

How to Survive Thirty Years' War?

Analysing Historical Data of the City of Augsburg

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Summary: With the extension of historical research from pure political history and event history to social history and economic history, the interest in analysing historical datasets is growing steadily. But the methods historians use today seem to be a little behind the techniques known in computer science and modern statistics. Although interactive and graphical based methods seem to be the right choice for these often massive datasets, they are not used in historical research.

Most social and economic data can only be interpreted correctly in their geographical context. To depict this geographical information, usually static maps are drawn. Static maps often fail to visualize multidimensional features of the data. Interactive maps, combined with other interactive statistical graphics, offer a multidimensional insight into historical datasets, which extend the possibilities of classical methods by far.

Using old tax-books of Augsburg for the years 1618 and 1648, this paper shows how computational and explorative methods can be applied to historical data.

1. A Change of Interest yields a Change of Methods

The Thirty Years' War became a paradigm for destruction and decline. Historic research was focused on the viewpoint: "big men make history". But to judge the social and economic structure and change during the war, the "small people" seem to become more and more important. Thus the influence of social and economic history research is growing. Figure 1 depicts the change of interests and methods. Both pictures are taken from contemporary leaflets. On the top, pope Urban VIII and king Gustav-Adolf of Sweden are emphasized — the "big man" making history. The lower flier shows the people of Augsburg — the "small people" — emphasized, while they swear to support king Gustav-Adolf of Sweden. Figure 1 should be seen as metaphor for the transition from event history to social history. Only both aspects together can complement historical research and therefore can not be viewed in isolation.

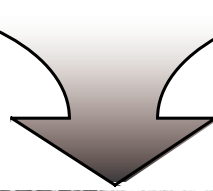


Figure 1: Two contemporary leaflets depicting the transition from political to social historical science.

2. The Dataset

The Augsburg tax-books contain information for every single tax payer. For each tax payer the tax and the profession were recorded. This detailed information is available for every year during the Thirty Years' War.

The data used in this paper is condensed information which was accumulated in a former analysis in Roeck (1989) to 95 tax regions. The available numbers for each of these tax regions are:

1. Number of tax payers in 1618 and 1646
2. Average tax payment in 1618 and 1646
3. Average age
4. Proportions of merchants, weavers and social subsidized
5. Proportions of catholics
6. Increase and decrease of population

Along with the raw numbers a map of the 95 tax regions was supplied. This map shows the tax regions as they have been defined on a tax collectors map in 1626.

It is obvious, that further analyses should include numbers for all years from 1618 to 1648. A second step would be to investigate the numbers at different levels of aggregation, as e.g. individual tax payers, households, houses. This is a common situation in geographical data analysis, and is known as the modifiable area unit (MAU) problem.

3. Classical Methods of Analysis

Many papers on historical datasets use the raw data-table as a means of presenting the data. Although every single value of the dataset is presented, a comprehensive interpretation of the data is then almost impossible.

Classical methods for analysing geographical data include the plotting of choropleth-maps. The visual perception of those maps depends strongly on the choice of categories and colors. Often the different levels are rendered by different hatching, which makes a comparison of the levels very hard. Figure 2 shows two choropleth-maps. The different levels are coded by different shades of grey. Using shades of grey is visually the most unbiased method for coloring choropleth-maps. But besides the difficulties of the visual perception of a single choropleth map, the comparison of different maps is very hard, too. As long as we compare the same dimensions this can be bypassed by plotting the map of the differences. But as the construction of the maps might be hard, and the number of possible maps that could be drawn is high, the analyst will perhaps leave out this extra step of the analysis, resulting in an incomplete analysis.

