Malthus in Sweden

Preliminary new version, please do not circulate yet

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Abstract: We merge parish-level data over birth, death, and marriage rates in 18th- and 19th-century Sweden with a seven-grade scale over harvest outcomes in the county where the parish was located. We find a Malthusian pattern: a good harvest leads to lower death rates, and higher birth and marriage rates. For birth rates the effect comes about a year later than for death rates, consistent with a nine-month delay. We also use historical weather data to examine the possible weather sources of harvest outcomes.

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1 Introduction

A new generation of growth models study demographic trends over the very long run. One challenge in this literature is to replicate a transition from a phase of development in which improvements in living standards raise population growth – a Malthusian pattern – to one where the relationship is the reverse.[1]

The pattern across countries in the world today is clearly non-Malthusian. Birth and death rates tend to decline in the wake of industrialization and improving living standards, and rich countries have lower birth rates and higher life expectancies than poor.

To document explicit evidence of a Malthusian pattern in pre-industrial societies is harder. Some studies even seem to reject such a pattern. For example, looking as U.S. data Jones and Tertilt (2008) examine the relationship between the number of children ever born by women and the husband's income (estimated from information about his occupation). They find a negative (i.e., non-Malthusian) relationship, even for cohorts born as early as 1828. One reason could be that the Malthusian pattern is a largely rural phenomenon that shows up when income differences are due to differences in land productivity; another could be that the U.S. was relatively non-Malthusian by the mid 19th century already.

Here we merge data over birth, death, and marriage rates across Swedish parishes in 18th- and 19th-century with a seven-grade scale measuring the harvest outcome in the county where the parish was located. The resulting panel covers roughly every fifth year with a few gaps, from 1774 to 1856, with variation in harvests both over time and across counties. This data set seems perfect to look for a Malthusian pattern: Sweden industrialized relatively late; its northern location made it sensitive to random weather-induced crop failures, a form natural experiment; and, finally, low population density and poor infrastructure made trade difficult, potentially amplifying

[1] Pioneering contributors include Galor and Weil (2000), Galor and Moav (2002), Hansen and Prescott (2002), and Lucas (2002). See Galor (2005) for an overview.

the demographic effects.

The pattern we find is indeed decidedly Malthusian: a good harvest one year leads to higher birth and marriage rates, in particular the following year, and lower death rates both the same year and the next. This timing is exactly what we should expect in a Malthusian world: birth rates should react with at least a nine-month lag, whereas death rates can react more or less immediately.

We also assess the size of these effects. Moving one single step on the seven-grade harvest scale, the death rate falls by 0.055 percentage points, and the birth rate increases by about 0.04 percentage points, in the following year. At the annual level these are no small numbers.

The rest of this paper is organized as follows. Next, Section 2 provides an overview of previous related work. Thereafter Section 3 describes the data we use. Section 4 discusses how to test the Malthusian hypothesis, describing both what we should expect to find if the hypothesis is true and what the regression results tell us. We discuss how weather correlates with harvest outcomes in Section 5. Finally, Section 6 ends with a concluding discussion.

2 Earlier literature

A recent attempt to test the Malthusian model is that of Ashraf and Galor (2008). They look at historical data over e.g. per-capita incomes and population densities of societies defined by modern borders. Consistent with the predictions of a standard growth model with Malthusian population dynamics, they find that those societies which had higher land productivity and which experienced an earlier introduction of agriculture had higher population densities, but similar levels of per-capita incomes, from year 0 to A.D. 1500. The exercise undertaken here should complement that of Ashraf and Galor (2008), since it tests not so much the predictions of the Malthusian model as the assumptions underlying it, i.e., a positive relationship between agricultural productivity shocks and subsequent population growth. Our approach is also more informative about the microeconomic underpinnings, since we look at cross-sectional data from one particular Malthusian society, namely pre-industrial Sweden.

