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The Human Capital of Central-Eastern and Eastern Europe in European Perspective

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Abstract

We trace the development of numeracy in historical Poland and Russia since the early 17th century and the ones of Belarus, Ukraine and Lithuania from the 18th century. The fact that Western Poland was still doing relatively well during the early 17th century, but was not able to converge to Western Europe during the 17th, 18th and early 19th century -- and even fell back relative to Southern Europe during this period -- might support the hypothesis that the second serfdom development was one of the core factors delaying Eastern European human capital accumulation, whereas in the 16th and 17th centuries, the region was comparatively well-off. Similarly, a devastating role was played by the major wars, which affected this region of Europe.

Acknowledgements: We thank Inna Vasylchuk for her very important input in the first phase of the project, and regret that she decided to leave academia and not to become a coauthor. We thank for able research assistance by Nadine Raimann, Nicholas Meinzer and many other students at the University of Tuebingen. Financial assistance was provided by the HIPOD EU program and ClioInfra (NWO).

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Introduction

Eastern Europe was once a world region with a high standard of living, even in comparison to Western Europe. Van Zanden (1999) found that wages expressed as purchasing power of grain were quite high in the Polish cities of Warshaw and Krakow during the 16th and early 17th century (and in Lviv which is in today's West Ukraine, during the 16th century), compared with many Western European locations.[1] Koepke and Baten (2005, 2008) found Northern and Eastern European health and nutrition levels to be more favorable than Western and Southern ones, using anthropometric indices. According to the estimates in Koepke and Baten (2005, Table 3), Eastern European males had a height of 171.4 cm during the 16th century, whereas the British were 170.4 cm, Southern Germans only 169.3 cm and the "North Rhine" (Dutch/West German) people were 170.0 cm tall.[2]

However, during the 19th century real wages as well as human capital (which is typically correlated with income) were clearly lower in Eastern Europe. Of course, the number of economic changes, wars and social transformations were large over such a long period. What had happened? And what were the determinants of this economic change? In order to answer this and related questions, we will study the development of numeracy in this world region. Numeracy is clearly a core component of human capital, especially in agricultural societies in which decisions about the timing of activities had to take a number of issues into account, such as weather, status of plants and animals, and

[1] Of course, the cities for which evidence is available, may not be representative for all of Eastern Europe. In fact, in our conclusion we will argue that Western and Central Poland, to which they refer, had in the early 17th century still a remarkably high level of numeracy, which was different in other regions.
[2] During the 17th century, Eastern European heights started to decline in a dramatic way, however.

other similar variables. Hence we will use the techniques to measure age-heaping in order to compare numeracy in several Eastern and Central-Eastern European regions with the Western and Southern evidence. Although Poland belongs to Central-Eastern Europe, we will speak of Eastern Europe in the following for reasons of brevity.

Our sources are in particular the (1) 'lists of souls' (either the Roman Catholic Libri Status Animarum or their Protestant Seelenregister equivalents, (2) censuses of the Civil-Military Order Commissions 1790–1792 in the territories of Poland-Lithuania, (3) the Russian 'revizii' (tax-oriented censuses); (4) the censuses of 1897 in Russia and 1880 in Prussia and Austria-Hungary, and (5) other types of household listings including 'communion books' and local administrative surveys, as well as Crown estate inventories.

These sources allow to estimate numeracy in several regions of what is today Poland, Belarus, Ukraine, Lithuania and Russia. The application of age-heaping-based numeracy estimates to this newly available data set is performed here for the first time for such a large region and the time frame (but see Mironov 1991 on Russian samples and Kaiser and Peyton 1993). Given the regional character of our sources, we decided to aggregate the numeracy estimates using today's country borders (rather than historical Empires or other regional units). This will allow the comparison of the estimates with other historical evidence in the future (such as GDP estimates, anthropometric welfare and other indicators).

The remaining part of the study is organized as follows. We first review some findings and hypotheses of the previous literature about why Eastern Europe might have fallen back relative to Western Europe in educational and welfare levels. We then present

our new data set and explain its capabilities and limitations in the second section. In section 3 we explain the age heaping methodology briefly, as well as its caveats and the doubts which scholars might have about it. We also report some of those responses which age-heaping proponents have given to potential criticism. In section 4, we report the results at the regional level and present a method how to adjust for regional biases. Finally, in section 5 we present the national estimates for the five Eastern European countries since the 17th century, and compare these estimates with Western and Southern European evidence. In a conclusion, we discuss tentatively the implications for our understanding of early modern economic growth.

1. Review of the literature

For literacy rates around 1800, Reis (2005) reports substantially lower values for Hungary (6 percent), which is the only Eastern (or Central-Eastern) country he documented. This value was substantially lower than in other European countries. A very long-run study on Russian literacy was performed by Mironov (1991). He reported the estimate of the Russian historian Sapunov for the mid-13th century period that Russia might have had 1-1.5 percent literates as a lower bound before the Mongol invasion (by assuming that monks, clergymen and the upper strata of secular society were literate). Mironov reported for the end of the 17th century that the number of books, records and similar literacy-related items increased. Literacy estimates based on signatures of witnesses in legal sources yield a very rough estimate of 2-2.5 percent literacy for the late 17th century. Finally, by organizing the 1897 census (which also reported literacy) by birth cohorts, he arrived at an estimate of 4 percent around 1800 and 13 percent around

1850. Literacy might have been 30 percent around 1900. In contrast, Western Europe was typically characterized by values between 15 and 65 already in the early modern period until around 1800 (A'Hearn et al. 2009, p. 802). Mironov also looked at local samples of Baltic peasants and other sources to assess their degree of age heaping, but did not organize this by birth cohorts of adults. Kaiser and Peyton (1993), who studied Tula and Viatka around 1700, unearthed very important evidence, but also did not do such a cohort analysis. A'Hearn et al. (2009) argued that Eastern Europe lagged in numeracy, compared to the West.

What might have caused the relatively low level of Eastern European educational levels in the 19th century, as well as the relatively modest welfare level? A number of prominent explanations for the adverse development of Eastern Europe have been given in the previous literature.

a) Hajnal famously argued that differences in the age at marriage and other aspects of household formation behaviour differed between Eastern and Western Europe. He identified a border at the line St.Petersburg-Trieste which might have left most of the Baltic and Western Poland in the "Western" part, and Ukraine, Russia, Belarus and eastern Poland the "Eastern" part. One could imagine that early marriage might have resulted in less educational investment per child. Already in 1970, Hajnal's observations were rejected as being too simplistic by Judith Sklar in her dissertation, and recently several other scholars critizised them harshly in a number of studies (Sklar 1970, Plakans and Wetherell 2005, Szołtysek 2004, 2007, 2008a, 2008b, 2009, Szołtysek and Goldstein 2010). But even after all the criticism the Hajnal hypothesis received, it is still a standard stereotype which persists in the economic history, as well as demographic literature.

Some of this discussion might be about the traditional dividing line between economists, who tend to accept simplifications and the statistical concept of the average, and family historians, who adhere to more nuanced and contextualized perspectives stressing micro- and meso-level variation.

But the East-West divide might also be caused by other factors mentioned below. We should say upfront that Hajnal hypothesis is considered here with very strong reservations.

b) Related to this, a lack of "girl power" (de Moor and van Zanden 2010, similarly Foreman-Peck 2011) could have played a role. De Moor and van Zanden argued that in the West and especially in the North Sea region, women had more customary rights on the labour market and other aspects of family economies (such as inheritance; see, however, Guzowski 2010 and Dennison 2011 for criticism). Educational gender inequalities might lead to less education on average, as women were mainly responsible for basic education in the household.

c) The second serfdom hypothesis is another classic in the economic history literature (Kula, 1976; Millward 1982; Cerman 2008; Ogilvie and Edwards 2000). In particular, historical Poland and Russia have been regarded as typical cases of the noble landlordism and village subjection (Mironov, 1996; Hagen, 1998).[3] The massive growth in landlord powers over the rural population in these areas was closely related to a rapid rise in agricultural commodity values in the West caused by the sixteenth-century 'price revolution'. To this, the Eastern European landowners responded by expanding their

[3] These were, namely: juridical subjection; migration regulations; legal attachement to a particular social status; subjection to communal payments and duties (including the most harsh compulsory labour); limited right to private property; limited choice of occupation; unprotected personal dignity; see Mironov, 1996, p. 323.

previously modest familial manor farms into large-scale domanial economies aiming at producing surpluses for sale on the urban markets of western Europe. This type of seigneurialism prompted landlords to claim from their peasant subjects not only rents in cash and kind, but above all labour services, which were essential to the very functioning of the demesne farms (Szołtysek 2008a). Serfs have less incentive and ability to invest in basic education, such as the numeracy concept applied in this study. Of course, serfdom has had very different forms. The most extreme one was the manorial system based on peasants' personal and hereditary subjection as well as on their labor obligation (corvée) to the manors. This was introduced in the territories of Poland-Lithuania essentially during the 16th to early 17th century; however, the strongest manorial system developed in western Poland and in some parts of Ukraine (esp. Volhynia); on the other hand, there have always been areas where such a form of serfdom could have never been fully introduced (Polessia in Belarus, subcarpathian Ukraine). For example, in wide areas of the historical Grand Duchy of Lithuania, a softened version of the system -- based on cash quitrents rather than on corvée, or a mixture of both – emerged in the second half of the 17th century and prevailed until the end of the Polish republic in 1795 (Szołtysek 2008a, 2008b).