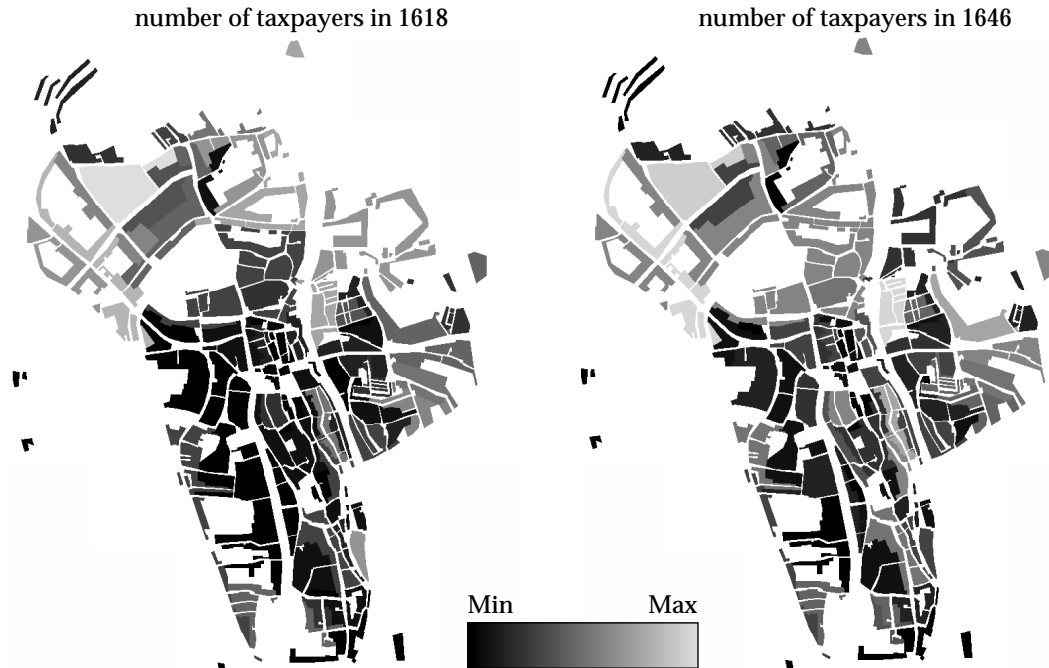


Figure 2: Two choropleth maps of the Augsburg dataset, showing the number of tax-payers before and after the war. The overall distribution of the population did not change. It is hard to detect outliers in this graphical representation, which suggests to use a map linked to the corresponding scatterplot.

To incorporate as many variables at a time as possible, very often multivariate statistical methods are applied to historical or geographical datasets. But analyses like principle component analysis or factor analysis transform the raw data, and the results must be interpreted based on the transformed data. This can be very cumbersome if the domain expert, namely the historian, is not acquainted with those methods.

Most mathematical statistical techniques fail to model meta data. The simplest kind of meta data are data measured on different supports. Analyses that operate on the raw data usually are more appropriate to handle meta data, so do interactive statistical methods

4. Interactive Statistical Methods

Layers:

Besides the data for the 95 tax regions, we have meta data on two different layers. We gathered information on the location of significant points like the cityhall etc. and the various churches in Augsburg. A third layer of information is the historic map dated back to the year 1626. Since the tax collectors map is based on this

