions of bidders for which object to bid, can lead to an outcome of “overbidding” for more attractive objects and therefore to the “inefficiency” of auction market.

Though there were too many "suppose", in the explanation above and the explanation itself was quite vague, it still seems to the author that the real world partly possesses the logic similar to the described above.

### **The Risk Avoidance and Liquidity Preference as a Possible Explanations of “Overbidding” in Auctions.**

We can state from the conducted empirical investigation that the decision to bid for extremely attractive objects is not justified by the correspondent money return. In the previous section we gave an explanation how just bounded rationality of the bidders can explain the existing phenomenon.

However, there are also other ways to explain the "overbidding". For example, we can suggest that other important characteristics of assets are correlated with the degree of "overbidding." Those characteristics can be risk<sup>21</sup> and liquidity of some type of stocks. We will try to present shortly only the ideas here. The attempt to consider deeply these explanations could finally lead to the work that is comparable to the writing one extra MA thesis.

Stocks are rarely traded on a stock market before some of those stocks are sold through a privatization auction. It is quite reasonable to suppose that if there will be no substantial increase in the price of a stock during auction (that is low "Winning Bid/Appraisal Ratio") then the stock will be less liquid. This means that it will be more difficult to find a buyer for the stocks in future. Most of the stocks of privatized enterprises are not traded in the stock market at all<sup>22</sup>. Thus, the lower market value of certificates invested into the most underestimated object can be considered as a compensation for higher liquidity of the stocks.

The similar situation can be with the riskiness of investment. If the amount of risk connected with the bidding for an object in auction is negatively correlated with the increase in the price of the stock during auction (that is higher "Winning Bid/Appraisal Ratio") then there is a rational justification for the existence of the "overbidding". The bidding for less attractive objects should be more profitable on average because of the higher uncertainty in the true value of the property in future.

Therefore, the logic is simple. Bidding for the enterprises that are the most underestimated by the initial assessment of the property is less risky than the bidding for the enterprises where the initial assessments were more correct. This makes bidding for the stocks more attractive for a risk-averse bidder if the expected market values of the certificates would be the same.

The statistical hypothesis can be constructed to check the validity of the risk avoidance or liquidity preference explanation of the "overbidding" phenomenon. But we have not made attempts to execute these tests. The reason for this is that those tests are not the subject of the paper. In addition, the outcomes of the tests are unlikely to be certain with so little data currently available.

## **Concluding Remarks**

We have researched "pricing efficiency" of privatization auctions market. This market is not

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<sup>21</sup> The idea with risk was initially mentioned by my advisor Dr. Lance Eric Brannman.

<sup>22</sup> This means that there can be a selection bias in the tests conducted in the section "Market Efficiency for Privatization Auctions". But this is only a suspect.

“efficient”. The bidders who bid for the initially most underestimated objects have been in inferior position compared to the bidders for the initially less underestimated objects. This result has implications first of all for the bidders who should be more interested in enterprises less attractive for the first sight. But the bidders should be very cautious by making their decisions, because wide spreading of the opposite interest to the less underestimated objects can lead to the reverse bias in auction prices. As it was said in the section “Market Efficiency” for Privatization Auctions”, it is quite difficult to get an “efficient market” under the considered procedure<sup>23</sup> if the bidders are making their investment decisions on the base of a system of common values.

We have not seen some very important policy implications for the government. The existing procedure currently allows the government to absorb more certificates for the issued amount of property than in the case of an efficient auction market.

Since we are not completely satisfied with the theoretical explanations<sup>24</sup> presented in the paper, we consider the found “market inefficiency” of the auction market, specifically, inferior returns for bidders for the most undervalued objects, as the main result of the paper.

We believe that Ukrainian mass privatization auctions are very promising for further research. Taking into account deepness and richness of the phenomenon, every attempt to approach its essence will be interesting and useful for both a researcher and the public.

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<sup>23</sup> There is one particular possibility to change the essence of the procedure for the bidders. It is to use far more often the price constraint in their claims for auctions for privatization property certificates.