As a small deviation from the literature review, we would like to look briefly at the regional distribution of serfs, as opposed to free or manumitted persons, and people on government-owned estates.

An overwhelming majority of the population of all territories under investigation lived in personal and hereditary subjection up until the nineteenth-century reforms, with their property rights limited to an indeterminate leasehold. This notwithstanding, it has

been observed that the share of hereditary or emphyteutic freeholders, or peasants holding more advantageous property rights diminished considerably when moving progressively into Polish eastern territories and Russia (Rutkowski, 1986; Moon 1999). If we consider the distribution in the share of serfs in the Russian Empire during mid-19th century, a clear regional pattern also emerges (Figure 4).[4] Especially in a central corridor between Belarus (Minsk) and Nishniy Novgorod, the share of serfs was particulary large. In contrast, the thinly populated regions in the Northeast had few serfs, and the same is true for the Southeast. Moreover, the Southeast was characterised during the late serfdom period by the slightly less oppressive system of Barshchina, in which feudal obligations were paid in money or kind, whereas the Obrok system of compulsory labor was more typical in other regions. The share of serfs actually corresponds quite well with the regional distribution of numeracy and literacy (Figure 2 and 3).

d) Large-farm agriculture is often associated with a political economy in which large landowners prevented tax-financed public schooling, as they saw no need for serfs to learn (and perhaps demand political rights), financed by the taxes of the rich. Similar considerations apply to agricultural labourers later-on, after the abolition of serfdom.[5]

e) Related to this, political governance of the Russian Empire did not favor schooling and the situation in the East of Russia was similar. The Russian Empire was dominated by the landed interests of its nobility. Hence investment in schooling was not very high on the national agenda, at least not until the Empire lost the Crimean War. During this major event, not only the military inferiority, but even more so the

[4] Note, however, that no data are provided for Polish territories.
[5] 'Agricultural laborers' were only part of socioeconomic landscape of Eastern Europe for the period after the formal abolition of serfdom; they emerged quite early in Galicia due to Josephinian reforms of 1780s, and then in the province of Greater Poland (Prussian Province of Posen) after 1820s.

backwardness in productivity and human capital became obvious. Hence the government began with reforms which also initiated a tendency towards larger-scale schooling investment.

f) Wars and civil wars might have had long-run consequences of risk aversion against investments of any sort. Terrible damage caused by mid-17th century wars, soon repeated during the 1720s, brought the development of manorial economy and land labor ratio to levels not very different to those known from the late 17th century, i.e. at the beginning of agrarian change (Szołtysek 2008a).

d) Lower life expectancy might have had the same effect. Life expectancy at birth, e0, was probably lower in this part of Europe compared to the West, although our evidence is still relatively weak. At least for historical Poland, this is only a tentative argument based on single case studies using different methodologies; 27 for males and something like 27-28 for women is usually taken as quite likely reflecting reality of the late 18th century, whereas some West European countries typically reached values above 30 (Kuklo 2009)

h) Low population density and lack of transport system makes commuting to schools more costly and returns to schooling lower; Of course, this only refers to the statistical average, and to the East in particular. There are regions in historical Poland with quite substantial population densities: Little Poland around Krakow, Galizia, and some regions under the Crown of Prussia. The 17th century wars cut deep wounds in terms of population densities as well. Regions of western and central Poland, as well as western Galizia generally represented the most populated areas of the country. Moving to

the eastern areas we observe a gradual decrease of population density; in late 18th-century Belarus it was definitely below 10 persons/km².

i) Religion: Could a lack of protestantism have played a role, or a lack of religious competition (Baten and van Zanden 2008)? While most of Slavic Russia was orthodox, the religious pattern was more mixed in the West. Calvinism emerged among the Polish nobility in the 16th century and dominated this political class well until mid 17th century, or even longer; large areas of western Poland were inhabited by religiously mixed communities, with a substantial share of protestants (mainly settlers from different parts of Germany and the Netherlands); Similarly important in this context could be the competiton between Uniates and Orthodox (Mitterauer 2003).

Some of those potential determinants will be discussed below by interregional comparison, others by using East-West comparisons. However, the aim of the present paper is not to perform a regression in which those potential explanations are systematically tested against each other.

2. Sources

Our sources are in particular the (1) 'lists of souls' (either the Roman Catholic Libri Status Animarum or their Protestant Seelenregister equivalents, (2) censuses of the Civil-Military Order Commissions 1790–1792 in the territories of Poland-Lithuania (which were occupied by the Russian Empire after the late 18th century), (3) the Russian revizii (tax-oriented censuses); (4) the censuses of 1880 in Prussia and Austria-Hungary (which had occupied other territories of modern Poland) and 1897 in Russia, and (5) other types

of household lists including 'communion books' and local administrative surveys, as well as Crown estate inventories.[6]

In Table 1, we report the places and regions on which evidence is available. In the second column, we report the country in which the regional unit is situated today. In the following three columns, the county, the larger district and the Empire are reported, in which those locations were situated towards the later 19th century. Please note that we accepted only places which had a large majority of Polish-speakers in those places which were situated in Prussia or Austria-Hungary. By this, we aim at avoiding reporting German-speaking communities under the category 'today's Poland', whose descendants might later have fled or have been moved to Germany after WWII. In the ethnic overlap between Poland, Lithuania and Belarus, we have been less restrictive. There might be some migration biases later-on. We also took care not to include any sources in which some counter-checking by priests or officials might have taken place. In those cases, there was almost no heaping present. We only included county-birth decade averages which were based on at least 50 observations (for the number of cases, see an Appendix available from the authors).

[6] All these sources, except for nineteenth-century censuses and the 17th/18th century sources on Russia, are the part of the *CEURFAMFORM Database* developed by M. Szołtysek. The database development was supported by the Marie Curie Intra-European Fellowship project (FP6-2002-Mobility-5, Proposal No. 515065) at the Cambridge Group for the History of Population and Social Structure, Cambridge, UK, 2006-2008. More details in Szołtysek 2008a, 2008b.

3. Assessing human capital formation with the age heaping indicator and other measures of human capital

Measuring the production factor "human capital" has never been simple, as advanced forms of skills are difficult to compare. Hence all economists have resorted to the use of proxy indicators, such as the share of people signing a marriage register. Grundlach (2001) notes that the empirical measurement of the human capital factor and the productivity of education in economic growth are still not completely satisfying in human capital research so far. A comparison of different proxy indicators might perhaps be the best possibility to obtain reliable insights. This is the rationale for using the age heaping methodology (as well as literacy and schooling in comparison, wherever this is available to us). We will explain the advantages and caveats in somewhat greater detail, as the application of the method in economic history is still relatively new.

This approach employs the set of methods that developed around the phenomenon of "age heaping", i.e. the tendency of poorly educated people to round their age erroneously – they answer more often "30", if they are in fact 29 or 31, compared with people with a better endowment of human capital (Mokyr 1985).[7] Crayen and Baten (2008) found that the relationship between illiteracy and age heaping for LDCs after 1950 is very close. They calculated age heaping and illiteracy for not less than 270,000 individuals that were organized by 416 regions, ranging from Latin America to Oceania. The correlation coefficient with illiteracy was as high as 0.7. The correlation with the

[7] Among demographers, this specific type of age misreporting constitutes 'one of most frustrating problems' (Ewbank 1981, 88). It is treated as a source of distortion in age specific vital rates, which needs to be removed, or at least minimized in order to study the family or household variables.

PISA results for numerical skills was even as high as 0.85, hence the age heaping measure "Whipple Index" is more strongly correlated with numerical skills. A'Hearn, Baten, and Crayen (2009) used a large U.S. census sample to perform a very detailed analysis of this relationship. They subdivided the sample by race, gender, high and low educational status and other criteria. In each case, they obtained a statistically significant relationship. Remarkable is also the fact that the coefficients are relatively stable between samples, i.e. a unit change in age heaping is associated with similar changes in literacy across the various tests. Those results are not only valid for the U.S.: In any country studied so far which had substantial age-heaping, the correlation was both statistically and economically significant.[8]

In order to assess the robustness of those U.S. census results and the similar conclusions which could be drawn from late twentieth century Less Developed Countries, as mentioned in the introduction to this study, A'Hearn et al. (2009) also assessed age heaping and literacy in 16 different European countries between the Middle Ages and the early nineteenth century. Again, they found a positive correlation between age heaping and literacy, although the relationship was somewhat weaker than for the nineteenth or twentieth century data. It is likely that the unavoidable measurement error when using early modern data induced the lower statistical significance.[9]

The possibly widest geographical sample studied so far has been created by Crayen and Baten (2010), who were able to include 70 countries for which both age

[8] On the regions of Argentina, see for example Manzel, Baten and Stolz (forthcoming).
[9] The experience of historical demographers show that data from premodern times were often very rough, imprecise or fragmentary. Even the18th century statistical materials are still a sheer jungle of uncertainties and traps, as they were not seldom collected haphazardly and analyzed without sill; as a result, they often embrace just part of the phenomenon which they refer to, which decides about their being incomplete (Szołtysek 2011). This refers in particular to age data quality.

heaping and schooling data (as well as other explanatory variables) were available. They found in a series of cross-sections between the 1880s and 1940s that primary schooling and age heaping were closely correlated, with R-squares between 0.55 and 0.76 (including other control variables, see below). Again, the coefficients were relatively stable over time. This large sample also allowed the examination of various other potential determinants of age heaping. To assess whether the degree of bureaucracy, birth registration, and government interaction with citizens is likely to influence the knowledge of one's exact age, independently of personal education, Crayen and Baten used the number of censuses performed for each individual country up to the period under study as explanatory variable for their age heaping measure. Except for countries with a very long history of census taking, all variations of this variable turned out insignificant, which would suggest that such an independent bureaucracy effect was rather weak. In other words, it is the case that societies with a high number of censuses and early introduction of birth registers had a high age-awareness. But those societies were also early to introduce schooling, and this was the variable that had clearly more explanatory power than the independent bureaucracy effect. Crayen and Baten also tested whether the general standard of living had an influence on age heaping tendencies (using height as well as GDP per capita as welfare indicators) and found a varying influence: in some decades, there was a statistically significant correlation, in others there was none.