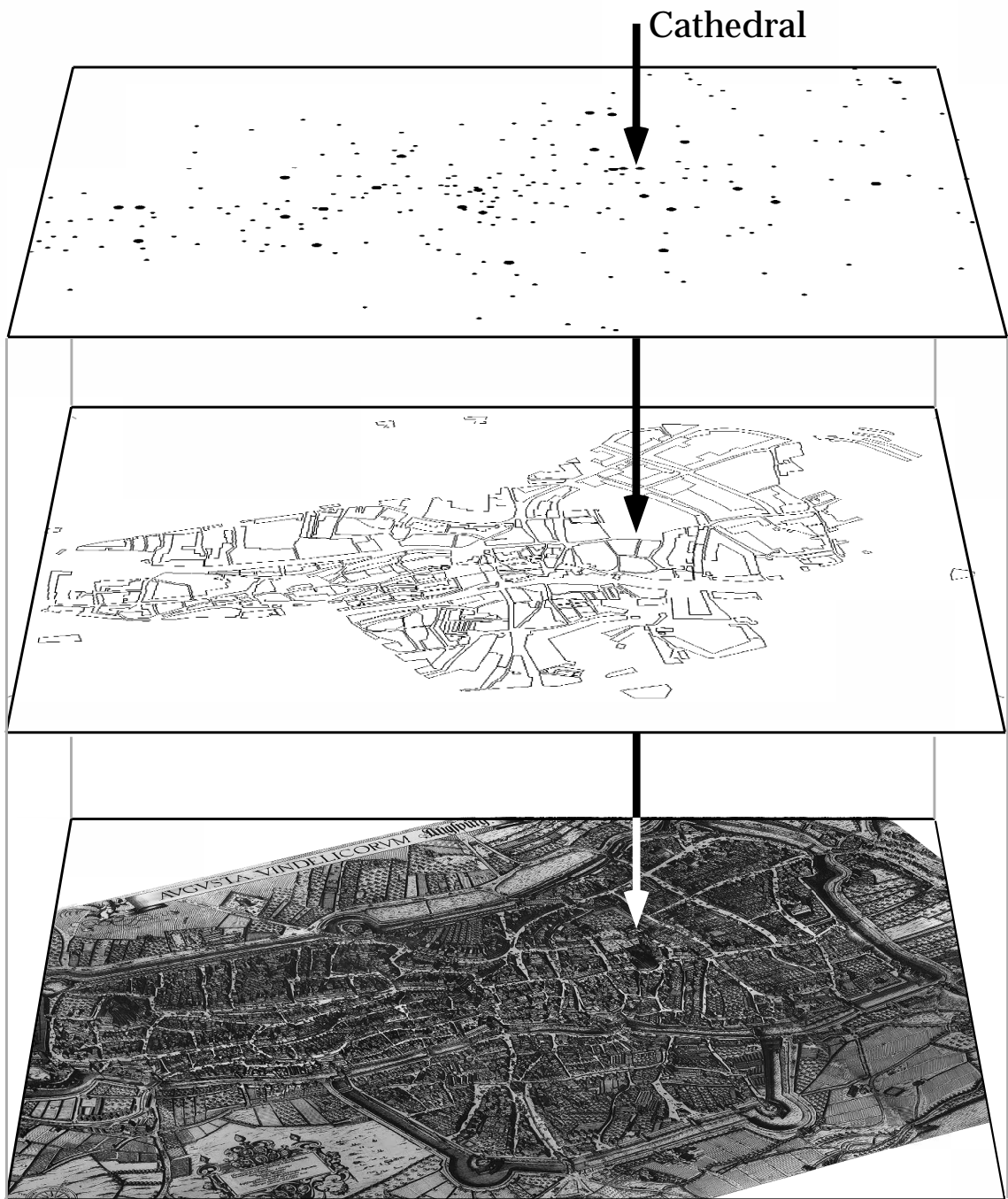


Figure 3: The Augsburg dataset contains data on a points-layer (top) a region layer (middle) and a picture layer (bottom). The REGARD software allows to match all three layers and analyze them simultaneously.

historic map, it is easy to match the two maps. Using interactive software like REGARD (Unwin, 1994) it is possible to combine exactly these layers, which are needed for a particular analysis. Figure 3 shows all three layers of the Augsburg dataset. The top set of layers includes churches and monasteries (big dots) and the important points (dots) marked on the map. The middle layer shows the tax regions, and the lower layer shows the historic map.

The paradigm of linked highlighting:

The key feature of interactive statistical graphics is the paradigm of linked highlighting. Objects which are selected in one plot are highlighted in all plots on the screen. Figure 4 shows an example for the Augsburg dataset. In the histogram of **number of**

