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Undervaluation in probate inventories probate inventory values and auction protocol market prices in eighteenth and nineteenth century Sweden

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ABSTRACT

In this article we examine the accuracy of valuations of movable property for a sample of 22 probate inventories from Swedish. The sample comprises a total of 785 probated items which we have been able to match with contemporary auction protocols, giving us an official sales price for each item. This enables us to determine the consistency between the appraisal values in the probates and prevailing market prices, despite the fact that the probated items were invariably second-hand and of uncertain quality, as the comparison can be made for one and the same items. Our results show that probate appraisal values were marked underestimates of contemporary market prices, but also, that they lacked internal consistency. We find a mean undervaluation for probated items of -36 ± 3 percent, but the degree of undervaluation varied both depending on (i) the category of item, (ii) the year of the probate, as well as depending on (iii) the social class of the deceased. Our results apply, first and foremost, for the Swedish counties of Uppland and Södermanland, but as there is no reason to assume that Swedish probate proceedings exhibited significant regional variation, our results are most likely valid for the whole country.

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Introduction

Probate inventories have for long been used within the fields of economic history, history and ethnology to answer a wide array of questions concerning wealth, material culture, economic development, credit market characteristics and much more.¹ Given the wealth of data contained in probate records, and given their wide availability in many countries and over time, such records have become an indispensable resource to answer questions that would otherwise be very hard to investigate. Many uses of probate inventories as a source material are more or less unproblematic, for instance when inventories are used to study certain aspects of consumption patterns and life-styles. More often than not, however, probate inventories are used in a manner which presupposes a degree of accuracy and consistency in the obtained data that is still a matter of debate.

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One longstanding issue with regard to the use of probate inventories as a source material is the question of whether the appraisal values of probated items are consistent with market prices. At present, most studies indicate that they are not. Rather, the values assigned to items in the probate records seem, in most countries, to have been marked underestimates of prevailing market prices. Another, closely related issue, is whether these appraisal values can be said to be internally consistent; i.e. whether any misvaluation is constant across different sub-groups of the inventory and over time. Presently, this second question has not been extensively studied, though what research is available tends to find that misvaluations in probate inventories are, at least, consistent over time.

A much discussed problem in previous studies on probate inventories is the fact that probated items are, more or less invariably, second-hand and of uncertain quality. This makes comparisons with market price data questionable, and has led some researchers to suggest that the apparent undervaluation of probated items is simply an artifact of their generally inferior quality.

In this article we examine the accuracy and internal consistency of valuations of movable property for a sample of 22 probate inventories from the Swedish counties of Uppland and Södermanland, covering the period 1728–1900. The sample comprises a total of 785 probated items which we have been able to match with contemporary auction protocols, giving us an official sales price for each item. This enables us to bypass the issue of the quality of probated items, as the comparison between appraisal values and sales prices can be made for one and the same items. Furthermore, we also analyze the internal consistency of the inventories in our sample along three separate dimensions: their consistency over time, between different categories of items and across different social classes.

Previous research

One of the most frequently cited studies on probate inventory valuations was made by Nancy and Jeff Cox during the 1970s, using thousands of inventories from Shropshire, England. In Cox & Cox they argued that there are important methodological problems involved when comparing probate valuations with market prices.² Among them the (previously mentioned) difficulties to estimate the quality of the items listed in the inventories, as well as the confounding influence of short-term price fluctuations, where the prices on speculative commodities, such as pepper, could vary a lot from month to month and make comparisons very hard and misleading. Such price fluctuations also appeared among common household utensils and to a large extent in the case of livestock, where the demand for horses, oxen, bullocks and dairy cows tended to vary with the access to fodder.³ In line with previous, but more limited studies of British inventories, Cox & Cox found that probate appraisal values were often set lower than prevailing market prices, but seemed to be consistent over time. For example, they found that valuations of horses, for which reliable market price series were available for comparison, were undervalued by approximately 10 percent. But since this misvaluation was more or less constant over time, they argued that the apparent undervaluation was mainly due to the generally inferior quality of horses listed in the inventories compared with those sold on a horse market.⁴

Further investigations on British probate inventories made in the 1990s confirmed the results of Cox & Cox⁵, but as Mark Overton has pointed out, none of them were based on

much empirical evidence.⁶ By using a large dataset on valuations of cattle, textiles and metal which he compared with market price series for the period 1550–1750, Overton was able to show that inventory valuations were consistently 10–30 percent lower than market prices. In line with Cox & Cox he argued, however, that this discrepancy was due to the inventoried items being second hand and of generally low quality, in addition to the fact that the probate values represented farm gate prices, where the costs for transportation had not been included.⁷

Cox & Cox, Overton and others have furthermore argued that there is little reason to distrust the probate appraisal values, as there were no apparent incentives to engage in misvaluation. For instance, Peter H. Lindert – who has written extensively on British and American income inequality, using probate inventories as a source material – has argued that while twentieth century inventories in both Britain and the US are unreliable due to transfer *inter vivos* and the suppression of wealth in order to avoid taxes, such problems ought to have been much less pronounced for earlier centuries as tax rates were generally low. Lindert stated that '[i]n the absence of large taxes, the main incentive should have been to give clear deathbed statements of intent covering the distribution of all private property[...]'.⁸

However, at least in the case of US inventories, the undervaluation persists even after controlling for the quality of the probated items. As in many other countries, the personal estates of deceased US citizens were commonly sold at auction to facilitate division among heirs or to clear debts. But, unlike in most countries, US inventories also often contain notes of discrepancies between auction sales prices and the values reported in the inventory. Hanson Jones states that probate values in inventories from Pennsylvania, New Jersey and Delaware tended to be lower than the corresponding auction sales prices, though the differences seem to have been small.⁹ Waterhouse and Paape, on the other hand, found a much greater degree of undervaluation for the cases of South Carolina and Maryland.¹⁰

Furthermore, eighteenth and nineteenth century probate inventories have been found to be undervalued both for countries with high death duties and concomitant incentives for tax evasion, such as Italy¹¹, as well as for countries with comparatively negligible death duties, like Finland.¹² To date, the only study which has found a very close correspondence between probate values and market prices is Ceylan's examination of inventories from the sixteenth to the early nineteenth century Ottoman Empire. Ottoman inventories differ from the inventories of most countries, however, in that the values of listed items are not, in most cases, appraised, but are prices that were recorded when estates were sold at auction.¹³ Bozkurt has shown that, in the case of Istanbul, this applied to around 90 percent of all estates.¹⁴

The available research thus shows, first of all, that the mere fact that death duties and/or other applicable taxes were low should not be taken as an indication that the valuations found in probate inventories are correct. Secondly, while there may certainly have been variations in the probate proceedings of different countries which may have caused the accuracy of valuations to diverge, the fact that US studies find probate appraisal values to have been consistently lower than corresponding auction sales prices does cast some doubt on the contention of Overton and Cox & Cox, that the undervaluation in British inventories is simply an artifact of the quality of the probated items.