<sup>24</sup> To our mind, they need to be made more elegant.



## Endnotes

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<sup>i</sup> Hillion Pierre and S. David Young "The Czechoslovak Privatization Auction: An Empirical Investigation", Social Science Working Paper 921, California Institute of Technology, 1995, Page 1.

<sup>ii</sup> Ibid, pages 1-2.

<sup>iii</sup> For a definition see "Інші інструменти приватизації", Частина 6, Закон України 1992 р. № 2173-ХІІ, "Про приватизацію державного майна" (Law of Ukraine N 2173-XII from 6<sup>th</sup> of March 1992, Database of Legal Documents "Pravo").

<sup>iv</sup> "Про приватизацію державного майна", Закон України 1992 р. № 2163-ХІІ, "Про приватизацію державного майна" (Law of Ukraine N 2163-XII from 4<sup>th</sup> of March 1992, Database of Legal Documents "Pravo")

<sup>v</sup> A short exposition of the "market efficiency" is given in the book of Philips Lois "The Economics of Imperfect

<sup>vi</sup> This is first paragraph in "Efficient Market Hypothesis" by B.G. Malkiel, p.211 in the New Palgrave "The World Economics" (1991) edited by Eatwell, Milgate, Newman.

<sup>vii</sup> Figlewski Stephen "Market Efficiency in a Market with Heterogeneous Information", Journal of Political Economy, August 1978, Vol. 86, Num. 4, Page 585.

<sup>viii</sup> It is a paraphrase of McAfee R.Preston and John McMillan "Auctions and Bidding", The Journal of Economic Literature, June 1987, Volume XXV, Number 2, p. 720-723.

N 2163-XII,

[“On Privatization of State Property”, Law of Ukraine N 2163-XII from 4<sup>th</sup> of March 1992, *Database of Legal Documents “Pravo”*].

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16. **Oxanych Serhiy** “Preferred Vehicles for Investment in Ukraine”, 1997, PFTS Materials.

17. **Phlips Lois** “The Economics of Imperfect Information”, Cambridge University Press, 1988.

18. **Malkiel B.G.** "Efficient Market Hypothesis", in the New Palgrave "The World Economics" edited by Eatwell, Milgate, Newman, W.W. Norton & Company, Inc., 1991, pp. 211-220.

## Appendix A. Program for Calculation of Probabilities based on a System of Common Values.

Below we present a text of the program that was used for calculation of probabilities for the system of normally distributed common values. The parameters of the distributions were given in Excel sheet in the format that is shown by the table “Input & Output” in Appendix B.

The program was written in Visual Basic which allows easily to communicate with the other Microsoft Office Components, specifically, with MS Excel. The simplest method of rectangles was used for calculation of improper integrals of type (1).