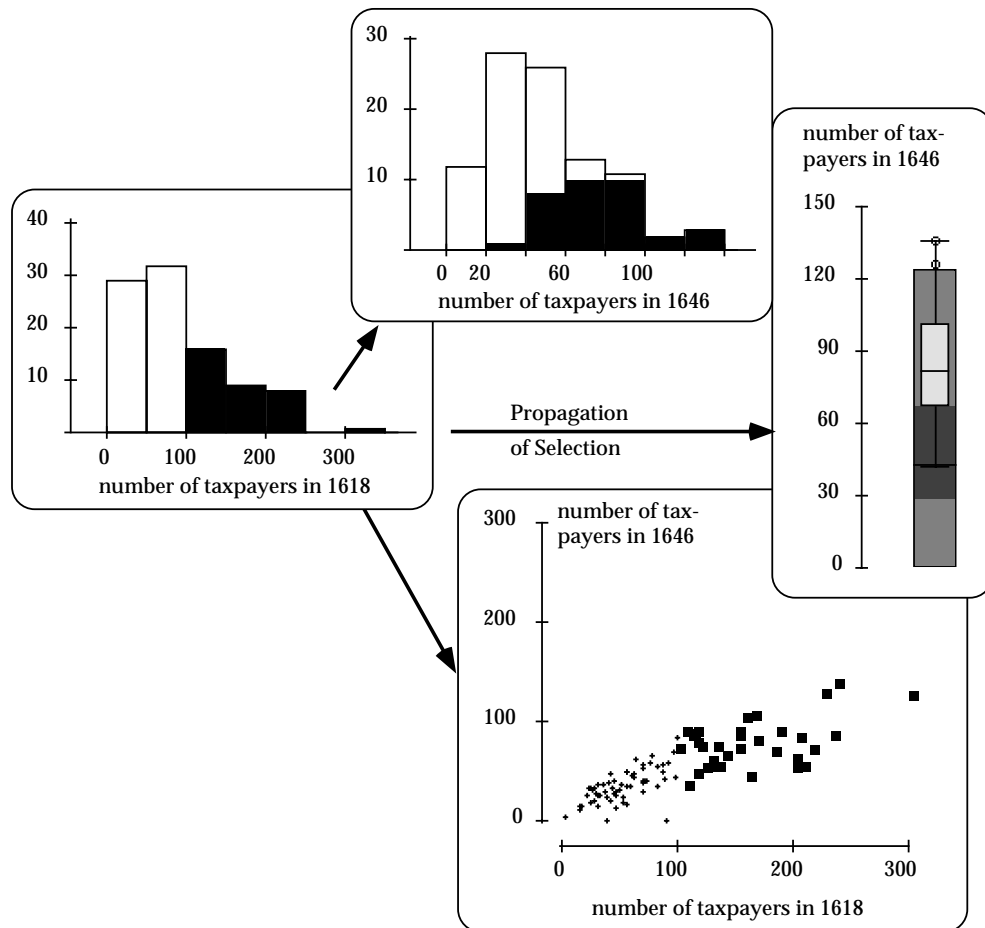


Figure 4: A sample selection in a histogram is propagated to be highlighted in three other plots — a histogram, a scatterplot and a boxplot.

taxpayers in 1618 the higher values are selected. This selection is propagated to all other plots: the histogram, the scatterplot and the boxplot. The way the boxplot is highlighted is an extension of the usual definition of boxplots, cf. (Theus 1996).

5. Analysing the Dataset

We would like to investigate five different issues with this dataset. Each of the questions corresponds to a set of graphics, which can offer an answer. Obviously a complete analysis of the dataset would include more plots and parametric analyses as fit into this article. Thus this analysis should be seen as a stimulation to show the capabilities of interactive methods.

1. What is the distribution of regions with high tax payment according to the number of tax payers?

Selecting the regions with high tax-payments shows that nearly all of them are placed in the middle of the town along the main road. The scatterplot of **number of tax-payers** vs. **tax-payment** shows a typical "L"-shape, which means, that in areas where rich people live, not very many taxpayers can be found. Calculating the correlation shows a highly significant value of -0.475 (Spearman's correlation coefficient), but neither reveals the geographical structure nor the special structure of the correlation.