Several papers study growth models with Malthusian population dynamics quantitatively to examine how well they fit observed long-run time trends in specific macro variables, like per-capita incomes and population growth rates.[2] This is useful if we want say something about the causes behind the industrial revolution and the demographic transition. Here we rather seek to estimate the relationship between harvests and demographic outcomes using panel regressions.

Some papers use vector-autoregressive techniques to examine the response of fertility and mortality to real wage changes; see e.g. Lee and Anderson (2002), Nicolini (2007), and Crafts and Mills (2009). These typically use aggregate time-series data from England, whereas we use disaggregate regional data from the contemporarily more rural and backwater Sweden. Using harvests rather than wages should also mitigate concerns about endogeneity, because bad harvests are more likely than wages to be caused by purely exogenous events, such as extreme weather.

Studies of the Swedish experience in particular date back to Hellstenius (1871), who provide the harvest data we use; the most classic summary of Swedish economic history is that of Heckscher (1954). These lacked the computational resources to pursue any serious statistical analysis. More modern empirical studies include Bengtsson (1984), who look at data from southern Sweden and measure harvests outcomes by grain prices, and Bengtsson and Ohlsson (1985), who examine how mortality reacts to real wage changes (similar in spirit to the literature cited above using English data). We are (probably) the first to use Hellstenius' (1871) harvest grades and set up a panel with both time and county variation across the whole of Sweden. Different from all of these cited studies, we also allow for time and county or

[2]See e.g. Tamura (1996, 2002), Lagerlöf (2003a,b, 2006), Cervellati and Sunde (2005), Fernández-Villaverde (2005), and Bar and Leukhina (2009).

parish dummies in the regressions.

A number of papers relate by using Swedish historical data, but they have different objectives. Schultz (1985) uses changes in the price of butter relative to rye occurring in the 1880's as an instrument for the male-female wage gap; the aim is to study the effects on fertility from the rising value of women's time. de la Croix, Lindh, and Malmberg (2008) study trends in Swedish income, population, and education levels from 1800 to 2000, but their aim in not to test the Malthusian hypothesis. Lagerlöf (2003b) studies the correlation in death rates between Sweden, Denmark, and England, also without testing the Malthusian hypothesis.

3 Data

3.1 Harvest data

The harvest data are numbers ranging from 0 to 6 from Hellstenius (1871, pp. 92-93). In other sources these are often labelled "subjective harvest judgments" (*subjektiva skördeomdömen*). We shall refer to them as harvest grades. These were meant to proxy for the harvest-seed ratio (*korntal)* for the most important crops. They thus measure productivity, rather than output. The grades were set by the King's representatives in the counties (*län*), in Swedish called *landshövdingar* (Hedqvist 1999, pp. 142-143).

How these grades were organized and interpreted has changed over time. The longest and most complete compilation we know of is the one published by Hellstenius (1871), who uses a seven-grade scale where lower numbers mean worse harvests. The interpretations given by Hellstenius (1871, p. 81) are indicated in Table 1, in Swedish and with English translations.

The harvest grades are available at the level of county (*län*), of which there were 24 over this period (there are 21 today). There is data for every county for the years 1816-1870 and 1793-1799; no data are available for 1800-1815. For 1749-1792 data are missing for some counties and years. The coverage is particularly sparse before 1774, so we disregard those years, thus ending up with (partial) harvest coverage for the periods 1774–1799 and 1816-1870. (A scanned copy of Hellstenius' table can be found at the very end of this paper.)

Over this period agricultural productivity improved significantly. According to Hellstenius himself, as well as other sources (e.g. Hedqvist 1999), the interpretation of the grades also changed over time; it took less of a drop in agricultural productivity to generate a low grade in later years than earlier. Also, the meaning of a grade might differ across locations, as the north had overall lower yields than the south. However, none of this should be a problem for our purposes, since we enter year and parish (or county) dummies in all regressions.