In this article we will, as stated, be using data on probate inventory valuations and auction sales prices to examine the case of another country where death duties and

other taxes associated with probate proceedings were very low, but where comparisons with market prices series have consistently shown probate inventories to have been undervalued; that of eighteenth and nineteenth century Sweden.

The case: Swedish probate inventory values and auction prices

The obligation of Swedish citizens to compile probate inventories for deceased relatives was introduced in the general Civil Code of 1734. Even though the legislation stated that probate inventories should be made in general, until the early 1800s inventories were primarily compiled by members of the upper classes and wealthier freehold peasants, but from the beginning of the nineteenth century gradually became more common amongst all peasants, farmhands and factory workers.¹⁵

The appraisers, usually two, were chosen among trusted men, on the countryside often members of the parliament (riksdagsmän) or members of the local court (nämndemän), in the towns often an alderman, or other trustworthy men. As in Britain we can assume that the appraisers had good knowledge on how to price the possessions of the households, since

the ancestors were directly involved in the production of some of these goods and so were able to base their valuations on costs of production, and partly because re-cycling gave known scrap values to many items of cloth and metal.¹⁶

This is most certainly true in a Swedish context. The eighteenth and nineteenth centuries saw a growing market integration and specialization, but the economy was heavy regulated until the mid nineteenth century – guilds were abolished as late as 1846 and a free trade policy introduced as late as in 1864 – and homemade or locally made goods were still very common in most households in the mid nineteenth century. We can also assume that the knowledge on present prices were good in general, since auctions played a major role in the economy, functioning as an informal free trade market and making it possible for people to access both old and new goods, which could not be bought easily in the towns. Auctions were held regularly during the springs and autumns in every parish and all towns in connection with deaths, bankruptcies or migration.¹⁷

After compiling all assets of the deceased in an inventory, 0.25 percent of its gross value was to be given to the poor. To this should be added the cost to register the inventory at court, the fee to the person who made the inventory and a few other small costs. In all, the total cost was usually less than two percent of gross assets, except in such cases where the estate lacked heirs, in which case an additional two percent wealth tax was levied. Hence, incentives for depreciations for purposes of avoiding taxes were presumably low, but nevertheless there are indications of considerable undervaluation.¹⁸

Isacsson has shown that moveable property was undervalued by around 25 percent in probate inventories from the Swedish county of Kopparberg during the eighteenth and nineteenth centuries.¹⁹ Kuuse found a similar degree of undervaluation for agricultural equipment and cattle in probates from the counties of Uppsala, Kronoberg and Malmöhus during the late nineteenth and early twentieth centuries²⁰ and Montelius reached similar conclusions for probates from the city of Västerås during the period 1776–1806.²¹ Gadd and Herlitz finally, both found that probate values for cows in west- and midwestern

Sweden were about 30 percent lower than prevailing market prices, while grain was undervalued by about ten percent.²²

The market prices against which probate appraisal values have been compared in previous Swedish research have consistently been the available market scale prices (*marktgångstaxor*), i.e. official standard prices that were corrected once a year. However, as market scale prices are only available for a small selection of items, the appraisal values of the majority of items in Swedish inventories have never been examined. In addition, market scale prices might differ from actual market prices, for instance due to short-term price fluctuations, and the item valued may not be the 'normal' item assumed in the market scale price series, but might be better or worse for a number of reasons, which could in turn be reflected in the valuation and the actual sales price.

As to why probated items were (at least apparently) undervalued in eighteenth and nineteenth century Sweden there is no clear answer. There is no known public decree of any kind advising this practice, nor any known agreements on a local level. The phenomenon seems to have been wide spread over the whole country and generally accepted. Previous Swedish research nevertheless suffers from the same problem that is prevalent in most research on European probate valuations, namely that a comparison is made between the valuations and general market prices on for instance grain, cattle or metal, and not between valuations and sales prices for the very same items.

Data and empirical strategy

That some assets, notably grain and cattle were undervalued in Swedish inventories is an indication, but to determine if the total value of the estate was undervalued in the probates, we need to find a method to examine the market prices of the assets in the probate. The reason why grain and cattle have been studied is that it is comparatively easy to find estimates of market prices for cattle and grain respectively, while it is much more difficult for other kinds of items, which nevertheless could make up a considerable proportion of the total assets of the deceased. We thus propose to use the same method found in studies of US inventories, i.e. comparing the probate value with the auction sales price of the very same item.

In Sweden, auction records and probate inventories are seldom found together in the same archives. Inventories were registered at the local court (*häradsrätten* in the country and *rådhusrätten* in urban areas) and are found in their archives. Auction records for auctions held in cities are found in the archives of the auction houses, which in most cases are kept. For auctions held in rural areas, the situation is much more difficult. Here, private trusted individuals were auctioneers, and it is more or less pure luck if records have survived. Finding matching pairs of probate inventories and auctions is thus difficult but not impossible.

The area chosen for this study is the small town of Enköping and the surrounding countryside in the counties of Uppland and Södermanland. Enköping is situated 80 kilometers northwest of the capital of Stockholm, on the northern coast of the Lake Mälaren, which separates the two counties. The region was historically one of the most expansive with extensive trade and urbanization. The Lake Mälaren tied the towns together with Stockholm, and was surrounded with fertile land with a grain surplus sold to the mining districts and iron works nearby. Enköping town had 700 inhabitants in 1700,

while in 1800, the population had grown to 1100. The town was foremost dependent on agriculture and to some extent crafts. In the early nineteenth century, a few small industries were founded and in 1900, Enköping had about 4000 inhabitants, and was much more industrialized, even though home-grown garden products, especially horseradish was still an importance source of income for the poor.²³

Probate inventories in the area were made for about 40 per cent of all adults in the year 1800. Fifty years later, the percentage was almost 70 per cent, which is normal for Sweden.²⁴ Probate inventories were made for virtually all Swedish households in which the estate of the deceased included some kind of debts or assets of some value. There were no probate inventories made when the estate had negligible assets and no debts.²⁵ The major proportion of the probate inventories made is still kept in the public court records.

All together we have managed to find 22 matching probate inventories and auction protocols between the years 1728 and 1900 (see [table A1](#) in the [appendix](#) for more details).²⁶ All auctions records have been carefully examined, as there is sometimes a discrepancy between these records and the probate inventories. Some items that are listed in the probate inventories are not found in the auction protocols, while others have been added. Only items that we could, with certainty, identify in both the probate inventory and the auction record have been included in this study. Another issue worthy of consideration is that the time between when the probate inventories were made and the auctions were held could be considerable. The smallest time difference in our sample between the making of a probate inventory and the auction is six days, but in some cases the time difference is more than seven, eight or even nine months. The explanation for this is probably related to weather conditions and the agrarian work cycle in most cases. As grain production dominated in the countryside as well as in Enköping town, most auctions were held during early spring and late autumn, when the weather conditions were quite good and the farmers, burghers and servants had time to spare.²⁷ At any rate, there is no indication that the time between inventory and auction seems to have affected the difference between probate valuations and auction sales prices, as the correlation between the two is very weak ($r = 0.02$).