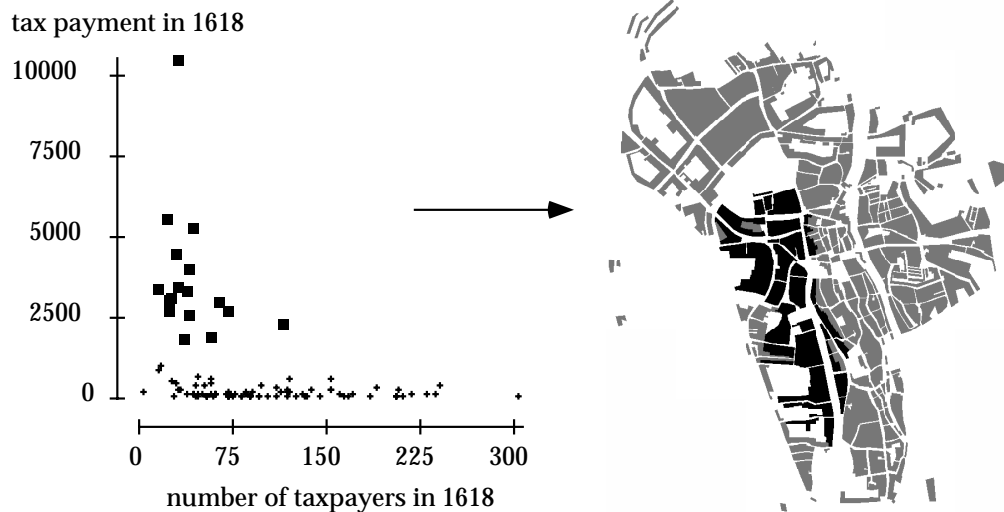


Figure 5: High tax payments can be found in areas with low population density. These tax districts form a coherent cluster in the middle of Augsburg along the "Maximilian Stree".

2. How are the major professions distributed over the different regions?

The scatterplot-matrix shows the portion of the three major professions in the town. If a profession is not found in a region, it was recorded as a missing value, for being able to access these values as separate groups. In the missing value chart in figure 6 it can easily be seen, that the regions are homogeneous. The left part of each bar in the missing value chart shows the proportion of non-missing values, the right part the cases with missing values. All regions where merchants can be found are highlighted, thus showing how the three

major social groups merge resp. separate.

The scatterplots show the missing values as a projection onto the axis, along which the values are not missing. It is easy to see, that weavers and social subsidized merge more than any other group.