3.2 Demographic data

The demographic data were purchased for 3,000 Swedish kronor from the Demographic Data Base (DDB) at Umeå University in Sweden. It is reported at a geographic level smaller than county (*län*), namely that of parish (*församling*), or similar (*pastorat* or *prosteri*). Some observations refer to a part of a parish, or groups of more than one parish. From here on we, shall refer to all sub-county units as parishes.

These data were delivered in different files. One file contains numbers for total population at the end of the year (December 31st), covering various years from 1749 to 1855, typically every fifth year. Another file contains more or less annual data over the total number of births, deaths, and the number of marriages entered (*vigda par*) over the year.[3] Each file provides, for each observation, an identifying number unique for the parish (or similar), enabling us to merge the data to create the following variables:

- The *death rate* is calculated as the total number of deaths in a given

[3] A third file contains some scattered data over the number of people who moved into, and out of, the parish. However, that data is of poor quality, often reporting simultaneous net in- and outflows of people. We do not use this migration data here.

parish during a given year, divided by the total population at the end of the preceding year in the same parish.

- The *birth rate* is calculated as the total number of births in a given parish during a given year, divided by the total population at the end of the preceding year in the same parish.

- The *marriage rate* is calculated as the total number of couples getting married in a given parish during a given year, divided by the total population at the end of the preceding year in the same parish.

Note that we use the population at the end of the preceding year to ensure that the rates are based on the initial population of the year in question.

3.3 The merged data

After merging the demographic data with the harvest data, we end up with about 50,000 observations (parish-years), although many are missing data for one or more variables. We clean this data in a couple of ways.

We are provided with two population measures: one is the total population reported by the priest (who collected the data), and the other is the sum of the number of male and female persons that he reported as living in the parish. For most parish-years these measures are equal, but for about 4,000 they are different or missing for one or both; those data points we throw out.

We also remove parishes with a population of only 100 people or less. This eliminates a couple of hundred parish-years, some of which have very high death and/or birth rates.

As yet another cleaning measure, we drop those years for which there is data for very few parishes. Recall that we calculated our rates after merging data over the total number of people dead and born and entered marriages with data over population. Due to a seemingly random selection of years for which these data are available, we end up with data for very few parishes for certain years. Eliminating years for which data is available for only 20 parishes, or less, we end up with the following years: 1774, 1776, 1781, 1786, 1791, 1796, 1816, 1821, 1826, 1831, 1836, 1841, 1846, 1851, and 1856.

Finally, we also lose some observations when we take logarithms of the outcome variables, namely those parish-years reporting zero rates. In marriage rate regressions we lose about 1,000 parish-years. As it happens, no observations have zero death or birth rates after the data cleaning described above. We need to take logs of these rates because they have clearly log-normally looking distributions. (One way to avoid taking logs is to aggregate the rates up to the county level; see Section 4.2).

Figure 1 shows the distribution of the harvest grades in the merged and cleaned data set, where each observation is a parish-year.

3.4 Weather data

The long-run weather data used in Section 5 was kindly provided by Ruben Durante. These data were originally collected for a project called the European Seasonal Temperature and Precipitation Reconstruction (ESTPR), and are used and described by Durante (2009). (See also Luterbacher et al. 2004.) They measure seasonal precipitation and temperature, as inferred from e.g. tree rings and ocean and lake sediments across a grid of cells over Europe, each about 35 miles (56 km) wide.

The cell-level data can be aggregated up to the level of modern-day counties, similar to those for which we have harvest data. The composition of counties changed in 1997-1998 due to a couple of mergers; see Table A.1 and Section A in the appendix for a discussion. Whereas Hellstenius' (1871) harvest data refers to the original 24 counties, the grid aggregation gives weather data for the 21 counties that exist today. When merging the harvest and weather data, we can either go by the code assigned to the new county or assign the average harvest across the merged counties. Here we use the former approach.

We use four variables: the average spring and summer temperatures (March to May and June to August, respectively), measured in Celsius; and average spring and summer precipitation, measured in centimeters.[4] These seem like good candidates to explain harvests, because crop failure in Sweden often depended on frost in the spring months, and too much or too little rain, according to Hellstenius (1871) and others.