Was this correlation between numeracy and literacy also visible in Eastern Europe? Comparing the log literacy in the Russian Imperial census of 1897 for the individuals born between 1825 and 1874 on the vertical axis, and their non-numeracy (see Figure 3, expressed by the Whipple index, divided by 100) on the horizontal axis,

there is a clear correlation. The Baltic gouvernments of Estland and Livland as well as the capital region of St.Petersburg featured very positively, whereas the 'serfdom'-intensive regions around Belarus had quite low values of both literacy and numeracy.[10] An outlier is the district of Kowno (we need to check whether this might be typographic error in the original sources). Interestingly, the Northeastern districts of European Russia, such as Archangelsk, Wologda, and Perm, were much better in numeracy than they were in literacy. The previous literature has noted that for literacy development, the existence of schools is even more important than for basic numeracy. For the latter, education in the family contributes more in relative terms. In the thinly populated regions of the Northeast, the access to schools was much more difficult, compared to the more densely populated areas further south.

In conclusion, the correlation between age heaping and other human capital indicators is quite well established, and the 'bureaucratic' factor is not invalidating this relationship. A caveat relates to other forms of heaping (apart from the heaping on multiples of five), such as heaping on multiples of two, which is quite widespread among children and teenagers and to a lesser extent among young adults in their twenties.[11] This shows that most individuals knew their age as teenagers, but only in well-educated societies they are able to remember or calculate again their exact age later in life. At higher ages, this heaping pattern is mostly negligible, but interestingly somewhat stronger among populations who are numerate enough not to round on multiples of five. We will

[10] Please note that serfdom was abolished on all these territories in 1864, a potential impact must have stemmed from the first four decades.

[11] It has been shown that in some societies, in addition to the usual overrepresentation of five and zero, there was also a decided preference for figures ending on other digits, whereas avoidance of some numbers was likely to occur in a patterned way as well (Stockwell 1966; Nagi, Stockwell and Snavley 1973).

exclude those below age 23 and above 72 since a number of possible distortions affect those specific age groups, leading to age reporting behaviour, different to the one featured by the adult group in between. Many young males and females married in their early twenties or late teens, when they also had to register as voters, military conscripts etc. At such occasions, they were sometimes subject to minimum age requirements, a condition which gave rise to increased age awareness. Moreover, individuals physically grow during this age group, which makes it easier to determine their age with a relatively high accuracy. All these factors tend to deflate age heaping levels for children and young adults, compared with the age reporting of the same individuals at higher ages. The age heaping pattern of very old individuals is subject to upward as well as downward bias for the reasons mentioned above, and hence the very old should also be excluded.

There remains some uncertainty about whether age heaping in the sources contains information about the numeracy of the responding individual, or rather about the diligence of the reporting personnel who wrote down the statements. Age data of the relevant age groups 23-72 are normally derived by statements from the person himself or herself. However, one could imagine that a second party, especially the husband, reported or influenced the age statement, or that even the enumerator estimated the age without asking the individual. If the latter occurred, we would not measure the numeracy of the person interviewed. In contrast, if the enumerator asked and obtained no response, a round age estimated by him would still measure basic numeracy correctly. A large body of literature has investigated the issue of other persons reporting. Foldvari et al. (2011) can imagine, for example, that wifes appear more numerate, because they improved their age statement with the help of their husband. They compared numeracy of married and

unmarried women and found that the latter had in some of their samples a significanly lower numeracy. However, de Moor (2011) recently rejected this view with a number of good arguments. Moreover, in the early modern period and the 19th century, marriage was often associated with higher educational and social status, as a number of studies find (for example, Baten and Murray 1998). We compared male and female numeracy in our sample, and found that sometimes women were more numerate than men, which would support the hypothesis that they reported their age themselves. On the other hand, there is a correlation between male and female numeracy of different households. Recently, Friesen et al. (2011) compared systematically the evidence of the gender gap in numeracy and in literacy for the late 19th and early 20th century, and found a strong correlation. They argue that there is no reason why misreporting about literacy and age should have yielded exactly the same gap between genders. A more likely explanation is that the well-known correlation between numeracy and literacy also applies to gender differences. For our study, the question of whether women answered themselves is slightly less important, because we aim only at estimating average numeracy.

Moreover, there is sometimes direct evidence in the sources that wifes were asked theirselves. Manzel et al. (2011) report sources on Latin American Indio women, in which statements are included such as ‘she says that she is 30, but she looks more like 40’. Even for black female and male slaves in the Cape Colony in South Africa who were accused of crimes, the legal personnel created a separate column that indicated whether the person was guessing her age, or whether she knew it really. One could imagine that if those Indio and African women, who probably did not receive much respect by colonial

officers, were asked for their age, European women might have been asked for their age theirselves, as the respect for them might have been also modest, but somewhat greater.

The problem of different enumerators influencing the quality of age statements has also been studied in a 20th century context. While a large part of age misreporting arises indeed because the respondents do not know their exact age, this problem is likely to be exacerbated by differences in the quality of performance of the enumerators, as some of them may have taken their duties more seriously than others (United Nations 1952, 59). With reference to the notorious hardships encountered in the surveying processes in contemporary developing countries, Ewbank noted as follows: "In particular, the training of interviewers, their level of education, and their ability to understand and pursue the interests of the researcher will significantly affect the quality of data [on age]" (Ewbank 1981, 15). However, the difference between 20th century enumerator behaviour and the priests and officials of the 17th to 19th century is that the former had much easier access to sources allowing counter-checking age statements. Priests of the 18th century could have looked up birth years in birth registers, but those were usually chronologically sorted and therefore age counter-checking required a substantial time investment. Still, some of the existing sources were clearly counter-checked (yielding ABCC values of around 100 very early), and hence we used historian's judgement to exclude them. Also Szołtysek (2011) found that differences in the age heaping patterns in historical Poland-Lithuania might be partly amenable to explanation by referring to different organizing principles of the enumeration process inherent to different types of listings.

Of course, a potential bias always exists if more than one person is involved in the creation of a historical source. For example, if literacy is measured by analysing the share

of signatures in marriage contracts, there might have been priests who were more or less interested in obtaining real signatures, as opposed to just crosses or other symbols. We find it reinforcing that previous studies always estimated generally much more age heaping (and less numeracy) for the lower social strata, and among the half of the sample population which had lower anthropometric values (Baten and Mumme 2010). Moreover, the regional differences of age-heaping are similar to regional differences in illiteracy. It can be concluded that the method of age heaping is a useful and innovative tool to assess human capital.

4. Results at the regional level and the adjustment of regional biases

We present the ABCC estimates for the individual regions in Table A.1 in the Appendix.[12] On the left side of Table A1, the new regional estimates for the period 1630s to 1810s are presented, whereas on the right side the 1820s to 1900s estimates are given. The latter are based on the 1880 and 1897 population census, and later censuses, while the former set of figures is based on the sources mentioned in the data section. For Russia, five regions can be documented, for sometimes very different periods. To which degree are those regions representative? The fact that Moscow is included in the five documented regions suggests that there is probably upward bias. Hence the next logical question would be: Did the regions have similar ABCC values to the average of Russia in

[12] The ABCC Index reports a society's share of individuals who probably know their true age (named after A'Hearn, Baten and Crayen as well as Greg Clark, who developed that measure). The formula is

$$ABCC = \left(1 - \frac{(Wh - 100)}{400}\right) \times 100 \text{ if } Wh \geq 100 \text{ ; else } ABCC = 100 .$$

The index ranges from 0 to 100. If everybody reports the correct age, ABCC has a value of 100.

the 1897 census? Or how large was the upward bias? In fact, four of the five regions had ABCC 15-25 percent above the Russian average (Column "Adjustment factor"). Only the Eyskij location in the Kuban territories south of Rostov/Don was similar to the Russian average for the birth decade of the 1820s. Hence we need a regional adjustment. For simplicity, we take the difference for the birth cohort of the 1820s, and report the regionally adjusted values in Table A.2 in the Appendix. This adjustment requires the assumption that the interregional bias was similar in the early period and for the birth decade of the 1820s. This might not have been the case for all the regions, but in general the estimate will be closer to the true national average after the adjustment than before. The fact that we have normally 4-5 different regional datasets to compare allows obtaining an impression for the size of measurement error implied by this procedure. For example, in the case of Przemyshlany and birth decade 1740s, the resulting value is clearly too low, also the Warshaw region might have been underestimated for the 18th century. But in the vast majority of cases, the regional adjustment procedure works relatively well. In order to remain consistent, we take all values into account.