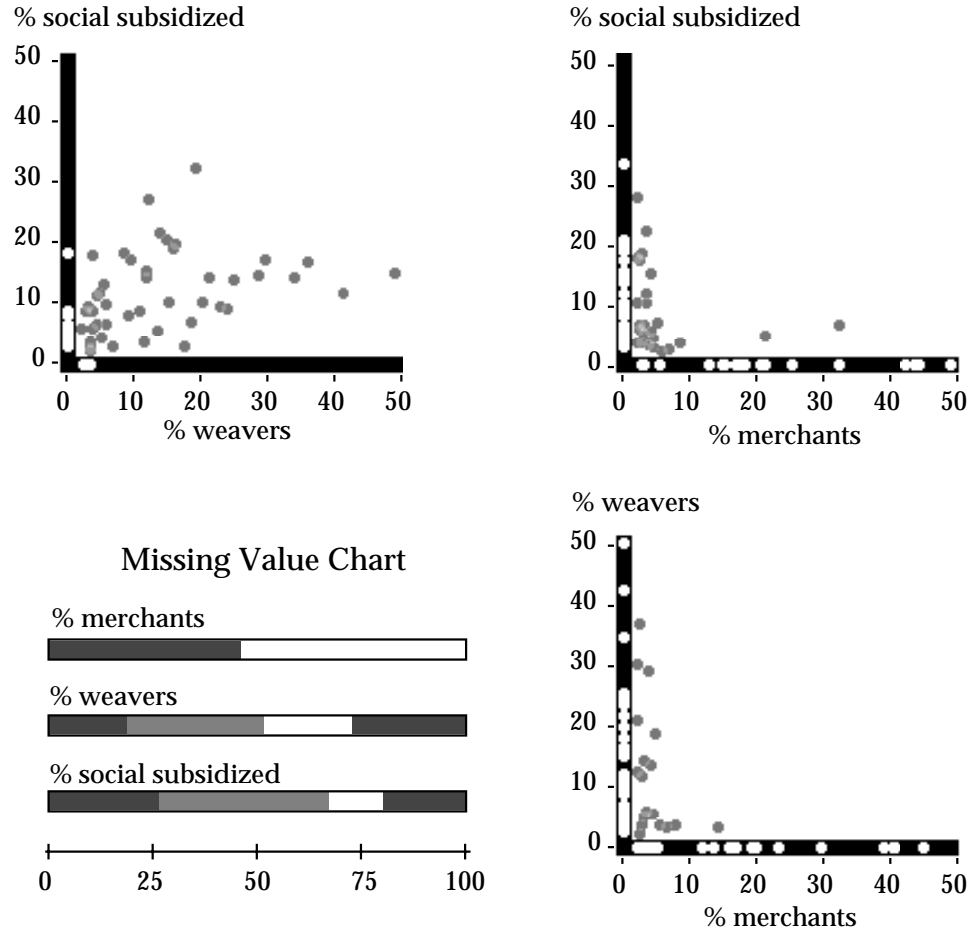


Figure 6: The three professional groups live more or less in separate groups. Whereas weavers and social subsidized mix quite well, merchants almost separate totally from the other two groups.

We prefer the representation using scatterplots, since only 16 out of the 95 districts have non-zero entries in all three professions, and thus most of the points would fall onto the axes or edges of a Ternary-plot. We can observe the typical "L"-shape in the two scatterplots on the right again.

3. Can an interaction be found between profession, age and religious confession?

To find out about the interaction structure between the professions and confession and age, boxplots of all the variables are plotted. All regions with a portion of more than 50% catholics are highlighted. Comparing the highlighting in the boxplots of the profession one sees, that there is an increasing

portion from merchants to weavers to socially subsidized. This could be a sign of poorer people being catholic.

Brushing (i.e. continuous selecting/highlighting in a plot) over the boxplots shows, that there are no interactions between age and any other variable.

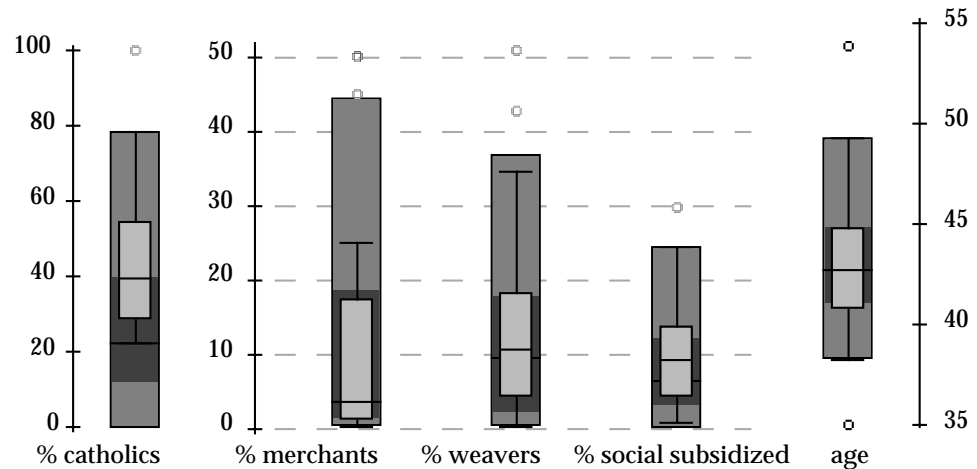


Figure 7: A slight interaction between profession and confession can be found by brushing over the boxplot of % Catholics.

4. How do figures change towards the end of the war?

To judge the change of figures from the beginning of the war in 1618 to the end of the war 1648 it is sensible to draw scatterplots of the tax payments in 1618 vs. 1646 and the number of tax payers in 1618 vs. 1646. Those scatterplots are meaningless, unless the aspect ratio of the x -axis and the y -axis is 1, which make the numbers comparable. For both variables it is obvious that the numbers for 1646 show a great decline. In both plots the points only scatter little around a linear line, which shows that the rich stayed rich and the poor stayed poor.