4 Testing the Malthusian hypothesis

The three outcome variables that we are interested in are death rates, birth rates, and marriage rates. According to the Malthusian hypothesis death rates should decline, and birth and marriage rates increase, in response to a good harvest. However, the *sign* of the harvest effect does not say anything about *when* it should occur.

A first guess might be that a good harvest in the fall of some year should have an effect in the following year. Figure 2 shows how birth and death rates, when averaged across parish-years, vary over the previous year's harvest. There is no clear relationship, but arguably some elements of a Malthusian pattern can be detected. In particular, for parish-years with a harvest grade of zero (i.e., a complete crop failure) the natural rate of population growth (the difference between birth and death rates) is close to zero; better harvest grades are associated with a natural population growth rate above 2%. However, there is no discernible effect for harvest grades above zero.

The pattern in Figure 2 obviously hides a great deal of information. Some harvest outcomes (e.g. 1 and 5) have much fewer observations than the others (see the histogram in Figure 1). No controls are made for which years and parishes have the highest or lowest grades. Also, Figure 2 shows only the mean of the death and birth rates for a given harvest, and not the distribution around those means, which may matter just as much. To test whether the data is consistent with the Malthusian hypothesis, we need to run a regression

[4] We use centimeters instead of the more standard millimeter measure to reduce the number of decimals of the reported coefficient estimates. (One centimeter equals ten millimeters.)

with both year and parish dummies.

Moreover, it is not obvious why (only) the previous year's harvest should have an effect. A fall harvest could impact death rates either in the remaining few months of the year, or in the following year(s), or both. Birth rates, by contrast, could not physically respond to harvest shocks in the current year, due to the nine-month pregnancy period (at least if harvests were not known by late March, which seems safe to assume).

The effect on marriage rates could arrive in the same year as the harvest, or later. Marriages in 18th- and 19th-century Sweden were often preceded by engagement (*trolovning*) and various forms of courtship, and thus often planned long in advance. Therefore, we may not expect to see an effect on marriage rates until the following year.

4.1 Parish-level regressions

Table 2 shows the results from a parish-level regression, where each observation is a parish-year, and where all specifications allow for parish and year fixed effects.

We also enter log population in all regressions. A larger population could exert a direct Malthusian effect, by implying lower per-capita land incomes. However, in a Malthusian environment population levels would adjust in the long-run to equalize per-capita incomes, and thus reflect the availability and productivity of land, rendering a Malthusian interpretation implausible. Rather, population is likely to proxy for urbanization, and by extension modernity of family forms, etc.[5] Notably, the parishes with the largest population level located around e.g. Stockholm and Gothenburg.

Since we are agnostic about the timing, we regress each outcome variable in year t (in logs to make the distribution look Gaussian) on the harvest in the current year (t), and harvests one and two years back (years $t-1$ and $t-2$). Regardless of specification we find a clear Malthusian pattern.

[5]Ideally, we would use population density or the fraction of the population living in cities above a certain size, but such detailed data is not available.

Consider first the results for death rates in columns (1) to (4). The harvests in years t and $t-1$ have negative effects, and all but one are statistically significant at the 1% risk level. A good harvest seems to lower death rates in the same year and the next.

Columns (5) to (8) show the results for birth rates, with the same specifications as used for death rates. All significant effects come with a positive sign, opposite that for death rates, and arrive a year later than for death rates: the year-t harvest has no significant effect, but harvests in year $t-1$ and $t-2$ do. Had we found a year-t harvest effect on birth rates, it would not make any Malthusian sense; as it so happens, we do not.

The results for marriage rates in columns (9) to (12) are qualitatively similar to those for birth rates. The harvest in year $t-1$ has a positive and significant effect, although harvests in year $t-2$ do not. There is some reversed (non-Malthusian) effect from year-t harvests, although less significant than that for year $t-1$-harvests. One possible (but very speculative) explanation may be that a good harvest exerts a direct time-cost effect, by demanding more labor input.