5 Estimates for the five Eastern European countries and international comparison

In a next step, we generate national estimates based on those regional values. In Figure 5, we display the regional and national estimates for Russia. Some of the early estimates are above and other below the estimate for Russia, but the emerging trend seems relatively clear. Hence we show the national trends for all five countries in Figure 6. We distinguish a Western and an Eastern part of today's Poland. The Western part was built of East Silesia and other parts of Prussia (only Polish speakers), as well as those districts who

were annexed by Prussia and Austria-Hungary in effect of the 18th century partitions of Poland, and the Eastern part was formed by those regions which were occupied by the Russian Empire. We were curious whether the West and East yielded similar estimates for the whole of Poland after being regionally adjusted to the national mean. In fact, the similarity of level suggests that this division does not affect the estimates for Poland much.

Finally, our aim was to make those series graphically comparable with estimates for other European regions. This was achieved by using the LOWESS procedure already used by Manzel et al. (2011). In order to make the comparison, the numerically relatively similar countries of Belarus and Lithuania were taken together, as well as the East and West of Poland (Figure 7).

Eastern Europe in international comparison

Which broad trends do we obtain from this procedure, and how do they compare with other European regions? In Figure 8, data from Eastern Europe were plotted against the evidence from Western and Southern European countries, which we derived from a yet unpublished study (Stolz et al. 2011, see also Tollnek and Baten 2011). The authors assessed the Northwestern European region, for which relatively continuous evidence from the 1730s is available on Austria, Germany, France, Sweden and the UK, and a Southern European Region (Italy, Spain, Portugal). Both series start around 80 percent numeracy in the early 18th C, but the Northwestern region made quicker progress and achieved 95 percent around 1800. The Northwest solved the basic numeracy problem around the middle of the 19th century. Southern Europe stagnated at the quite high level

of around 82 percent from the 1730s until the 1820s and then slowly converged. Earlier evidence suggests that during the 15th century, the European landscape varied from 72 percent ABCC in the Netherlands, 55 percent in Northern Italy, 40 percent in Germany down to 18 percent in Southern Italy (A'Hearn et al. 2009). Juif and Baten (2011) found that Spain and Portugal had numeracy levels of around 60 percent both in the early and late 17th century.

Hence, the Northwestern and Southern European regions were clearly more numerate than all of the Eastern European ones which we assess here during the 18th and 19th centuries, although during the 17th century, Poland did not differ very much from the European south (Juif and Baten 2011). Moreover, the trends of convergence and slowing down in the individual regions are interesting. Russia started much lower than Portugal, at around 20 percent in the early 17th century, but the gap to Poland declined to less than 5 percent in the days of Tsar Peter the Great. During the difficult years of the late 18th century, there might have been a slow-down, but during the 19th century human capital was accumulated again and the problem if basic numeracy was almost solved around 1900.

Poland revealed stagnant levels of numeracy throughout much of the 17th and early 18th century (around 60), whereas the European south grew by some 20 ABCC points during this period. Basic trends in numeracy continued to increase in Poland during middle decades of the 18th century, but the process seemed to have slowed down in the time of partitions. During the 19th century, a steady upward trend can be discerned in all the Eastern European regions.

Belarus, Lithuania and Ukraine were the most lagging countries among those studied here. During the early to mid-18th century, numeracy still stood at around 30 percent, but then first Ukraine started a rapid development, which resulted in an slight overtaking of Russian levels during the 19th century. It would be interesting to assess whether the migration of Jewish people from Polish-Lithuanian regions to Ukraine also stimulated this overtaking of Ukrainian numeracy. Belarus and Lithuania experienced their most rapid numeracy growth during the 19th century.

The relatively strong discrepancy between Polish and Russian levels early-on, and a much stronger dissimilarity of the former in relation to the territories of Belarus, Lithuania and Ukraine, is one of the major findings here.

Results and Conclusion

Serfdom seems to have played a key role in limiting human capital development in Eastern Europe, as became visible in the regional patterns we discussed in a deviation to the literature review. The earliest evidence we have on the West of Poland suggests that in the early 17th century, the region was not so far behind other regions of Europe. For example, it displayed a similar level as Portugal and Spain in 1600-49 and 1650-99 (Juif and Baten 2011). In contrast, Russia was probably on a much lower level during this period, whereas Belarus, Ukraine and Lithuania started on a very low level when our evidence becomes available in the 18th century. The fact that Western Poland was still doing relatively well during the early 17th century, but was not able to converge to Western Europe during the 17th,18th and early 19th centuries -- and even fell back relative to Southern Europe during this period -- might support a second serfdom hypothesis.

Apart from the devastating role of wars, which also affected other regions of Europe such as Central and Southern Europe, it might in fact have been the second serfdom tendencies which continued in the 17th and 18th centuries and which limited the educational progress in Eastern Europe.

References

A'Hearn, Brian, Baten, Jörg, and Crayen, Dorothee and "Quantifying Quantitative Literacy: Age Heaping and the History of Human Capital" *Journal of Economic History* 69-3 (Sept 2009), pp.783-808.

Baten, Jörg and Christina Mumme: "Globalization and Educational Inequality in Long-Run Development during the 17th to 20th Centuries: Latin America and other Developing World Regions", *Journal of Iberian and Latin American Economic History* 28-2 (2010)*,* 279 -305. doi:10.1017/S021261091000008X.

Baten, Jörg and John Murray (1998). "Women's Stature and Marriage Markets in Pre-Industrial Bavaria", *Journal of Family History* 23-2, pp. 124-135

Baten, Jörg and Jan Luiten van Zanden (2008): "Book Production and the Onset of Early Modern Growth", *Journal of Economic Growth 13-3* , pp. 217-235,

Cerman, M. (2008). Social structures and land markets in late medieval central and eastern-central Europe.Continuity and Change 23(1), 55-100.

Crayen, Dorothee and Baten, Jörg "New Evidence and New Methods to Measure Human Capital Inequality before and during the Industrial Revolution: France and the U.S. in the 17th to 19th Centuries " *Economic History Review* 53-2 (2010), pp. 452-478.

Crayen, Dorothee and Baten, Jörg "Global Trends in Numeracy 1820-1949 and its Implications for Long-Run Growth", with Dorothee Crayen, *Explorations in Economic History 47-1 (2010), pp. 82-99* doi:10.1016/j.eeh.2009.05.004 Older version is available as CESifo Working Paper 2218.

Crayen, Dorothee and Joerg Baten (2008): Global Trends in Numeracy 1820-1949 and its Implications for Long-Run Growth, *CESifo Working Paper 2218.*

De Moor, Tine (2011). Art History and Numeracy#if

De Moor, Tine and Jan Luiten van Zanden (2010) Girl power: the European marriage pattern and labour markets in the North Sea region in the late medieval and early modern period, Economic History Review 63-1, pp. 1-33.

De Moor, Tine, and Van Zanden, J.-L., 'Uit fouten kun je leren. Een kritische benadering van de mogelijkheden van 'leeftijdstapelen' voor sociaal-economisch historisch onderzoek naar gecijferdheid in het pre-industriële Vlaanderen en Nederland', *Tijdschrift voor Economische en Sociale Geschiedenis,* 5 (2008), pp. 55-86.

Dennison, T. (2011). Household formation, institutions, and economic development: Evidence from imperial Russia. The History of the Family Volume 16, Issue 4, 456-465.

Ewbank, Douglas C. (1981), Age misreporting and age-selective underenumeration: sources, patterns, and consequences for demographic analysis. Committee on Population and Demography, Report No. 4, Washington, D.C.: National Academy Press.

Friesen, Julia, Joerg Baten and Valeria Prayon: "Women count. Gender (In-)Equalities in the Human Capital Development in Asia, 1900-1960", Working Paper Univ. Tuebingen.

Guzowski, P. (2010). European Marriage Pattern in Central Europe: the case of late mediewal and Early modern Poland. Paper presented at the 35th Annual Meeting of the Social Science History Association (SSHA), Palmer House Hilton, Chicago, Illinois (USA), November 2010.

Hagen, W.W. (1998). Village life in East-Elbian Germany and Poland, 1400-1800: subjection, self-defense, survival. In T. Scott (ed.), *The peasantries of Europe from the fourteenth to the eighteenth centuries* (pp. 145-190). London: Longman.

Juif , Dácil-Tania and Joerg Baten (2011) "On the Human Capital of 'Inca' Indios before and after the Spanish Conquest" Working Paper Univ. Tuebingen

Kayser, Daniel and Peyton Engel. "Time- and Age-Awareness in Early Modern Russia." Comparative Studies in Society and History 35, no. 4 (1993): 824–39.

Koepke, Nikola and Joerg Baten (2005), "The Biological Standard of Living in Europe During the Last Two Millennia," *European Review of Economic History* 9-1 (2005), pp. 61-95

Koepke, Nikola and Jörg Baten (2008) "Agricultural Specialization and Height in Ancient and Medieval Europe", *Explorations in Economic History* 45 (2008), pp. 127-146.

Kuklo, C. (2009). *Demografia Rzeczypospolitej przedrozbiorowej*. Warszawa: DiG.