*' Declaration of Variables*

*Dim m(130), sd(130) 'm -- array of means, sd -- array of standard deviations*

*Private mmin, mmax, sdmax, oq*

*,*

*' The program calculates system of probabilities*

*,*

*Sub calcul\_system\_of\_probabilities()*

*Sheets("Input & Output").Select*

*Range("A1").Activate*

*oq = ActiveCell.Offset(0, 1) ' oq -- quantity of objects*

*For i = 1 To oq*

*m(i) = ActiveCell.Offset(i + 1, 1)*

*If m(i) > mmax Then*

*mmax = m(i)*

*Else*

*If m(i) < mmin Then*

*mmin = m(i)*

*End If*

*End If*

*sd(i) = ActiveCell.Offset(i + 1, 2)*

*If sd(i) > sdmax Then*

*sdmax = sd(i)*

*End If*

*Next i*

*For i = 1 To oq*

*ActiveCell.Offset(i + 1, 4).FormulaR1C1 = get\_probability(m(i), i)*

*Next i*

*End Sub*

```

' **** The function below calculates an integral of type (1) ****
' **** (that is probability to invest into kth object) ****
' **** for given system of common beliefs ****
' ****

Function get_probability(k_mean, k)
    upper_limit = mmax + 10 * sdmax
    lower_limit = mmin - 10 * sdmax
    h = (upper_limit - lower_limit) / 10
    prior_p = 300
    current_p = 200

    Do While Abs((prior_p - current_p) / current_p) > 0.001
        prior_p = current_p
        h = h / 2
        ss = 0
        For x = lower_limit To upper_limit Step h
            ss1 = Application.NormDist(x, k_mean, sd(k), False)
            For j = 1 To oq
                If j = k Then
                    Else
                        ss1 = ss1 * Application.NormDist(x, m(j), sd(j), True)
                    End If
                Next j
            ss = ss + ss1
        Next x
        current_p = ss * h
    Loop

    get_probability = current_p
End Function

```

### Appendix B. Table “Input & Output”

Quantity of objects	30			
Number	Mean	Standard Deviation	Probabilities	Mean/ Probability
1	100.1	10	8.87E-16	1.13E+17
2	100.4	10	1.10E-15	9.14E+16
3	100.9	10	1.57E-15	6.44E+16
4	101.6	10	2.57E-15	3.96E+16
5	102.5	10	4.81E-15	2.13E+16
6	103.6	10	1.03E-14	1.01E+16
7	104.9	10	2.49E-14	4.21E+15
8	106.4	10	6.81E-14	1.56E+15
9	108.1	10	2.08E-13	5.20E+14
10	110	10	7.05E-13	1.56E+14
11	112.1	10	2.62E-12	4.27E+13
12	114.4	10	1.06E-11	1.08E+13
13	116.9	10	4.64E-11	2.52E+12
14	119.6	10	2.16E-10	5.54E+11
15	122.5	10	1.05E-09	1.16E+11
16	125.6	10	5.34E-09	2.35E+10
17	128.9	10	2.77E-08	4.66E+09
18	132.4	10	1.44E-07	9.17E+08
19	136.1	10	7.49E-07	1.82E+08
20	140	10	3.79E-06	3.69E+07
21	144.1	10	1.85E-05	7.80E+06
22	148.4	10	8.52E-05	1.74E+06
23	152.9	10	0.00036623	4.17E+05
24	157.6	10	1.44E-03	1.09E+05
25	162.5	10	5.16E-03	3.15E+04
26	165	10	9.32E-03	1.77E+04
27	170	10	2.71E-02	6.26E+03
28	178.4	10	1.20E-01	1.48E+03
29	184.1	10	2.74E-01	6.72E+02
30	190	10	5.62E-01	3.38E+02

### Appendix C. The Histogram of the Means from the Table ‘Input & Output’

<i>Bin</i>	<i>Frequenc</i> <i>y</i>	<i>Cumulati</i> <i>ve %</i>
100.1	1	3.33%
118.08	12	43.33%
136.06	5	60.00%
154.04	5	76.67%
172.02	4	90.00%
More	3	100.00%