Our final dataset includes probate records and auction prices for 22 cases for the years 1728, 1730, 1760, 1810, 1843, 1860, 1868, 1869, 1870, 1887 and 1900, comprising a total number of 785 different items. The probated items have been divided into the following categories; animals, tools, furniture, farm equipment, household goods metal, household goods ceramics and textile. Grain has not been found, and the number of young animals was too low to justify dividing animals into two separate categories.

A comparison of probate inventory values and auction prices

In the following, we analyze whether our data on probate inventory values can be said to reflect market prices, in the sense that they are consistent with the sales prices that were later fetched for the very same items at auctions. In making this determination we do not, of course, expect to find a perfect coherence between probate values and auction prices. The appointed appraisers, however well informed by contemporary standards, did not possess perfect information on prices and were charged with the task of assigning values to second-hand items of a very non-uniform character. In such a setting, a

certain degree of over- and undervaluation of items must be expected. Rather, what we would expect to find if we assume that probate valuations provide an unbiased approximation of market prices is that such over/under valuations would have been relatively minor and equally distributed around a mean close to unity.

If we measure over/undervaluation as the percentage deviation from unity and look at the magnitude and relative frequency of misvaluations, it quickly becomes clear that our data does not conform to these expectations. First of all, our data contains a sizeable portion of very large misvaluations. More than 40 percent (or 334 of 785) of the probated items were valued at ± 50 percent of the auction price (misvaluations range from a low of $1/15$ to a high of 12 times the auction price). Secondly, and consistent with previous research on Swedish probate records, undervaluations of probated items seem to have been much more common than overvaluations, which is illustrated in [Figure 1](#) below. As seen in [Figure 1](#), the vast majority of the probated items were, as expected, misvalued. Only 52 (or ~ 6 percent) of the 785 items received a valuation that was equal to the auction sales price. 123 items (or ~ 16 percent) were overvalued, while the remaining 610 items (or ~ 78 percent) were undervalued. There is thus a clear bias towards undervaluation in our sample, as 4 out of 5 items received a valuation below the auction sales price.

The mean of the valuations for the full sample is -19.4 percent, with a standard deviation of 87.7 percent. From this we can derive an interval at the 95% confidence level ranging from -25.6 to -13.3 percent for the degree of undervaluation. Despite the very high relative frequency of undervaluations in the sample the confidence interval is thus still quite wide. This has mainly to do with the character of the data, which has a lower bound at -100 percent, but no upper bound, and the distribution of the data is also heavily skewed to the right as can be seen in [Figure 2\(a\)](#) below. Data that has a lower bound and is right-skewed tends to follow a lognormal, rather than a normal, distribution. For such data, the geometric mean is a more suitable measure of the central tendency of the data than the arithmetic mean. The geometric mean is defined as the n th root of the product of the data points, and lies at the center of the distribution of the logarithms of these points. If the data is lognormally

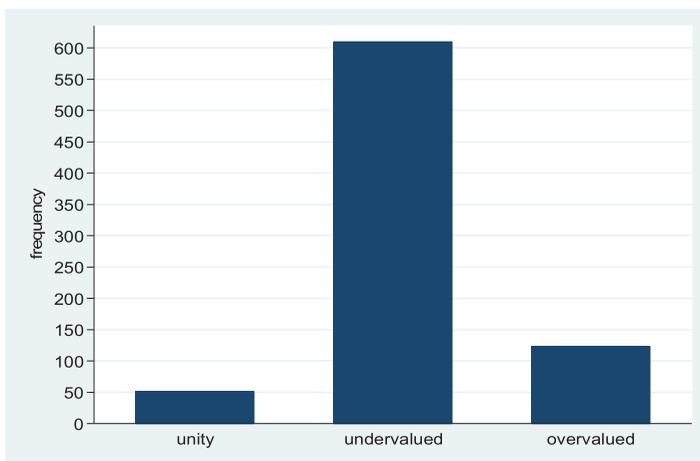


Figure 1. Frequency of misvaluations of probated items in relation to auction prices, 1710–1900. Source: Probate inventories 1710–1900 auction database.

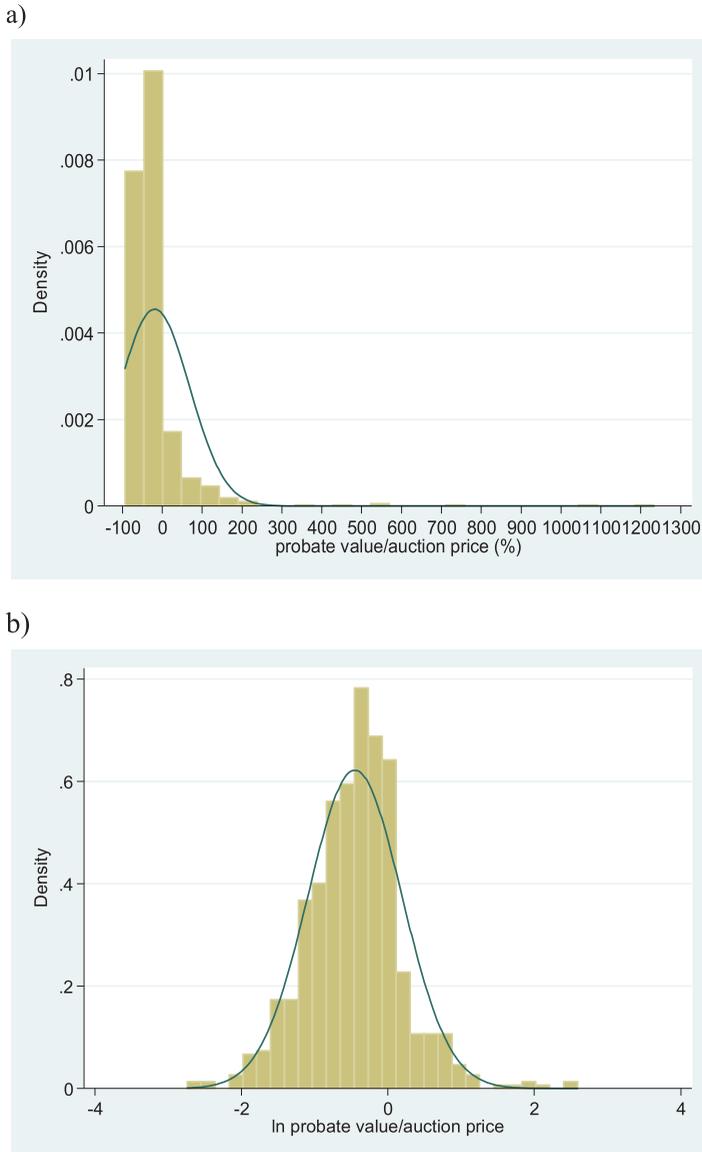


Figure 2. Histogram and normal probability curve for probate value/auction price (%) before and after log-transformation. Source: Probate inventories 1710–1900 auction database.