Kula, W. (1976). *An economic theory of the feudal system: towards a model of the Polish economy, 1500-1800*. London: N.L.B.

Lyashchenko, Peter I. (1949). *History of the National Economy of Russia to the 1917 Revolution,* tr. Leon M. Herman. New York: Macmillan.

Manzel, Kerstin, Stolz,Yvonne, Baten, Jörg "Convergence and Divergence of Numeracy: The Development of Age Heaping in Latin America, 17th to 20th Century", *Economic History Review* (forthcoming).

Millward, R. (1982). "An economic analysis of the organization of serfdom in Eastern Europe." Journal of Economic History, 42, 513-48.

Mironov**,** Boris N. (1991). The Development of Literacy in Russia and the USSR from the Tenth to the Twentieth Centuries. *History of Education Quarterly*, Vol. 31, No. 2. (Summer, 1991), pp. 229-252.

Mironov, B.N. (1996). When and why was the Russian peasantry emancipated? In M.L. Bush (Ed.), *Serfdom and slavery: studies in legal bondage* (pp. 324-347). Harlow : Longman.

Mironov, Boris N., 'Novaya Istoricheskaya Demografia Imperskoy Rossii: Analycheski obsor Corremennoy Istoriografii', *Vestnik Sankt-Peterbursgskovo Universiteta*, 4 (2006), pp. 62-90.

Mitterauer, Michael: Warum Europa? Mittelalterliche Grundlagen eines Sonderwegs. München 2003

Moon, D. (1999). *The Russian peasantry, 1600–1930: the world the peasants made.* London & New York: Longman.

Nagi, M. H., E. G. Stockwell, and L. M. Snavley (1973). Digit Preference and Avoidance in the Age Statistics of Some Recent African Censuses: Some Patterns and Correlates. International Statistical ReviewVol. 41, No. 2, pp. 165-174.

Nafziger, Steven "Communal Institutions, Resource Allocation, and Russian Economic Development: 1861-1905," *The Journal of Economic History* (June 2008): 570-575.

Nafziger, Steven "Peasant Communes and Factor Markets in Late Nineteenth-Century Russia," *Explorations in Economic History* 47.4 (2010): 381-402.

Ogilvie, S J. S. S. Edwards (2000). Women and the Second Serfdom: Evidence from Early Modern Bohemia. Journal of Economic History, 60, 961-994.

Plakans, A. & Wetherell, C. (2005). The Hajnal line and Eastern Europe. In T. Engelen & A.P.Wolf (Eds.), *Marriage and the family in Eurasia. Perspectives on the Hajnal hypothesis* (pp. 105-126). Amsterdam: Aksant.

Reis, Jaime. "Economic Growth, Human Capital Formation, and Consumption in Western Europe Before 1800." In *Living Standards in the Past*, edited by Robert C. Allen, Tommy Bengtsson, and Martin Dribe, 195–225. Oxford: Oxford University Press, 2005.

Rutkowski, J. (1986 [1921]). Poddaństwo włościan w XVIII wieku w Polsce i niektórych innych krajach Europy. In J. Rutkowski, *Wieś europejska późnego feudalizmu,* selected and edited by J. Topolski (pp. 25-215). Warszawa: PIW.

Stockwell, Edward G. (1966). Patterns of digit preference and avoidance in the age statistics of some recent national censuses : a test of the Turner hypothesis. *Eugenics quarterly 13(3), 205-208.*

Stolz, Yvonne, Joerg Baten and Jaime Reis "Portuguese Living Standards 1720-1980 in European Comparison – Heights, Income and Human Capital", Working Paper Univ. Tuebingen

Szołtysek, M. (2004). Astride the Hajnal line - household and family in the Upper Silesian parish of Bujakow, 1766–1803. Polish Population Review, 11, 59-93.

Szołtysek, M. (2007). Central European household and family systems, and the "Hajnal-Mitterauer" line: the parish of Bujakow (18th-19th centuries). The History of the Family, 1, 19-42.

Szołtysek, M. (2008a). *Three* kinds of preindustrial *household formation system* in historical Eastern Europe: A *challenge to spatial patterns of the European family. The History of the Family, 13 (3), 223-257.*

Szołtysek, M. (2008b). Rethinking Eastern Europe: household formation patterns in the Polish-Lithuanian Commonwealth and European family systems. Continuity and Change, 23, 389-427.

Szołtysek, M. (2009). Life cycle service and family systems in the rural countryside: a lesson from historical East-Central Europe. Annales de Démographie Historique, 1, 53-94.

Szołtysek, M. (2011). „A sheer jungle of uncertainties and traps": uses and misuses of premodern census microdata. Paper presented at the Seminar of Economic History, University of Tübingen, Department of Economics (Germany), June 2011.

Szołtysek, M., and B. Zuber Goldstein, (2010). Historical family systems and the great European divide: the invention of the Slavic East. Demográfia: English Edition, 52(5), 5-47.

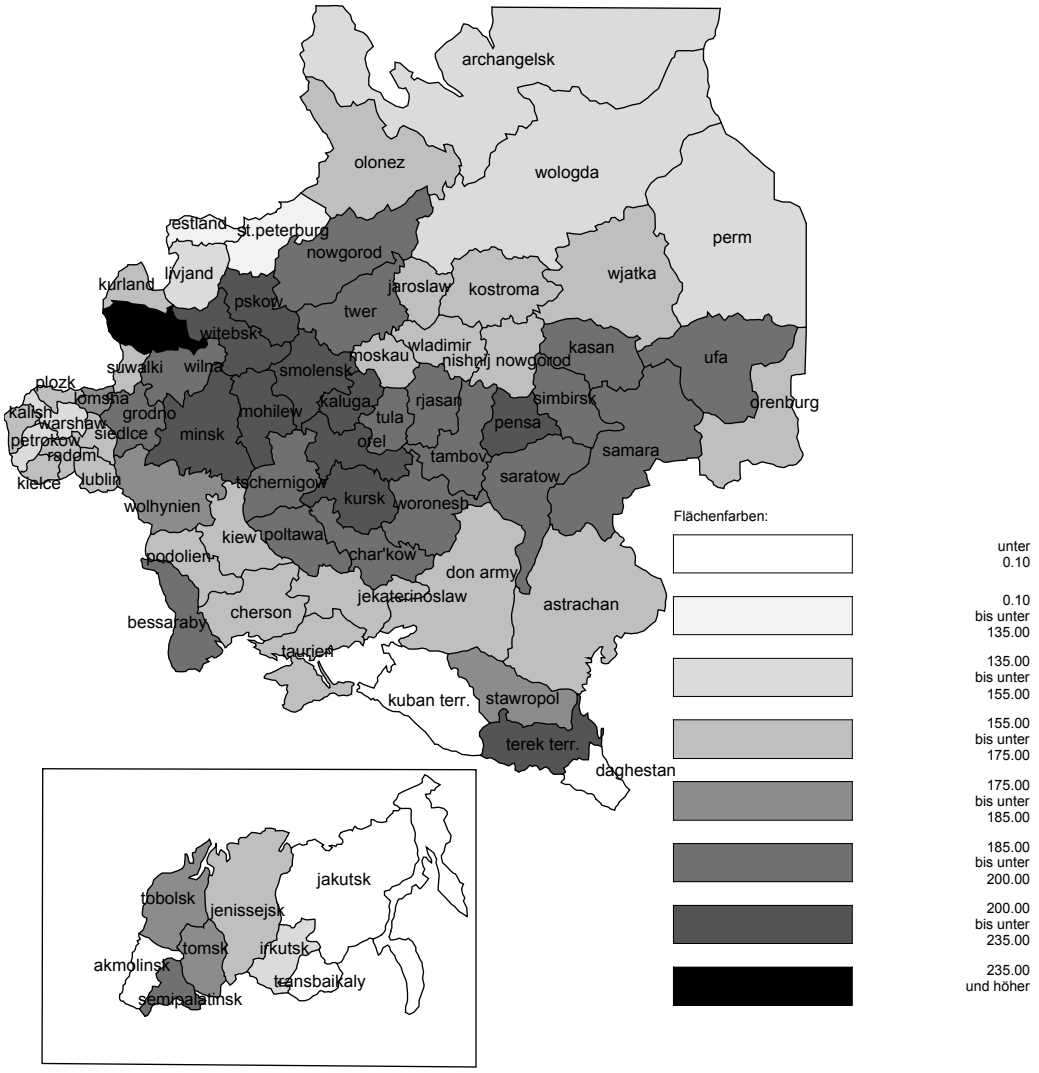
Tollnek, Franziska and Joerg Baten (2011). "The Farmer's U: Which Occupational Group Inherited Human Capital in Early Modern Europe and Latin America?" Working Paper Univ. Tuebingen

Van Zanden, Jan Luiten (1999). "Wages and the Standard of Living in Europe, 1500-1800" European Review of Economic History, August 1999, v. 3, iss. 2, pp. 175-97

Table 1: Places and provinces included (period before 1880/1897)