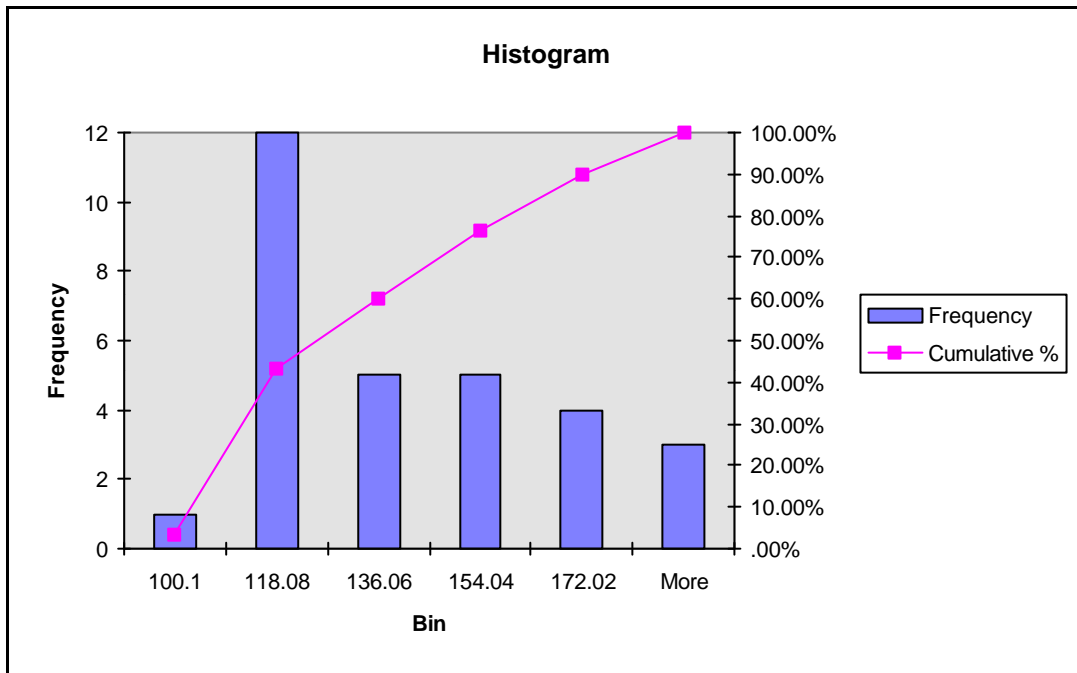


Figure 7

### Appendix D. The Data for the Auctions for Privatization Property Certificates

Name	Market Value of the Privatization Property Certificate, UAH	PFTS Prices as of 03/06/98, UAH	Auction Number	Number of Submitted Certificates	Number of Submitted Certificates by Physical Persons	Number of Submitted Certificates by Juridical Persons	Number of Submitted Certificates with a Price Constraint	Total Number of "Winning Certificates"	Total Number of "Winning Certificates" with a Price Constraint	Number of Certificates Needed for Buying All Stocks for Their Face Values.	Ratio of Winning Certificates to the Quantity of Certificates Needed
ARTEMIIVSKY Z-D COL MET (0.25)	24.00825	0.891	3	117886	22	117864	2475	117886	2475	75630.29	1.558714
BALCEM (0.05)	7.649691	0.467	7	118341	1121	117220	8500	109841	0	8567.857	12.82013
BALCEM (0.05)	6.079605	0.467	18	59491	1580	57911	500	58991	0	3657	16.13098
DNIP.METAL-Y Z-D KOMIN. (0.25)	164.8903	0.52	25	52326	12318	40008	1000	52326	1000	8296.2	6.307225
DNIPROAZOT (0.25)	40.00004	4	7	99395	1765	97630	10000	92347	3740	21987.4	4.199995
DNIPROCEMENT	29.11244	1.263	7	35814	93	35721	1428	34440	1428	3780.238	9.110537
DONETSKY METALURG Z-D (0.25)	89.93669	0.135	31	84841	2405	82436	24616	84841	24616	28260.44	3.002112