There are no very significant effects on death or birth rates from population, but a strongly significant negative effect on marriage rates. This seems consistent with the interpretation of the population variable as a proxy for urbanization or modernization.

As a final remark, recall that the harvest data is available only at the county level. Thus, in these regressions, even though the number of observations is quite large (typically over 20,000), there is no variation in harvests across parishes within the same county. Moreover, many counties have the same grade in any given year, making the variation even smaller. For this reason it may be interesting to compare these results with those from a county-level regression.

4.2 County-level regressions

Table 3 shows the results from a county-level regression, where each observation is a county-year. All specifications here allow for county and year fixed effects, and are otherwise the same as in Table 2.

Since parishes are very small some of them have very high rates. When averaging the parish-level rates to the county level we get rid of some of these extreme values. Averaging thus has the benefit of giving the rates more normal-looking distributions, so we do not need to take logarithms of the dependent variables. Instead, we use the death, birth, and marriage rates in percent as dependent variables. This also makes the interpretation of the coefficient estimates more intuitive (see Section 4.5 below).

Using the cross-parish average of each county gives those counties that have fewer parishes higher relative weight; most such counties are located in northern Sweden.

The results for death rates in columns (1) to (4) of Table 3 are very similar to those in Table 2, perhaps slightly are weaker. The year-t harvest is of the right sign but not as strongly significant in some specifications. The year-$t-1$ harvest does have a negative and significant effect, but loses some significance when entered together with the harvest in year $t-2$.

The results for birth rates in columns (5) to (8) are perfectly consistent with the Malthusian hypothesis, with positive and highly significant effects of year-$t-1$ harvests, but no significant effects of year-t (or year-$t-2$) harvests.

The results for marriage rates are reported in columns (9) to (12) of Table 3. Here the effects are also clearly Malthusian, with harvests in year $t-1$ having a positive and highly significant effect. The seemingly non-Malthusian effects of harvests in year t, observed at the parish-level regressions in Table 2, are absent.

One difference from Table 2 is that population has a positive and significant effect on birth rates, but no significant effect on either death rates or marriage rates. (This contrasts with the strongly significant negative effects on marriage rates in Table 2.)

4.3 Non-linear effects

Recall that our measure of harvests is a discrete variable. Thus, a change in the harvest grade from 0 to 1 need not mean the same thing as a change from 5 to 6, say. One way to account for this would be to use 6 dummy variables, each indicating whether some harvest grade was realized, or not. However, with several lagged harvest variables the number of explanatory variables then quickly becomes very large, thus putting very little structure on the regression model. For example, if we let harvests in years t, $t-1$, and $t-2$ enter the regression, then we have 18 (6 times 3) dummy variables that all measure some harvest outcome (e.g., whether or not a harvest grade of 3 was realized in year $t-1$, and so on). Even if there is no statistical relationship present, Malthusian or otherwise, some variables might show up as significant by chance. Put another way, as a discrete variable takes sufficiently many values it effectively becomes a continuous variable.

An alternative approach is to enter non-linear (quadratic) harvest terms into the regressions. This should alleviate some of the discrete-variable concerns since it allows for differences in the effects of harvest improvements from low levels compared to high. Besides, even if we had a continuous measure of actual harvest volumes (or harvest-to-seed ratios), there is still no Malthusian basis for expecting the relationship to be linear (although it should be monotonic).

Table 4 reports the results when we run the same regressions as in Table 2, at the parish level, but adding quadratic harvest terms. Where applicable, we also report where the implied non-linear relationship reaches its peak or trough: since the harvest grades run from 0 to 6, if the minimum or maximum point exceeds 6, then the sign of the first-order effect indicates whether the harvest effect is positive or negative throughout; if the minimum or maximum point falls below 6, it indicates a non-monotonic relationship.