Place/County	Country today	County 1880/1897	Adm. Gouv./Province 1880/1897	Empire
Bobrujski	by	Bobrujskij	Minskaja	Poland/Russia
Lelowski	pl	Chenstohovskij	Petrokovskaja	Poland/Russia
Charkov	ua	Charkov	Charkov	Russia
Crakow	pl	Cracow (Bezirks-Hauptmannschaft)	Galizien	Austria-Hungary
Proszowski	pl	Cracow (Bezirks-Hauptmannschaft)	Galizien	Austria-Hungary
Olsztynski	pl	Ermland-Masuren	Koenigsberg	Prussia
Mozyrski	by	Gomel'skij	Mogilevskaja	Russia
Koscian	pl	County in Greater Poland	Posen	Prussia
Kaliski	pl	Kaliskij	Kaliskaja	Poland/Russia
Kruszwicki	pl	Kaliskij	Kaliskaja	Poland/Russia
Ostrzeszowski	pl	Kaliskij	Kaliskaja	Poland/Russia
Wielunski	pl	Kaliskij	Kaliskaja	Poland/Russia
Kossow	ua	Kossow (Bezirks-Hauptmannschaft)		Austria-Hungary
Radziejowski	pl	County in Greater Poland	Posen	Prussia
Sepólno	pl	County in Greater Poland	Posen	Prussia
Wyrzysk	pl	County in Greater Poland	Posen	Prussia
Olesnicki	pl	Limanowa (Bezirks-Hauptmannschaft)	Galizien	Austria-Hungary
Leczycki	pl	Lodzinskij	Petrokovskaja	Poland/Russia
Krasnystaw	pl	Lublinskij (East)	Lublinskaja	Poland/Russia
Minski	by	Minskij	Minskaja	Poland/Russia
Nieswieski	by	Minskij	Minskaja	Poland/Russia
Nowogrodzki	by	Minskij	Minskaja	Poland/Russia
Slucki	by	Minskij	Minskaja	Poland/Russia
Wilejka	by	Minskij	Minskaja	Poland/Russia
Bytomski	pl	Opole	Opole	Prussia
Siewierski	pl	Opole	Opole	Prussia
Dawidgrodecki	by	Pinskij	Minskaja	Poland/Russia
Malborski	pl	Pomerania	Koeslin	Prussia
Przemyslany	ua	Przemyshlany (Bezirks-Hauptmannschaft)	Galizien	Austria-Hungary
Wilenski	lt	Vilenskij	Vilenskaja	Poland/Russia
Kcynski	pl	Warschavskij	Warschavskaja	Poland/Russia
Eyskij	ru	Eyskij	Kuban territory	Russia
Moskovskij	ru	Moskovskij	Moskovskij	Russia
Orenburgskij	ru	Orenburgskij	Orenburgskij	Russia
Tulskij	ru	Tulskij	Tulskij	Russia
Vjatskij	ru	Vjatskij	Vjatskij	Russia

Figure 2: Non-numeracy in the gouvernements of the Russian Empire (Whipple index: the lighter, the better numeracy)



Note: It refers to individuals born between 1825 and 1874. Whipple index varies between 113 in Estland and nearly 335 in Erivan. Values below 0.10 (white) are missing values, and the black value of Kovno is probably an outlier.

Figure 3: Comparison of Literacy and Non-Numeracy (Whipple-Index)

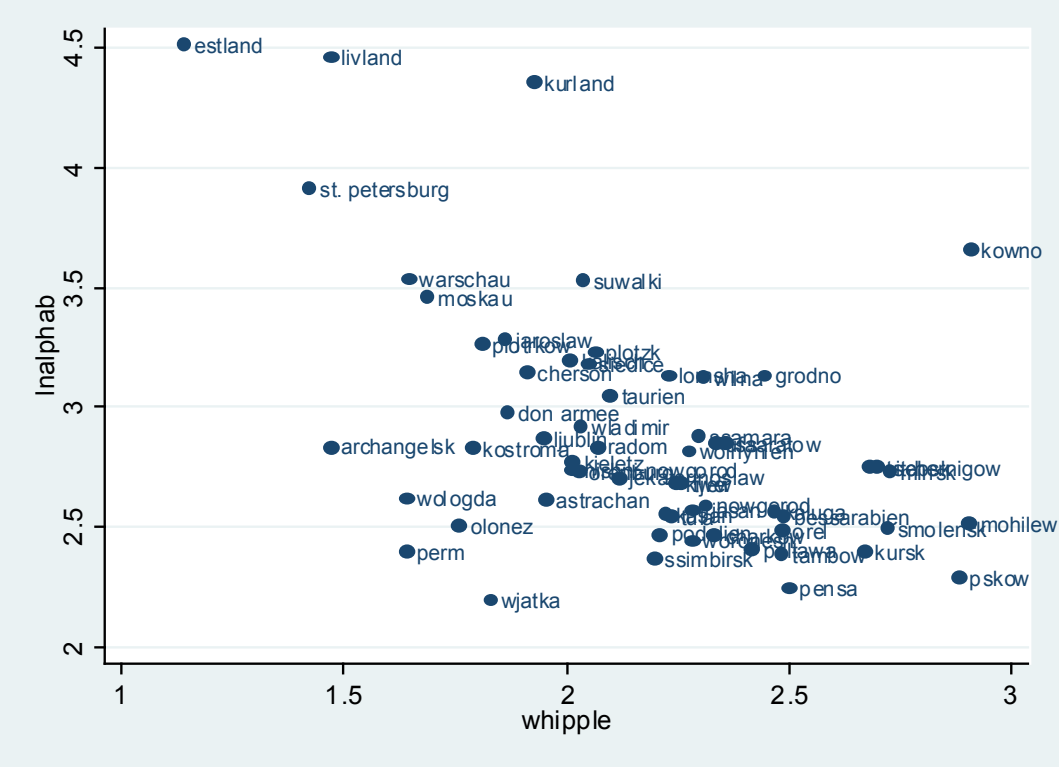
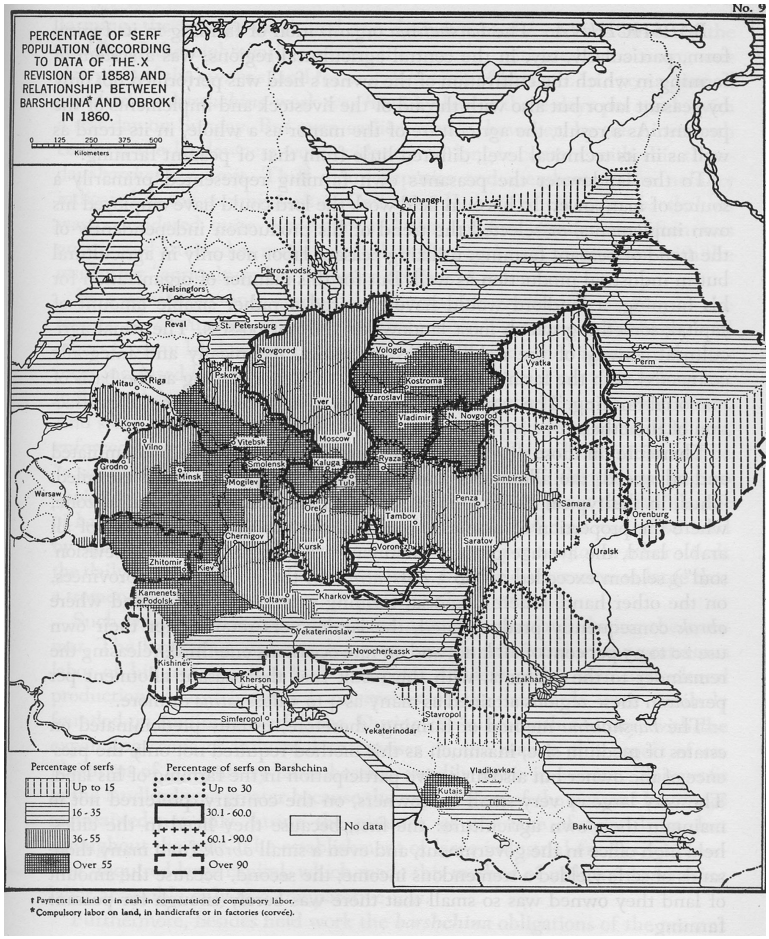


Figure 4: Serfdom in the Russian Empire



Source: Lyashchenko (1949)