Estimating the decline by a linear regression results in a reduction of nearly factor 3 for the number of tax payers and more than factor 4 for the tax payments — which corresponds with an average reduction of per capita tax payment to about 70%. Looking at the different groups of profession and confession shows the same results as for the complete population — thus there is no economic profiteer of the war.

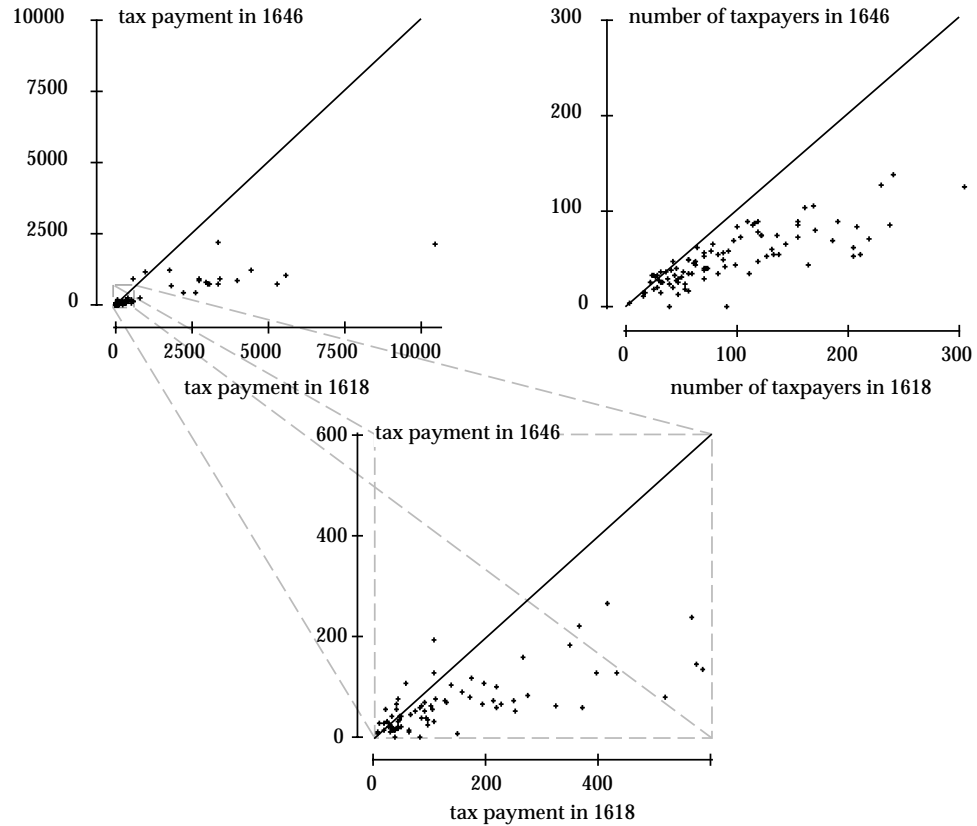


Figure 8: The decrease in number of tax payers and tax payment. A zoomed view of the cases with very little tax payment has been added. The zoomed view reveals the self-similarity of the pattern.

5. Was there a structural change?

Figure 8 already showed, that no structural change took place during the Thirty Years' War in Augsburg. A possible explanation for this could be the fact that Augsburg was never destroyed by plunderings, but was only suppressed by an interruption of the supply of food and goods.

The scatterplots in figure 9 of **number of tax payers** vs. **tax payment** show exactly the same structure for the years 1618 and 1646. The extreme decline of the tax district with a payment of over 10,000 Gulden in 1618 is most probable due to a redistribution of the tax payers funds.

If a structural change would have taken place, we would find distinct sub-groups, which fall of the line in figure 9. Brushing over the different regions of the city shows no structural change, but an overall decline. The plots in figure 9 have the same aspect ratio for better comparison.