distributed, we should also use a log-transformation of the data before proceeding with any (parametric) statistical tests, in order to ensure their reliability.²⁸

We have superimposed a normal probability curve in Figure 2(a), and as seen in the figure the normal distribution of the data extends well below the lower bound of –100 percent. A visual inspection of Figure 2(a) clearly indicates that the data does not follow a normal distribution. In Figure 2(b) we have instead used a log-transformation of the ratio between probate values and auction prices. This transformation makes the distribution come very close to a normal distribution, with ~ 95 percent of the observations

lying within \pm two standard deviations of the (geometric) mean. We therefore conclude that our data is, in fact, lognormal. The same conclusion can be drawn from looking at P–P plots of the data before and after log-transformation (these plots can be found in figure A1 in the appendix).

It is also worth noticing that the actual distribution of the non-transformed data in Figure 2(a) has a right tail that extends to a maximum value of 1233 percent. If one of the standard rules to identify outliers is applied, the non-transformed data show a very high frequency of outliers in its right tail.²⁹ There is nothing markedly different about these data points however, that could make us suspect that they are from a different population, so there is no reason to drop them. But these observations do, of course, have a very strong influence on the arithmetic average of the data. By contrast, after logtransformation, most of these outliers disappear, making the geometric mean much less sensitive to large values in the data. For these reasons, in the following, all analyzes are performed with logtransformed data. In order to ease interpretation the results have been back-transformed to the original measurement scale, and are expressed as percentages.

Table 1 below shows the geometric mean and standard deviation for the full sample as well as for different categories of probated items, along with confidence intervals for the respective means at the 95% probability level. The mean for the full sample is -36 percent, with a 95% confidence interval that ranges between -39 and -33 percent. The calculated means for the different categories of items ranges from -21 percent in the case of tools to -44 percent in the case of animals. One-sample t-tests show that all of the means are statistically different from zero, and the confidence intervals of all means include only negative values. We can thus safely conclude that the assigned values of probated items were significantly lower than prevailing market prices, with an average undervaluation of -36 ± 3 percent (at least in the geographical areas that are included in our sample; i.e. the Swedish counties of Södermanland and Uppland). Seeing as we have measured undervaluation by looking at the ratio of probate values and auction prices for the very same items, the undervaluation is clearly not due to the items being second-hand or of lower quality than items sold on the market, but must have some other explanation.

As can be seen in Table 1, the confidence intervals of the means for the different categories of items all overlap. This can be taken as a crude indication that the true means of the different categories are equal, such that all items were subject to the same degree of

Table 1. Mean, standard deviation and 95% confidence interval for probate value/ auction price (%) for animals, tools, furniture, farm equipment, household goods metal, household goods ceramics, textiles and total for 22 probate records/auctions between 1728–1900.

Category	N	Mean	SD	95% Conf. Interval	
Animals	27	-44.16^{**}	175.67	-55.31	-30.21
Tools	46	-21.23^*	217.13	-37.43	-0.84
Furniture	166	-41.18^{**}	181.27	-46.30	-35.56
Farm equipment	146	-29.50^{**}	208.48	-37.48	-20.50
Household goods metal	186	-34.18^{**}	178.30	-39.46	-28.44
Household goods ceramics	44	-29.76^{**}	192.27	-42.42	-14.32
Textiles	170	-42.64^{**}	183.75	-47.69	-37.10
Total	785	-36.27^{**}	189.87	-39.07	-33.34

Note: Reported significance refers to one-sample t-tests, where H_0 : mean = 0.

Source: Probate inventories 1710–1900 auction database.

$+p < 0.1$, $* p < 0.05$, $**p < 0.01$.

undervaluation. In order to test this hypothesis more rigorously we performed a one-way anova with the log of the ratio of probate values and auction sales prices as the response variable and category of items as the factor variable. The results of the anova showed that there were, in fact, significant differences between the means ($p = 0.005$). In order to find which means differed significantly from each of the other we conducted pairwise comparisons of the means using Bonferroni's method to adjust for multiple testing (see Table 3). While the omnibus anova showed that there were significant differences between the means, in the pairwise comparison none of the means were different from each other at the 95% confidence level. As can be seen in Table 5, the undervaluation of textiles is shown to be larger than that of farm equipment and tools at the 90% confidence level, but no other pairwise combinations reach significance. The fact that the omnibus anova indicates differences while the pairwise comparisons do not may be due to our rather limited sample size, and the fact that three of the groups only contain between 27 and 46 observations. The Bonferroni method of adjusting for multiple testing is quite conservative, and with a small sample size we may not have enough statistical power to discriminate between the group means. But it may also be due to a small effect size; i.e. that the actual differences between the true means are relatively small (Table 2).

This far into the analysis it is thus clear (i) that probate values in our sample were significantly lower than market prices, and (ii) that the degree of undervaluation differed between different categories of probated items. However, if the differences between the true mean probate valuations of different categories of items are so small as to be practically insignificant (i.e. have a very small effect size), probate values could still be used without major bias to address a wide variety of research questions that require data on price changes and relative prices, granted that the degree of undervaluation is consistent over time. Furthermore, if the magnitude of the undervaluation could be estimated to a satisfactory degree of accuracy it would still be possible to derive actual market prices from probate records in a quite straightforward manner.

The next question then becomes whether the mean difference between probate values and auction prices in our sample varies over time or is constant? As our sample consists of probate- and auction records spanning from 1728 to 1900, this makes it relatively straightforward to answer this question (note that as our response variable is a ratio we do not have to be concerned about trends in the data). Theoretically, one could argue that

Table 2. Pairwise comparison of mean undervaluation of farm equipment, household goods ceramics, animals, household goods metal, furniture and textiles (Bonferroni-adjusted p -values).

	Farm equipment	Hg ceramics	Animals	Hg metal	Furniture	Textiles
Hg ceramics	-0.26 1					
Animals	-14.66 1	-14.39 1				
Hg metal	-4.68 1	-4.42 1	9.97 1			
Furniture	-11.68 0.259	-11.41 1	2.98 1	-6.99 1		
Textiles	-13.14 ⁺ 0.088	-12.87 1	1.52 1	-8.45 0.881	-1.46 1	
Tools	8.27 1	8.53 1	22.92 0.546	12.95 1	19.94 0.126	21.41 ⁺ 0.058

Note: Levene's test indicated no departure from equality of variances ($p = 0.188$).