DONETSKY METALURG Z-D (0.25)	66.16294	0.135	21	96086	3234	92852	0	96086	0	23545.68	4.080834
ENAKIEVSKY METALURG. Z-D	78.00925	1.4	2	146354	168	146186	146159	146354	146159	116499.7	1.256261
EXIMNAFTOPRODUCT	111.4474	6.14	7	54734	4143	50591	3341	54471	3203	23540.6	2.313918
EXIMNAFTOPRODUCT	85.96079	6.14	4	95746	10971	84775	58862	85640	49926	28546.93	2.999972
HALYCHYNA NPZ (0.25)	99.40307	3.2	6	213205	16526	196679	6409	213131	6409	157633	1.352071
HERSONSKY CEL-PAPER C-T (0.25)	1.797169	0.09	3	16532	781	15751	6459	16532	6459	7860	2.103308
HIM-FARM Z-D CHER ZIRKA (0.25)	10.15505	0.25	14	43485	1995	41490	8265	35220	0	715.322	49.23657
IZMAILSKY CEL-PAPER C-T (1.75)	3014.655	27.93	15	183773	1828	181945	44025	174773	35025	44325	3.942989
KOVELNAFTOPRODUCT (0.25)	18.41738	0.83	12	32806	1782	31024	5793	27013	0	299.704	90.13226
KREMENCHUTSKY STALELIVARNY Z-D	297.4697	0.15	10	3130	445	2685	0	3130	0	3103.601	1.008506
KREMENCHUTSKY STALELIVARNY Z-D	99.90464	0.15	15	19187	1011	18176	11746	15989	8548	5324.585	3.002863
KREMENCHUTSKY STALELIVARNY Z-D	98.68754	0.15	20	5813	713	5100	5000	5813	5000	1912.236	3.039898
KREMENCHUTSKY STALELIVARNY Z-D	37.46278	0.15	23	14713	6372	8341	1500	14213	1000	1774.862	8.007949