Few of the quadratic terms in Table 4 are significant, suggesting that the linear specification in Table 2 is reasonable. Moreover, although insignificant, most relationships seem to be monotonically Malthusian. Death rates tend to fall monotonically in response to a good harvest in years t and $t-1$ (although not $t-2$). Birth rates tend to increase monotonically in response a good harvest in years $t-1$ and $t-2$.

There is some indication of a non-monotonic effect on marriage rates from harvests in year $t-2$, such that a very good harvest tends to lower marriage rates two years later. One explanation could be a composition effect on the marriageable population. If many young and eligible got married in the year following a good harvest, that might imply there are few marriageable people around in the subsequent year.

Similar to Table 2 we note a strongly significant negative effect of population on marriage rates, but little effect on birth or death rates.

4.4 Future harvests

As long as the harvest shocks were not predictable in the preceding year already (which seems unlikely that they would be), we should not expect death, birth, and marriage rates in one year to correlate with harvest shocks in future years. This suggests a type of "nonsense" test, in which we allow future harvests to enter the regressions to see if they do indeed come out insignificant.

Table 5 shows the results when regressing each one of the three outcome variables in year t on five different harvest variables: the harvest in the current year (t), one and two years back ($t-1$ and $t-2$), and one and two years into the future ($t+1$ and $t+2$). The regressions are at the parish level. We report the results first when letting each harvest variable enter individually, one by one, and then letting all enter together, in a "horse race." Columns (3), (9) and (15) in Table 5 is the same as columns (1), (5) and (9) in Table 2.

The results are overall Malthusian, with some mild caveats. Consider first death rates. In column (4), the harvest in year $t+1$ seems to have a positive effect on death rates, significant at the 10% level, and in the "horse race" regression in column (6) the harvest in year $t+2$ has a positive effect, also significant at the 10% level. However, these effects are not robust: no future harvest has a significant impact *both* when entered on its own, *and* in the "horse race." The only harvest effects that robustly show up significantly are those for year t and year $t-1$, and the estimates of these coefficients are Malthusian in sign (negative) and highly significant.

Similarly, there are some weak indications of future harvests affecting birth and marriage rates, but these are not robust either. The only harvest effects that are robustly significant are clearly Malthusian in sign. There is no effect on birth rates from year-t harvests, only on death rates, just as we should expect.

4.5 Quantitative assessment

To assess the magnitude of the demographic effects of harvests, consider the specification where the harvest in year $t-1$ enters as the only explanatory harvest variable. Column (2) in Table 5 reports a harvest coefficient estimate of -0.027, implying that a one-unit increase in the harvest grade along the seven-grade scale reduces death rates by 2.7%. Similarly, for birth rates column (8) reports a coefficient of 0.013, meaning that a step up on the seven-grade harvest scale raises birth rates by 1.3%. This implies that the associated change in the natural rate of population growth equals about 3.9%. In other words, a one-unit improvement on the seven-grade harvest scale leads to roughly a 4% increase in the natural population growth rate. An improvement from 0 to 6 leads to a rise by six-fold that amount, i.e., almost a 24% increase in the natural population growth rate.

Similarly, column (14) in Table 5 tells us that an increase in the harvest in year $t-1$ by one unit raises the marriage rate in year t by 2%. An improvement in the harvest from 0 to 6 thus leads to an increase in the marriage rate by about 12%.

These are percentage changes in growth rates. To assess the size of the absolute change we may look at a regression where the dependent available is not in logs, as in Table 3. (Recall that we do not need to log the dependent variable to make the error terms look Gaussian when we run the regressions at the county level.) Columns (2) and (6) in Table 3 show that a one-step increase in the year-$t-1$ harvest reduces the death rate by 0.055 percentage points and raises the birth rate by 0.041 percentage points; this adds up to 0.096 percentage points, or almost one tenth of a percent. A harvest improvement from 0 to 6 would thus raise the population growth rate by 0.6% per annum.