⁺ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

Table 3. Pairwise comparison of mean undervaluation for different years (Bonferroni-adjusted *p*-values).

	1728	1730	1760	1810	1843	1868	1869	1870	1887
1730	-3.96 1								
1760	-2.49 1	1.47 1							
1810	-29.67** 0.000	-25.71 ⁺ 0.088	-27.18** 0.000						
1843	0.76 1	4.72 1	3.25 1	30.44** 0.000					
1868	2.73 1	6.69 1	5.22 1	32.41** 0.000	1.97 1				
1869	-17.99 0.227	-14.03 1	-15.50 0.100	11.69 0.260	-18.75* 0.047	-20.72** 0.003			
1870	16.03 1	19.99 1	18.52 1	45.70** 0.000	15.26 1	13.29 1	34.01** 0.000		
1887	9.95 1	13.91 1	12.44 1	39.62** 0.000	9.18 1	7.21 1	27.93** 0.002	-6.08 1	
1900	-9.24 1	-5.28 1	-6.75 1	20.43 0.000	-10.01 1	-11.98 0.951	8.74 1	-25.27 ⁺ 0.050	-19.19 0.306

Note: *P*-value for omnibus anova = 0.000. Levene's test indicated no departure from equality of variances ($p = 0.278$).

Means, standard deviations and number of observations for each year can be found in the appendix.

⁺ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

probate records should be more accurate in the eighteenth century as the number of items included were lower and not as diverse as was the case in the second part of the nineteenth century, when industrialization had increased the number of goods available for consumption. On the other hand, more probate records executed could mean more professionalization, and thus more accurate valuations. It is also likely that handmade goods would have been significantly harder to value than (standardized) factory made goods. As the proportion of factory made goods in the probate records increased over time, this may also have rendered the valuations more accurate.

Table 3 below shows the results from pairwise comparisons of the mean undervaluation in our sample for different years, again using the Bonferroni adjustment. As can be seen in the table, there are significant differences between the means. These differences do not follow any discernible trend over time however. Rather, two years (1810 and 1869) have mean valuations that are significantly lower than the means of most other years. The fact that the year 1810 stands out, with a mean valuation that is significantly lower than all other years apart from 1869, is interesting. In 1810, the Napoleonic War raged in Europe, exerting a strong upward pressure on both domestic and import prices in Sweden.³⁰ According to Collin the cost of living in the Swedish county of Uppsala rose by almost 20 percent between 1807 and 1810, while day wages of male farm workers rose by over 60 percent over the same period. If one compares the mean undervaluation of probated items for the different years in our sample with the price development in Uppsala/Södermanland over the preceding 3–4 years, the fit is relatively good (see table A4 in the appendix). In years that were preceded by sharp price increases the probate records are, on average, more undervalued and vice versa. A simple explanation as to why the degree of undervaluation differs between years may thus be that the price quotes of appraisers tended to lag behind market prices, and that this effect became especially accentuated during periods of sharp price increases. If this is true, this would

also offer at least part of an explanation as to why the degree of undervaluation seems to have differed between different categories of probated items. Items that experienced above-average price changes, such that the relative price versus other items either increased or decreased, would in that case have been subject to a different degree of undervaluation than the average item.

It should be noted, however, that the fit between the degree of undervaluation in different years and the general price development is considerably less good if one only looks at the price difference vis-à-vis the most adjacent year (see [table A4](#) in the [appendix](#)). The best fit is had by comparing valuations with the price development over the preceding 3–4 years. In other words, for this hypothesis to be correct, we must believe that the price quotes of appraisers could lag several years behind market prices. For this to have been true, the price quotes of the appraisers must presumably have constituted some kind of standard prices that were corrected relatively infrequently. We know, however, that this was in fact true in the case of for instance Swedish foreign trade statistics in the eighteenth and nineteenth centuries. Official standard prices that were used to assess import values could remain unchanged for several years, even though these values directly determined the states customs revenue.³¹ Similarly, from the early nineteenth century onwards, real estate taxes in Sweden were determined by official value assessments of estates conducted every three years. There are good indications that these assessments also lagged considerably behind the market values of the estates.³²

As we have found that probate valuations varied on at least two dimensions (by category of item and by year), we would of course need to examine whether the variation in either dimension is still significant after controlling for the other. Before proceeding with this exercise, however, we need first to examine a third dimension in which probate valuations may have varied, i.e. by social class. This examination is motivated, first and foremost, not for theoretical- but rather for practical reasons. As mentioned previously, there is a large body of research that has used probate records to derive estimates of wealth inequality between social classes. These studies do not depend on the assumption that probate values are consistent with market prices, but they do depend on the assumption that the probate records are internally consistent; i.e. that the degree of misevaluation is constant across different subgroups of the sample. Now, we have already shown that the degree of undervaluation varied between different categories of items. This could in and of itself constitute a problem for these kinds of studies. However, if we assume that the proportion of different categories of items in the probate records varies randomly across different social classes – an assumption which is not necessarily true, but at least plausible –, the difference in the degree of undervaluation between items would not introduce bias in studies of wealth inequality. If, however, the degree of undervaluation in the probate records varies by the actual analytical categories – i.e. the social classes – then such studies would be severely biased.

In order to test whether the degree of undervaluation in our sample is in fact constant across different social classes, we divided our sample into three broad social class levels, following the definitions put forth in Bengtsson et al. (2018).³³ The three levels were (i) Bourgeoisie, (ii) Farmers and (iii) Workers. An omnibus anova with the log of the ratio of probate values and auction sales prices as the response variable and social class as the factor variable reject the null hypothesis of no difference in the means of social classes ($p = 0.048$). In [Table 4](#) below we perform a new pairwise comparison of the

means of the different social classes (with Bonferroni-adjusted p -values). As can be seen in the table the degree of undervaluation in probate records pertaining to workers is considerably, and significantly, smaller compared to the undervaluation in records pertaining to the bourgeoisie. A Levene's test rejected the assumption of homogeneity of variances between the groups. For this reason we also performed three Welch two-sample t -tests to compare the means of the different social classes. The difference between workers and the bourgeoisie remained significant also in this analysis (with $p = 0.041$ after applying the Bonferroni adjustment).