## Z-D

KYIVOBLENERGO (10)	25.92677	16.999	34	226807	6309	220498	145877	125230	44300	3820	32.78272
KYIVOBLGAZ (0.05)	146.6197	5.9	12	82502	6420	76082	13100	69402	0	8212.833	8.450433
KYIVSKA RUS HOTEL (0.01)	31.04537	0.0887	8	55623	8369	47254	45732	36096	26205	12032.14	2.999964
LISICHANSK NAFTORGSINT. (0.01)	26.21929	0.062	2	446100	253	445847	190361	446100	190361	179668.6	2.482905
MARIUPOLSKY METAL-Y Z-D (0.25)	63.77322	0.19	27	712026	9815	702211	330972	495619	114565	83176.9	5.958614
MELIT Z-D TRACT GIDR-V (0.25)	61.99792	0.25	10	3936	1138	2798	0	3936	0	3094.905	1.271768
MYKOLAIVCEMENT (0.25)	35.33077	3	13	110227	7875	102352	6890	110226	6890	30907.69	3.566297
NAFTOKHIMIK PRICARPATYA (0.25)	35.21335	4.4	15	601960	21782	580178	168507	491851	58398	93721.43	5.24801
NIKOPOLSKY ZAVOD FEROSPLAVOV	2.95315	1.1	30	227298	5038	222260	120464	106834	0	2221.509	48.09073
NIZHNODN. TRUBOPR. Z-D (0.25)	60.91784	4.65	9	181637	3130	178507	4891	177852	1106	55475.48	3.205957
ODESCABEL	42.50036	0.85	20	157783	4515	153268	56630	113208	12055	2830.224	39.99966
ORZHENIKIDZEVSKY GZC (0.25)	75.00008	0.75	21	435139	11018	424121	146355	345622	56838	17281.12	19.99998
POLTAVSKY ALMAZNY Z-D (0.05)	12.7636	0.059	19	225852	10205	215647	53188	172490	0	3731.516	46.22519
PTAHOFABRYCA "UKRAINA"	52.97012	0.11	24	569	469	100	0	569	0	137	4.153285
PTAHOFABRYCA "UKRAINA"	52.36252	0.11	16	12971	4735	8236	4500	10178	1707	2422.481	4.201479
ROSAVA VAT (0.25)	63.84045	0.48	28	235999	9253	226746	173865	166608	104474	11079.44	15.03758
ROVENSKY Z-D VISOKOV. (0.05)	8.764089	0.795	8	20543	3036	17507	1540	19003	0	4987.857	3.809852
SEVAST PIVO-BEZALK Z-D (0.25)	30.97824	0.42	12	14432	134	14298	1059	13373	0	493.181	27.11581
STAH-Y Z-D FEROSPLAVIV (0.01)	22.83422	0.8	20	274588	2795	271793	45000	229587	0	6241	36.78689
STIROL CONCERN	155.1358	3.6	3	22629	3818	18811	17220	22629	17220	16515.5	1.370167
SUKHA BALKKA (0.05)	27.01483	0.694	12	381089	5522	375567	7635	380909	7455	70606.5	5.394815
SUMSKE NVO IM. FRUNZE	18.56015	1.5	25	357014	6959	350055	121984	295030	60000	17383.5	16.97184
SVES'KY NASOSNY ZAVOD (0.25)	0.600357	0.4	23	30235	1241	28994	5000	25235	0	6312.5	3.997624
TERNOPILOBLENERGO (10)	58.75	23.5	32	90104	3005	87099	68755	48880	27531	2444	20
UGCEMENT VAT (0.25)	58.26894	2.5	16	8567	247	8320	900	8567	900	4754.19	1.801989
UGCEMENT VAT (0.25)	38.00248	2.5	6	6448	114	6334	1000	6448	1000	2333.714	2.762977
UKRGRAFIT (0.25)	12.11994	1.73	11	238129	3858	234271	40801	197328	0	32915	5.995078
UKRNAFTA (0.25)	271.4109	7.98	10	486299	31899	454400	287435	486299	287435	393802.5	1.23488
VALSA	91.62194	0.08	29	25079	3567	21512	20000	25079	20000	14361.17	1.746307
ZAPORIZHFEROSPLAV (0.01)	32.71666	0.95	17	521112	7699	513413	151907	369205	0	12109.43	30.48905
ZAPORIZHKOKS (0.10)	6.1958	0.105	7	48693	4100	44593	7400	48693	7400	27364.36	1.779431
ZAPORIZHSKY AVTOZAVOD (0.25)	72.99757	2.7	14	73665	24034	49631	3100	73665	3100	47419.45	1.553476
ZAPORIZHTRANSFORMATOR (0.01)	0.582918	0.185	14	282459	45187	237272	13840	280559	11940	88401.5	3.17369
ZHYDACH TCEL-PAP C-T (0.05)	6.650034	0.07	19	109253	8420	100833	68973	75778	35499	3599.474	21.05252
ZHYTOMYROBLENERGO (0.25)	44.37988	0.42	20	10130	2938	7192	508	9622	0	508.361	18.92749
ZHYTOMYROBLENERGO (0.25)	27.30171	0.42	33	11625	2616	9009	8264	4668	1307	151.7195	30.7673