Figure 5: Regionally adjusted numeracy (ABCC) of places in Russia

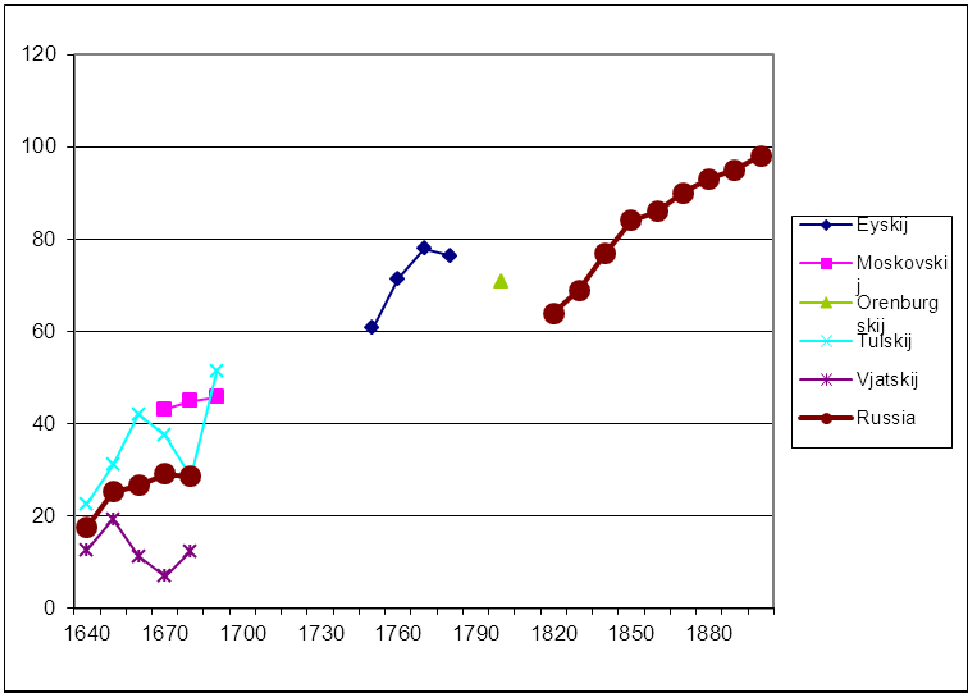
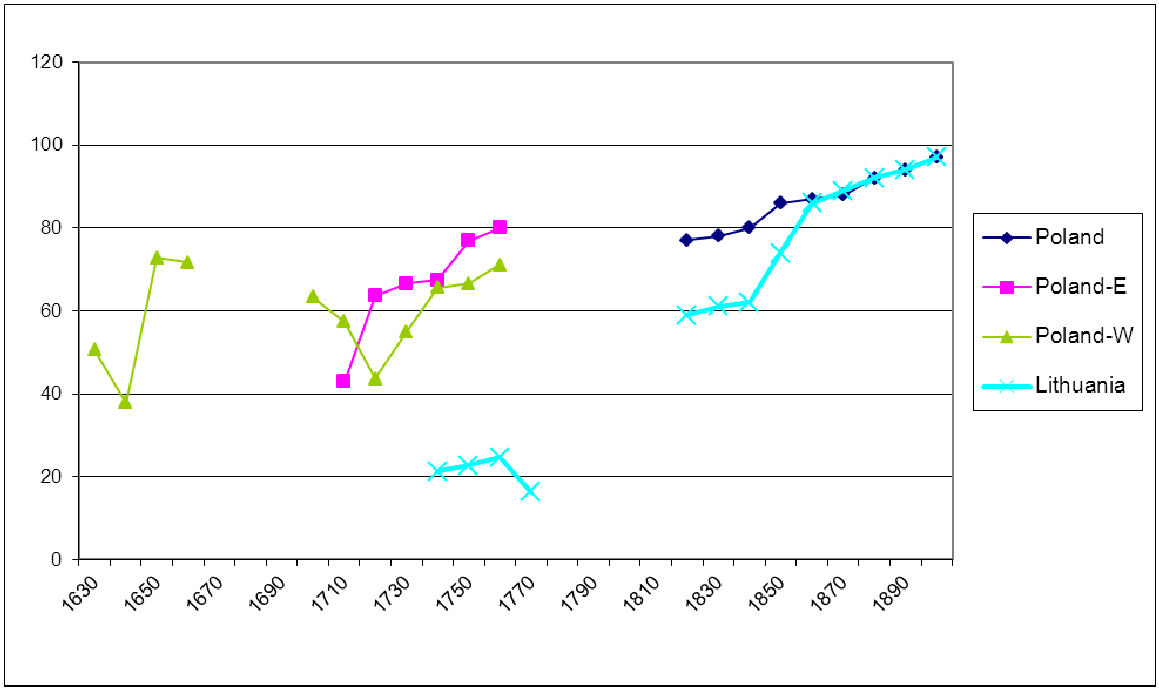


Figure 6: ABCC country trends



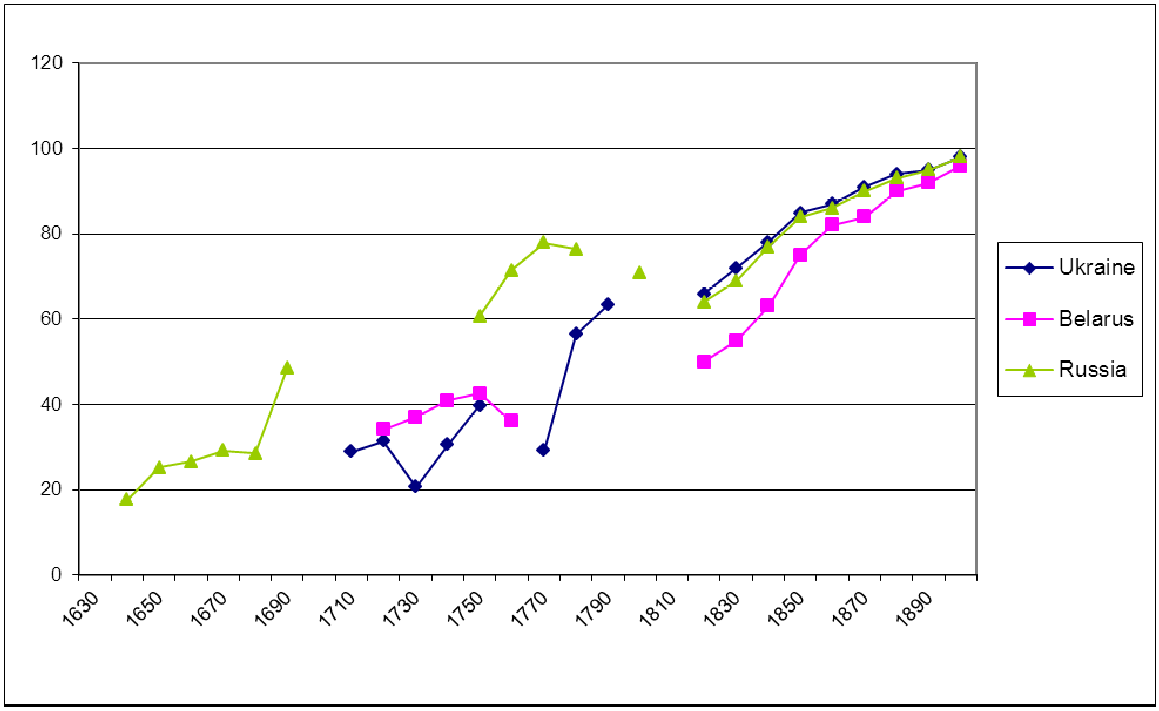
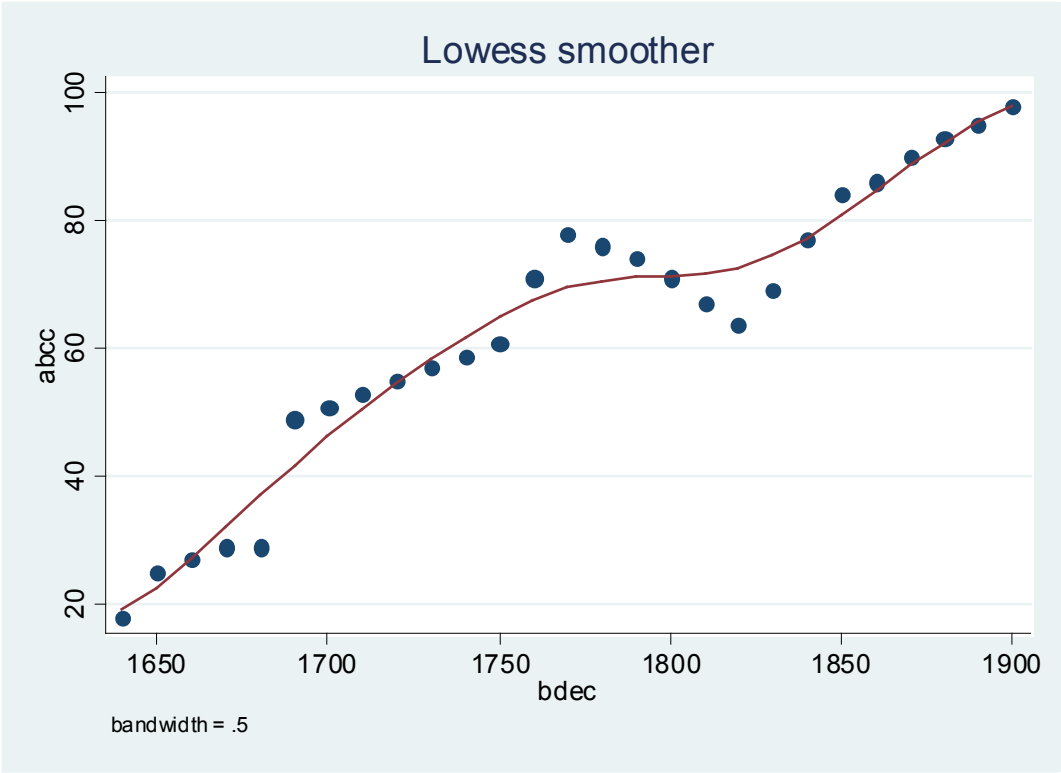


Figure 7: LOWESS-smoothed ABCC trends: Belarus and Lithuania:

Poland:

Russia:



Ukraine:

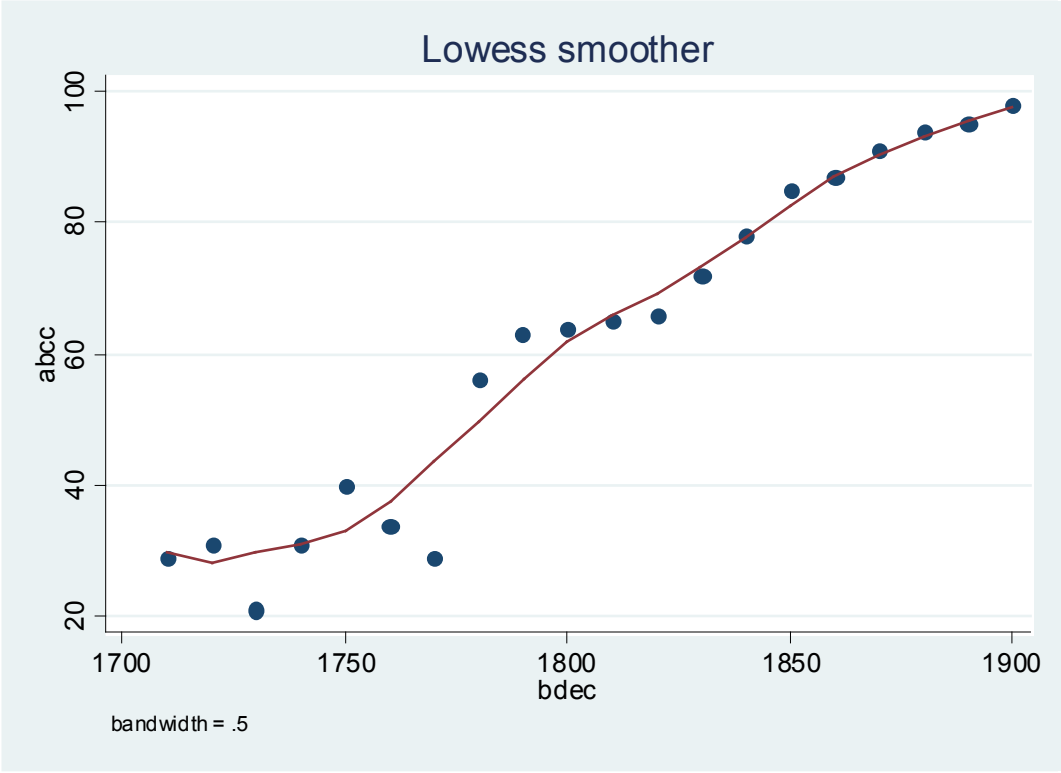
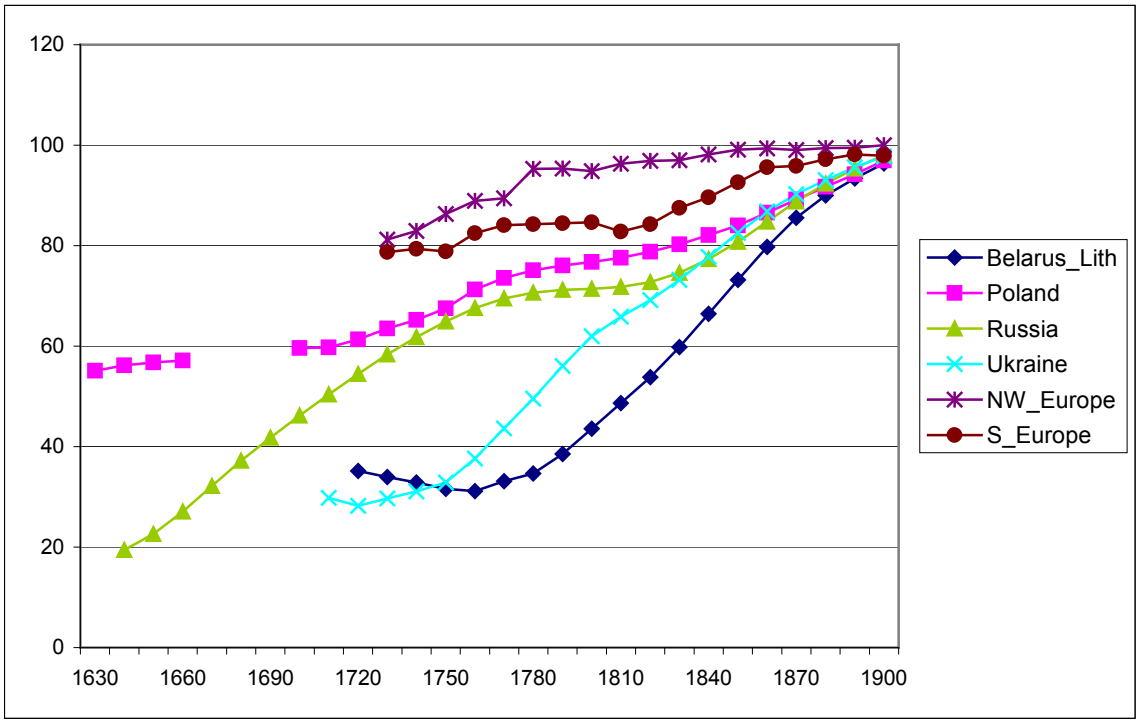


Figure 8: Eastern European ABCC estimates in comparison



Sources for NW and S Europe: Stolz et al. 2011, see also Tollnek and Baten 2011

Table A.1: ABCC by region (raw values), and regional adjustment factors

Region	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900	Adj.factor
Russia																													
Eyskij													62	73	79	78				65	72	80	87	88					1
Moskovskij					66	68	69													83	84	88	93	96					19
Orenburgskij																		90		87	80	75	81	84					23
Tulskij		45	48	59	61	57	51													87	81	81	87	92					23
Vjatskij		26	35	32	33	38														78	80	85	90	90					14
Russia																				64	69	77	84	86	90	93	95	98	
Poland-East (later Russian)																													
Chenstohovskij											66	60	73	74						76	78	78	89	88					-1
Kaliskij										76	77	72	71	88						74	77	77	90	87					-3
Lublinskij										83	85	84	86							79	80	81	91	92					2
Warschavskij									57	41	50	67								91	90	91	96	98					14
Poland																				77	78	80	86	87	88	92	94	97	
Poland-West (19th C Austria/Prussia)																													
Ermland-Masuren	62	49	84	83															98	88	89	90	95	91					11
Cracow_County										34	62	75	75	81					92	97	95	100	98						20
Posen										66	71	82	83	86					92	92	93	95	97						15
Oppeln												83	93	97					93	93	93	95	98						16
Pomerania								83	77	85	87	93							98	97	98	98	98						20
Poland																				77	78	80	86	87	88	92	94	97	
Belarus																													
Bobrujskij										24	34	37	35	28						48	54	63	75	81					-2
Gomelskij										42	41	48	51	45						50	59	70	82	84					0
Minskij										43	34	37	40	34						55	60	66	77	81					5
Pinskij										38	50	51	54	48						57	62	68	80	80					7
Belarus																				50	55	63	75	82	84	90	92	96	
Lithuania																													

Vilenskij				31	33	35	26				69	68	71	82	87						10
Lithuania											59	61	62	74	86	89	92	94	97		
Ukraine																					
Charkovskij	42	44	53	60	67			84			67	72	79	87	91						1
Kossow							60	73	94	98	97	96	96	97							31
Przemyshlany			28	41	51					90	92	97	93	92							26
Ukraine											66	72	78	85	87	91	94	95	98		

Table A.2: ABCC by region (regionally adjusted values)

Region	1630	1640	1650	1660	1670	1680	1690	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790	1800	1810	1820	1830	1840	1850	1860	1870	1880	1890	1900
Russia																												
Eyskij													61	71	78	76												
Moskovskij					43	45	46																					
Orenburgskij																		71										
Tulskij		23	31	42	37	28	51																					
Vjatskij		13	19	11	7	12																						
Russia		18	25	27	29	29														64	69	77	84	86	90	93	95	98
Russia		18	25	27	29	29	49						61	71	78	76		71		64	69	77	84	86	90	93	95	98
Poland-East (later Russian)																												
Chenstohovskij											63	57	70	71														
Kaliskij										77	78	73	72	89														
Lublinskij										86	88	87	89															
Warschavskij									43	27	36	53																
Poland-East										64	67	67	77	80						77	78	80	86	87	88	92	94	97
Poland									43	64	67	67	77	80						77	78	80	86	87	88	92	94	97
Poland-West (19th C Austria/Prussia)																												
Ermland-Masuren	51	38	73	72																								
Cracow_County										14	42	55	55	61														
Posen										51	56	67	68	71														
Oppeln												67	77	81														
Pomerania								63	57	65	67	73																
Poland	51	38	73	72				63	57	44	55	66	67	71						77	78	80	86	87	88	92	94	97
Belarus																												
Bobrujskij										26	36	39	37	30														
Gomelskij										42	41	48	51	45														
Minskij										38	29	32	35	29														
Pinskij										31	43	44	47	41														
Belarus										34	37	41	42	36						50	55	63	75	82	84	90	92	96

Lithuania																			
Vilenskij				21	23	25	16												
Lithuania				21	23	25	16			59	61	62	74	86	89	92	94	97	
Ukraine																			
Charkovskij	29	31	40	47	54			71											
Kossow							29	42	63										
Przemyshlany			2	15	25														
Ukraine	29	31	21	31	40		29	56	63	66	72	78	85	87	91	94	95	98	