The degree of undervaluation in the probate records thus varies on (at least) three dimensions, (i) by category of item, (ii) by year and (iii) by social class. As already stated, it is of course possible that the variation in one dimension is simply a function of the variation in other dimensions. We therefore need to analyze our factor variables together, so as to determine which factors contain significant differences after controlling for the others. As we have three factors with 3, 7 and 11 levels respectively, the number of possible pairwise comparisons becomes impractically large. When the number of pairwise comparisons is very large the Bonferroni method also tends to suffer from low statistical power; i.e. it becomes very conservative (with 200+ comparisons we would need p -values < 0.00025 to reach significance at the 95% level for any given comparison). For these reasons we do not use anova with post-hoc pairwise comparisons for this part of the analysis, but instead employ regression analysis with (weighted) effect coded factor variables.

Using effect coding (also known as anova coding) enables us to test the means of all levels of our factor variables against the sample mean, rather than against the mean of an arbitrarily chosen reference category (as in dummy coding). Like dummy coding, effect coding requires one level of each factor variable to be omitted from the regression equation. And similar to dummy coding all levels of a factor variable is coded 1 for observations within that level and 0 for observations within other levels, but -1 (rather than 0) for observations within the omitted level. This imposes a constraint on the regression equation in which the sum of all coefficients (β) of all levels (L) of a factor variable will equal 0 (i.e. $\sum_{l=1}^L \beta_l = 0$). The coefficients of effect coded factor variables will therefore represent deviations from the unweighted grand mean (i.e. the mean of the means of all levels of the variable), rather than deviations from the mean of a single omitted (reference) level.³⁴

Granted that the number of observations is equal for all levels of the factor variable, the unweighted grand mean will equal the sample mean. If the number of observations varies between levels (as is the case with all our factor variables) the unweighted grand mean may, on the other hand, start to deviate from the sample mean (the unweighted grand

Table 4. Pairwise comparison of mean undervaluation for different social classes (Bonferroni-adjusted p -values).

	Bourgeoisie	Farmer
Farmer	1.80 1	
Worker	8.05* 0.046	6.25 0.414

Note: Means, standard deviations and number of observations for each social class can be found in the appendix.

⁺ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

mean for our categories of items in Table 4 is for instance -34.66 , while the sample mean is -36.27). In order to adjust for the fact that the levels of our factor variables contain an unequal number of observations, we use the weighted effect coding scheme suggested by Grotenhuis et al. (2017), where observations for the omitted level of each factor variable is coded $-(N_x/N_o)$ instead of -1 , and where N_x stands for the number of observations in level x of a factor variable and N_o stands for the number of observations in the omitted level of said factor variable.³⁵ This weighting scheme enables us to test each level of our factor variables against the sample mean (rather than an unweighted grand mean) even though the number of observations is unbalanced between levels.

This can be seen in Table 5 – which displays the regression results – by looking at the coefficient for the constant, which is equal to the sample mean of -36.27 . The coefficients for the different levels of the factor variables thus represent their estimated deviation from this sample mean after controlling for (or holding constant) other factors. The results confirm our previous analyses, in that significant deviations from the mean are found within all three factors. Since our data is longitudinal, we used the Breusch–Pagan test to control for heteroskedasticity, with negative result ($p = 0.320$). Visual inspection of a residuals vs. predicted values plot did, however, suggest a possible violation of the assumption of homoskedasticity (see figure A2 in the appendix). For this reason we estimated a second model using heteroskedasticity-robust standard errors. As can be seen in the table, this did not have a major impact on the estimated standard errors. Ramsey's reset test further indicated no model misspecification problems ($p = 0.141$). We can thus safely conclude that the degree of undervaluation in our sample varies by all three factors; by category of item, by year and by social class.

In line with the previous analyses, textiles and also furniture are found to have been subjected to a greater degree of undervaluation than other items. The coefficients show that these items had a mean undervaluation that was around eight percentage points below the sample mean, after controlling for the year of the inventory/auction and the social class of the deceased. A significant difference (at the 90% level) is also found for farm equipment, but with the opposite sign, indicating that items which belonged to this category were less undervalued than the average item. While none of the remaining coefficients reached significance, it may be worth noting that, in our sample, household goods and tools were also less undervalued, while animals were more undervalued than average.

The sharper undervaluation of furniture and textiles may plausibly be explained with the background of the so called consumer revolution of the eighteenth century and the rise of new forms of fashionable consumption. Both furniture and textiles were an integral part of the consumer revolution, in the sense that select types of furniture and pieces of clothing started to become important markers of social distinction, giving them a value above and beyond their use-values.³⁶ Although what constituted status items of course varied both over time and across different social classes. As Edwards has shown in the case of Britain, and Ulväng et al. for Sweden, the middle classes commonly used auctions as a means to acquire furniture from people of higher social rank. But over time, certain types of unembellished eighteenth century furniture underwent a revaluation amongst members of the upper classes – passing from old to antique –, and consequently became items of status.³⁷ Such undulating shifts in tastes and preferences must presumably have reduced the transparency of the affected markets, from the viewpoint of the average individual. By most accounts, probate appraisers were normally laymen,

Table 5. (OLS) regression results comparing the mean undervaluation of different probated items, different years and different social classes to the sample mean undervaluation (standard errors in parenthesis).

	Model 1	Model 2
Constant	-36.27** (2.20)	-36.27** (2.20)
<i>Probated item:</i>		
Farm equipment	9.04+ (4.85)	9.04+ (5.35)
Hg ceramics	13.88 (9.71)	13.88 (9.92)
Animals	-10.01 (12.64)	-10.01 (9.52)
Hg metal	4.09 (4.03)	4.09 (3.79)
Furniture	-8.15* (4.37)	-8.15* (4.07)
Textiles	-8.57* (4.49)	-8.57* (4.54)
Tools	14.86 (9.46)	14.86 (11.18)
<i>Year:</i>		
1728	16.04 (10.96)	16.04 (11.81)
1730	13.95 (16.36)	13.95 (11.51)
1760	4.64 (7.23)	4.64 (8.38)
1810	-32.39** (9.40)	-32.39** (10.03)
1843	29.86 (18.51)	29.86 (18.16)
1860	-7.52 (18.87)	-7.52 (17.92)
1868	14.34 (7.94)	14.34 (9.02)
1869	-22.52* (10.66)	-22.52** (10.04)
1870	42.12** (12.03)	42.12** (10.32)
1887	8.16 (10.62)	8.16 (9.15)
1900	-12.53* (6.53)	-12.53* (6.35)
<i>Social class:</i>		
Bourgeoisie	-2.51 (6.29)	-2.51 (6.72)
Farmer	-16.57 (16.86)	-16.57 (16.07)
Worker	14.45* (5.61)	14.45* (5.84)
<i>N</i>	785	785
<i>R</i> ²	0.12	0.12
Robust SE	No	Yes

Note: The results presented in this table were obtained by estimating two separate regression equations. In the first equation, the levels farm equipment, 1728 and bourgeoisie were omitted. In the second equation, the weighted effect coding scheme was rearranged so that these levels could be included, whilst omitting the levels hg ceramics, 1730 and farmer. Note that as the regression coefficients represent deviations from the sample mean they are not affected by which levels are omitted.