These numbers capture the effects of changes in the harvest grades on annual rates. Note also that these harvest grades do not incorporate the pedestrian growth in agricultural productivity over this period: any given grade means something different in later years than earlier. It is therefore hard to pin down from this data what the long-run effect would be from a sustained increase of, say, 10% in land productivity. However, it is worth keeping in mind that even very small changes to the annual population growth rate can have big effects on levels over those centuries-long time horizons that unified growth theories usually work with.

5 Weather

One indication that our harvest measures indeed seem to capture what they are supposed to is that they fluctuate with the weather. Table 6 shows the result when regressing the year-t harvest outcome on a number of variables measuring the weather in the spring and summer of the same year.

Columns (1)-(5) show the results from an ordinary least-squares regression and columns (6)-(10) show the results form an ordered logit regression. The ordered logit regressions should be considered if we think that the discrete nature of the dependent variable (the harvest grades) is important.

The spring temperature shows a highly significant positive correlation with harvest outcomes, which is not surprising, because harvest failures were often due to frost in the early phase of the harvest cycle. This is also illustrated in Figure 3, which shows the time series of the country-wide average of harvest grades and spring temperatures 1815-1870.[6]

The OLS coefficient in spring temperature in column (1) implies that an increase by one degree Celsius is associated with about half a step up on the seven-grade harvest scale. The corresponding ordered logit estimate in column (6) suggests bigger effects: a one degree Celsius increase in the average spring temperature leads to an increase in the harvest grade from its average level by approximately 0.87.

Letting the average summer temperature enter does not change the significance of spring temperatures and neither does summer or spring precipitation. However, allowing for a non-linear effect from summer temperature renders the spring temperature effect insignificant; see columns (4) and (9). The coefficients on the temperature variables suggest that both very hot and very cool summers generate bad harvests, with the harvest outcome being maximized around 13.4 degrees Celsius (56 degrees Fahrenheit) of average summer temperature.

That spring temperatures become insignificant when we enter non-linear effects from summer temperatures may have to do with co-variation between the two.[7] That they co-vary is surprising, since they span time intervals next to one another (March to May and June to August, respectively). Thus, when entering both (either linearly or non-linearly) one of them may end up picking up the variation in harvests.

It may also be noted that the raw correlation between spring temperatures and harvests is higher for northern counties.

[6] Due to the idiosyncratic feature of both time series, the covariation over time is easier to distinguish for a limited time interval. We choose 1815-1870 since harvest data is more complete for that period.

[7] For each county the correlation between summer and spring temperature over time is between about 0.27 to 0.30.

6 Conclusions

The task we have undertaken in this paper is to test the Malthusian hypothesis on data from Sweden in the 18th and 19th century. We use a seven-grade scale over harvest outcomes across 24 Swedish counties, published by Hellstenius (1871). This data is meant to proxy for the harvest-seed ratio (*korntal*), i.e. agricultural productivity. (A scanned copy of Hellstenius' table appears at the end of this paper.)

We try several different specifications and merging techniques and the results are overall very supportive of the Malthusian hypothesis. A good harvest raises birth and marriage rates, and lowers death rates.

The timing is right too. A good harvest in a given year raises the birth rate in the following year, but not in the current year, which is exactly what we would expect to see if the rise in births is a response to the harvest, since it takes at least nine months from deciding to have a child to its birth. Indicatively, the negative effects from a good harvest on death rates are visible in the same year as the harvest (as well as the next). This makes perfect Malthusian sense, because a good harvest, arriving around the fall season, can arguably lower deaths both before and after the start of the new year. It was during the winter months that mortality was the highest (see Table A.2).

We also examine if there is a "nonsense" relationship between harvests in future years and demographic outcomes in the current year, but there is no robust such pattern in the data. This also suggests that the pattern that we see is indeed Malthusian, i.e., that harvests cause subsequent changes in the outcome variables.

Our empirical strategy interprets harvest outcomes as exogenous shocks. Obviously, changes in harvest outcomes over time and differences across locations would probably have depended on potentially endogenous (spatial and/or temporal) variation in crop innovations and agricultural technologies, but that should be accounted for by our time and county/parish dummies.