ZHYTOMYROBLENERGO (0.25)      27.02866    0.42    28    53367    1558    51809    33900    32267    12800    1038.255    31.07812

Spearman's rank correlation between the market value of certificate and "Ratio of Winning Certificates to the Quantity of Certificates Needed" (that is -0.44568. (Critical value for negative association is -0.432 for 30 observations for  $\alpha = 0.01$ <sup>25</sup>)

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<sup>25</sup> Newbold Paul "Statistics for Business & Economics", Prentice - Hall, 1995, p.843.

### Appendix E. The Data for the Auctions for Compensation Certificates

Name	Prices as of 03/06/98, UAH	Market Value of the Compensation Certificate, UAH	Auction Number	Number of Submitted Certificates	Number of Submitted Certificates by Physical Persons	Number of Submitted Certificates by Juridical Persons	Number of Certificates Needed for Buying All Offered Stocks for Their Face Values	Ratio of "Winning Compensation Certificates to the Quantity of Certificates Needed
ZAPORIZHTRANSFORMATOR (0.01)	0.185	0.131423524	8	711955	133100	578855	53105.955	13.40631197
HERSONSKY CEL-PAPER C-T (0.25)	0.09	0.309904077	4	11259	11215	44	969.225	11.61649772
VELIKOANADOLSKIY VOGNETRIVKIY COMBINAT (0.5)	0.445	0.321867082	17	56042	39080	16962	2026.75	27.65116566
SVES'KY NASOSNY ZAVOD (0.25)	0.4	0.341222779	8	39124	30324	8800	5840.625	6.698598181
ZAPORIZHKOKS (0.10)	0.105	0.564488351	7	216774	96133	120641	11653.97	18.60087163
DONETS'KKOKS (0.25)	0.095	0.667836315	15	146077	32377	113700	256737	0.568975255
ZHYDACH TCEL-PAP C-T (0.05)	0.07	0.668253093	8	143299	38799	104500	34200	4.19002924
ROSAVA VAT (0.25)	0.48	1.535679321	20	1385223	224185	1161038	110794	12.50268968
KYIVOBLENERGO (10)	16.999	1.802647442	20	1634873	230681	1404192	173369	9.430019208
SCLOPLASTYC (0.25)	0.02	2.717887739	8	52950	25289	27661	179890.2	0.294346218
KYIVSKA RUS HOTEL (0.01)	0.0887	2.831013643	5	506692	381809	124883	16171.95	31.33153392
POLTAVSKY ALMAZNY Z-D (0.05)	0.059	3.136437384	9	630531	244157	386374	167595	3.762230377
HIM-FARM Z-D CHER ZIRKA (0.25)	0.25	3.144145905	17	8951	4951	4000	2814.325	3.180513978
DNIPROAZOT (0.25)	4	3.387040019	9	657609	20739	636870	13920.925	47.23888678
PTAHOFABRYCA "UKRAINA"	0.11	3.866525522	19	5172	5172	0	4544.925	1.137972574
ROVENSKY Z-D VISOKOV. (0.05)	0.795	4.208868916	1	49457	49457	0	6545.85	7.555474079
BALCEM (0.05)	0.467	4.41274621	1	224311	224311	0	10597.725	21.16595779
KYIVMETROBUD (0.25)	0.53	5.571243724	8	32371	31871	500	8506.9	3.805263962
HIM-FARM Z-D CHER ZIRKA (0.25)	0.25	5.61880765	2	33933	33933	0	19066.3	1.779737023
POLTAVSKY GOK (0.25)	0.35	5.952049939	15	310058	16858	293200	131820.05	2.352130803
HALYCHYNA NPZ (0.25)	3.2	6.334794682	10	799444	139609	659835	39564.95	20.20586403
PTAHOFABRYCA "UKRAINA"	0.11	6.757722681	15	11979	6979	5000	18397.9	0.65110692
VALSA	0.08	6.87946102	19	485005	63333	421672	1042679	0.465152746
KYIVMETROBUD (0.25)	0.53	11.30666353	10	39400	38800	600	21013.275	1.875005205
DNIP.METAL-Y Z-D KOMIN. (0.25)	0.52	11.82532954	14	456013	48369	407644	259255	1.758936183
PTAHOFABRYCA "UKRAINA"	0.11	14.32655935	2	28358	28358	0	92334.675	0.307121891

KREMENCHUTSKY STALELIVARNY Z-D	0.15	17.85573441	6	14910	4910	10000	44371.5	0.336026503
KREMENCHUTSKY STALELIVARNY Z-D	0.15	18.63342526	13	13961	5811	8150	43356.875	0.322001989
DONETSKY METALURG Z-D (0.25)	0.135	23.59137537	7	41458	12458	29000	181120.6	0.22889721
LVIVSKY AVTOZAVOD (0.25)	1.27	24.9837088	10	81455	32149	49306	40060	2.033325012
MARKOCHIM (0.25)	0.22	28.39631258	5	1810889	254141	1556748	1168694.775	1.549496959
MELIT Z-D TRACT GIDR-V (0.25)	0.25	33.09840591	4	11229	11126	103	4949.4	2.26875985
LISICHANSKA SODA (1.05)	44.1	109.7288631	7	61563	23363	38200	16083.9	3.827616436

Spearman's rank correlation between the market value of certificate and "Ratio of Winning Compensation Certificates to the Quantity of Certificates" is -0.54078. (Critical value for negative association is -0.478 for 30 observations for  $\alpha = 0.005^{26}$ )

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<sup>26</sup> Newbold Paul "Statistics for Business & Economics", Prentice - Hall, 1995, p.843.