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$.

neighboring farmers or burghers, with limited knowledge, or view of the market as a whole. It is perhaps only natural that their valuations were not as far off the mark in the case of for instance farm equipment or tools – where the above dynamics did most likely not apply – as they were in the case of furniture and textiles.

In respect to the variation between years we find significant differences from the mean in four cases: with a negative sign for the years 1810, 1869 and 1900, and with a positive sign for 1870. It is worth noticing that the three years with a greater undervaluation than average were all preceded by a rise in the general price level, while the year 1870 was preceded by falling prices (see [table A4](#) in the [appendix](#)). This seems to support the hypothesis that the undervaluation of probate inventories may in part be due to the fact that the price quotes of probate appraisers simply tended to lag behind market prices. This effect would have become particularly accentuated during periods of fast price changes, generating a variation in the degree of undervaluation between years that developed in tandem with the general price level. This seems to have been the case, though we should emphasize that the price information that we have used when making this analysis are simple cost-of-living indices for Uppland and Södermanland that are based on the data in Jörberg.³⁸ These indices are, of course, only a crude proxy for the price development of the probated items in our sample. With a larger sample of auctions, covering more years, it would be possible to construct more pertinent price series for the different categories of items analyzed – using data on auction sales prices – against which to test this hypothesis.

Finally, as can be seen in [Table 5](#), the coefficients for the different social classes also confirm the previous analyses. The coefficient for workers shows that the probates of this social class were less undervalued than average (by about 14.5 percentage points), while the mean undervaluation of burghers and farmers were not significantly different from the sample mean. Thus, even after controlling for the year of the probate and the category of item, there still remains a significant difference between the mean undervaluation of workers and other social classes. It is, however, hard to explain what this difference might be due to. The most plausible explanation for the difference would, on the face of it, have been that it resulted from differences in possessions, but as we control for the variation in probated items this seems not to have been the case. It may of course be that our categorization is too crude to fully capture the effect of the variation in probated items on the degree of misvaluation. Exploring this possibility further would, once again, require a larger sample to enable a more detailed categorization of items. This, in our view, offers an interesting direction for future research.

Conclusions

Probate inventories have for long been used within the fields of economic history, history and ethnology to answer a wide array of questions concerning wealth, material culture, economic development, credit market characteristics and much more. It is therefore important to get a better and more detailed understanding of the data contained in the probate records, in order to understand what kinds of questions such records can be used to answer and, perhaps more importantly, when they should not be used.

In this article we have examined the accuracy and internal consistency of valuations of movable property for a sample of 22 probate inventories from the Swedish counties of Uppland and Södermanland, covering the period 1728–1900. The sample comprises a total

of 785 probated items which we have been able to match with contemporary auction protocols, giving us an official sales price for each item. This enabled us to determine the consistency between the appraisal values in the probates and prevailing market prices, despite the fact that the probated items were invariably second-hand and of uncertain quality, as the comparison between appraisal values and sales prices could be made for one and the same items.

Our results confirm previous research on Swedish probate inventories, which has found that appraisal values in the probates lie significantly below market prices. In this study, we found a mean undervaluation for probated items of -36 ± 3 percent. We also found that the degree of undervaluation in the probate inventories varied depending on (i) the category of item, (ii) the year of the probate, as well as depending on (iii) the social class of the deceased. The variation along all three of these dimensions was statistically significant even after controlling for the others. Swedish probate appraisal values are thus, first of all, marked underestimates of market prices and, secondly, lacking in internal consistency. These results apply, first and foremost, for the Swedish counties that are included in our sample, i.e. Uppland and Södermanland. There is, however, no known reason to assume that Swedish probate proceedings exhibited significant regional variation, which means that our results are most likely valid for the whole country.

As to why probated items were undervalued to such a degree in eighteenth and nineteenth century Sweden there is no clear answer. There is no known public decree of any kind advising this practice, nor any known agreements on a local level. The phenomenon seems to have been wide spread over the whole country and generally accepted.

While our results are, of course, only applicable to Swedish probate inventories, our methods have broad applicability to studies of probate inventories also in other countries. The results we present in this article, in combination with the results from previous studies of U.S. inventories, suggest that a careful comparison of probate inventory valuations to auction sales prices might prove a fruitful approach for future studies of the probate records in, for instance, Great Britain as well as in other countries. Such future studies could plausibly lead to a reassessment of some of the main conclusions that have been drawn in previous research, or could alternatively provide strong additional support in favor of these conclusions.

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Appendix

Table A1. The probate inventories and auction protocols in the study, the difference in time between date of inventories and date of auctions, and the number of items in the study.

Title and Name	Location	Date for probate inventory	Date auction protocol	Days between inventory date and auction date	Number of items in the study
Burgher Per Öhman	Enköping town	1727/10/11	1728/04/26	196	50
Merchant Olof Livin	Enköping town	1730/04/23	1730/06/09	46	19
Burgher Anders Berger	Enköping town	1759/11/07	1760/02/07	90	49
Bricklayer Eric Söderholm	Enköping town	1760/02/28	1760/03/06	6	36
Daughter Christina Orre	Enköping town	1760/06/25	1760/09/23	88	18
Doctor Abraham Almroth	Enköping town	1810/06/08	1810/11/30	172	39
Mrs Ulrica Holmgren	Enköping town	1810/09/17	1810/12/06	79	17
Miss Brita Christina Nebb	Enköping town	1810/11/14	1810/12/05	21	15
Miss Margareta Elisabeth Freugdendahl	Enköping town	1810/06/13	1810/07/01	18	7
Farmer Erik Ersson	Albäck, Norrby parish, Uppland	1843/05/17	1843/06/12	25	73
Reverend Johan August Lundell	Teda Vicarage, Teda parish, Uppland	1868/01/30	1868/09/24	234	110
Landowner Conrad Albrecht Grevesmühl	Hista manor, Kärnbo parish, Södermanland	1860/06/20	1860/09/10	81	60
Civil servant Johan Floderus	Bondängen, Kärnbo parish, Södermanland	1869/06/13	1869/10/26	133	50
Landowner Fredrik Daniel Johan Erdman	Stora Lundby manor, Kärnbo parish, Södermanland	1869/12/17	1870/06/29	223	22
Worker Carl Johan Asp	Enköping town	1870/02/25	1870/03/05	8	22
Shoemaker Erik Bernhard Waxlund	Dalkarlsbo, Almunge parish, Uppland	1886/05/17	1887/03/15	298	50
Bookkeeper Johan Gustaf Israel Winblad	Enköping town	1900/02/01	1900/02/16	15	32
Civil servant Carl Johan Sandqvist	Enköping town	1900/01/31	1900/02/28	28	26
Carpenter Carl Arvid Thernelius	Enköping town	1900/09/04	1900/09/15	11	19
Church warden Petrus Olof Leonard Björklund	Enköping town	1900/06/14	1900/07/28	44	16
Merchant Fredrik Löfgren	Enköping town	1900/03/01	1900/03/24	23	31
Tailor's widow Brita Catharina Bergnér	Enköping town	1900/04/10	1900/04/27	17	24
Total no. items					785