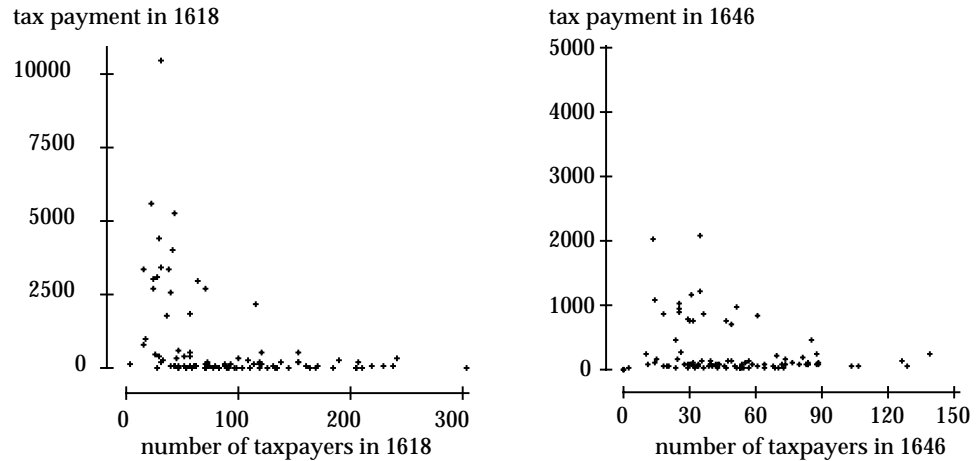


Figure 9: No structural change in the distribution of tax payment and tax payers can be found. The scale of the post war plot had been reduced by factor two.

Although data similar to the Augsburg tax data can be found in other cities — like the nearby city of Munich — this data has still not been collected from the old archives. Thus a direct comparison with other cities based on tax payment is not possible yet. However, it is well known that many other regions and cities, like the nearby Nördlingen or Magdeburg, suffered severe devastations along with more significant structural changes compared to those found in Augsburg.

6. Conclusions

The change in historical research demands a change in methods. Analysing often large economic and social datasets makes the use of computational power indispensable. Static charts and maps offer a limited insight into the data, which can only be interpreted in their multidimensional structure. Interactive graphical techniques yield a much deeper insight into the raw data. Thus the interpretation is easy, because the data can be displayed on a very low abstraction level. Graphical methods can be used without a greater primary knowledge of mathematics or statistics. Therefore they can be applied by domain experts more easily. The interactive, explorative approach supports strongly the cooperation of data analyst experts together with domain experts.

Many of the above mentioned ideas are implemented in the software packages REGARD and MANET. But researchers in the fields of statistics, geography and history have not been influenced by these new ideas very much. This paper should encourage the use of new techniques to reach beyond old frontiers.

But what is the answer to the question initially raised in the headline? Why was there no structural change in Augsburg? Due to the *Confessio Augusta* in 1530 and

the *Augsburg Religious Peace* in 1555, Augsburg was a city of major interest for both confessions, catholics as well as protestants. Although both opponents were interested in controlling the city, none of them was interested in a destroyed city, because Augsburg was too important a center of trade and supply. After the Swedes erected a new citywall, Augsburg was too well fortified to be attacked. The only kind of suppression against the city were attempts to starve it out. The richest families, like the Fugger family, were able to invest their money in properties outside the city like fields and woods, which couldn't lose too much of their value even in war times. The merchants of average wealth suffered the most decline, since they were often exposed to minor plunderings by the troops installed in the city.

Since there was no major structural change of the social and economic situation in Augsburg, the only remarkable tax districts are two located outside the city wall. For these two districts no tax payers are recorded for the year 1646, although 90 resp. 38 have been found 28 years before. Although the data set does not reveal any information about these 128 tax payers in particular, it leads to the policy: "Stay inside the city wall!" — although this policy might not have been a good policy during the 1628 pest!

For more information on either the REGARD or MANET software please refer to the WWW site: <http://www1.math.uni-augsburg.de/Manet>.

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