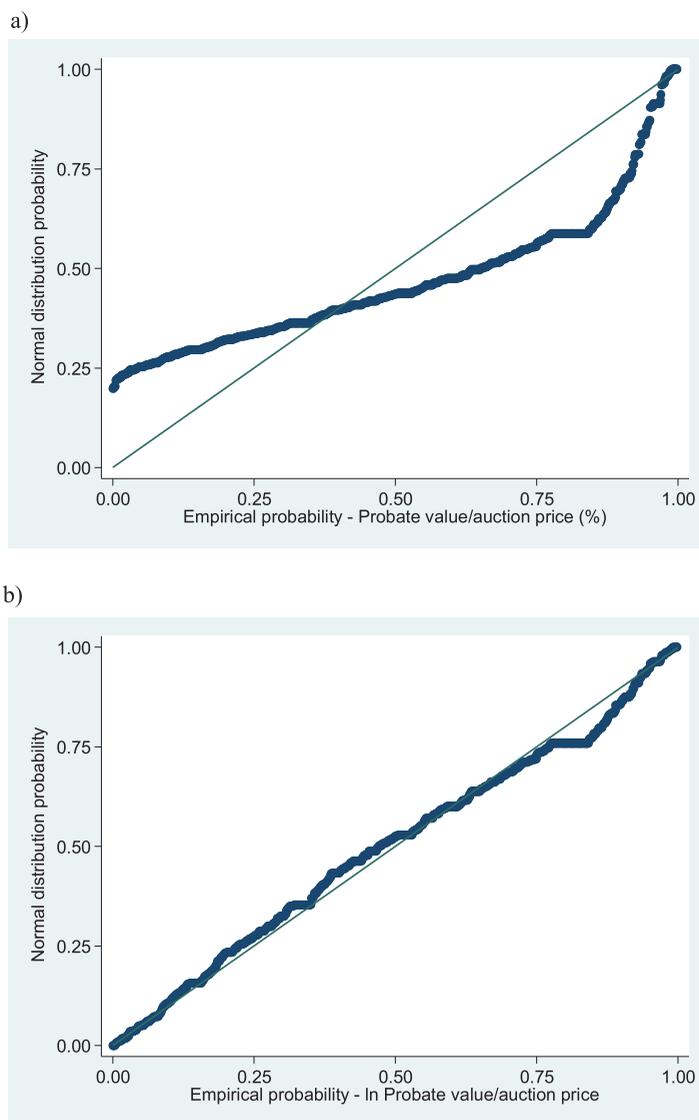


Figure A1. P–P plots of probate value/auction price before (a) and after (b) log-transformation. Source: Probate inventories 1710–1900 auction database.

Table A2. Mean, standard deviation and 95% confidence interval for probate value/auction price (%) for the different years in our sample.

Year	N	Mean	SD	95% Conf. Interval	
1728	50	-29.44	96.19	-41.74	-14.54
1730	19	-33.40	49.60	-45.15	-19.13
1760	103	-31.93	111.26	-41.19	-21.21
1810	78	-59.11	89.48	-64.60	-52.77
1843	73	-28.67	93.69	-38.87	-16.78
1860	60	-50.86	71.51	-57.25	-43.51
1868	110	-26.70	86.03	-34.82	-17.58
1869	50	-42.99	85.99	-52.21	-31.99
1870	44	-13.41	80.73	-27.67	3.66
1887	50	-19.49	62.92	-29.92	-7.51
1900	148	-38.68	69.78	-43.74	-33.18

Source: Probate inventories 1710–1900 auction database.

Table A3. Mean, standard deviation and 95% confidence interval for probate value/ auction price (%) for the different social classes in our sample.

Year	N	Mean	SD	95% Conf. Interval	
Bourgeoisie	355	-39,34	96,46	-43,47	-34,91
Farmer	155	-37,54	90,42	-43,61	-30,82
Worker	275	-31,29	79,92	-35,92	-26,33

Source: Probate inventories 1710–1900 auction database.

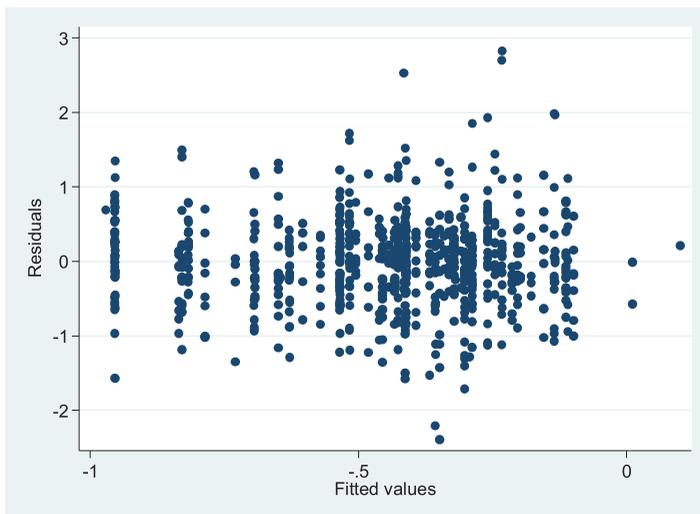
**Figure A2.** Scatter plot of residuals vs. fitted values for Table 7.

Table A4. Mean valuation, distance and estimated distance from the sample mean for different years compared to the development of the general price level between time t and t_{-3} .

Year	Mean valuation (%)	Distance from sample mean (%)	Estimated distance from sample mean (%)	Price difference $t-t_{-3}$
1728	-29,44	6,83	16,04 ns	-1,43*
1730	-33,40	2,87	13,95 ns	-16,88*
1760	-31,93	4,34	4,64 ns	-12,41
1810	-59,11	-22,84	-32,39	18,85
1843	-28,67	7,60	29,86 ns	-4,63
1860	-50,86	-14,59	-7,52 ns	-8,04
1868	-26,70	9,57	14,34 ns	44,51
1869	-42,99	-6,72	-22,52	15,60†
1870	-13,41	22,86	42,12	-22,47†
1887	-19,49	16,78	8,16 ns	-23,67
1900	-38,68	-2,41	-12,53	19,41

ns not significant ($p > 0.1$). * Data on prices for 1728 and 1730 are from Edvinsson & Söderberg (2010) and are for the whole country. † Data for 1869 and for one of the probate records/auctions in 1870 are for Södermanland.