A more serious endogeneity concern could be related to some third factor influencing birth and death rates as well as harvests. One example could be if people who are more productive, healthier, and more fertile move into a parish or county in some year. That could be a plausible explanation if we observed that birth rates and harvests rise in the same year. As it so happens, we do not: birth rates react a year later, suggesting a Malthusian interpretation.

APPENDIX

A Swedish counties

For the period we study Sweden had 24 counties, with codes from 2 to 24, as listed in Table A.1. The capital Stockholm constituted its own administrative unit, with code 1.

Two mergers in 1997 and 1998 reduced the number of counties from 24 to 21. On January 1st, 1997, Kristianstad and Malmöhus län merged became Skåne län. On January 1st, 1998, Göteborgs and Bohus län, Älvsborgs län, and Skaraborgs län, merged into Västra Götalands län (with the exception of two municipalities that went to Jönköpings län).

One county has also changed name: Kopparbergs län is now called Dalarnas län.

The counties existing today also carry letter codes, as indicated in Table A.1. Their locations are indicated on Map 1.

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Table 1: Interpretation of the harvest grades

Grade	Swedish	Free English translation
0	Fullkomlig missväxt	Complete crop failure
1	Nära allmän missväxt eller knapp skörd	Almost general crop failure or scarce harvest
2	Svag eller klen skörd	Weak or frail harvest
3	Under eller nära medelmåttig skörd	Below or close to mediorce harvest
4	Medelmåttig eller fullt medelmåttig skörd	Mediocre or fully mediocre harvest
5	Öfver medelmåttig skörd	Above mediocre harvest
6	God eller ymnig skörd	Good or bountiful harvest

Note: The Swedish text is from Hellstenius (1871, p. 81).

Table 2: Current and lagged harvests across parishes.

	Dependent variable: log death rate in year t				Dependent variable: log birth rate in year t				Dependent variable: log marriage rate in year t			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Harvest t-2			-0.001	-0.002			0.010***	0.010***			-0.002	0.001
			(0.006)	(0.006)			(0.004)	(0.004)			(0.006)	(0.005)
Harvest t-1		-0.023***		-0.017**		0.015***		0.017***		0.022***		0.023***
		(0.007)		(0.007)		(0.004)		(0.004)		(0.006)		(0.006)
Harvest t	-0.019***	-0.016***	-0.020***	-0.018***	0.001	-0.002	0.002	-0.001	-0.001	-0.004	-0.002	-0.004
	(0.005)	(0.005)	(0.006)	(0.006)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Constant	-3.892***	-3.799***	-3.710***	-3.655***	-3.357***	-3.299***	-3.595***	-3.643***	-5.084***	-4.848***	-5.081***	-5.150***
	(0.069)	(0.070)	(0.104)	(0.109)	(0.051)	(0.087)	(0.085)	(0.087)	(0.212)	(0.207)	(0.211)	(0.205)
Number of observations	16947	16251	15921	15574	16961	16264	15944	15596	16349	15664	15340	14996
Adjusted R-squared	0.30	0.30	0.30	0.30	0.27	0.28	0.29	0.29	0.11	0.11	0.11	0.11

Notes: Ordinary least squares estimations. All specifications allow for year and parish dummies (not reported). Standard errors are reported in parenthesis and adjusted for clustering on county-years. *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 3: Current and lagged harvests across counties.

	Dep. variable: death rate in year t (%)				Dep. variable: birth rate in year t (%)				Dep. variable: marriage rate in year t (%)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Harvest t-2			0.008	0.005			0.014	0.015			-0.005	-0.002
			(0.012)	(0.011)			(0.013)	(0.013)			(0.006)	(0.005)
Harvest t-1		-0.055***		-0.042**		0.041***		0.046***		0.017***		0.018***
		(0.017)		(0.018)		(0.012)		(0.013)		(0.005)		(0.005)
Harvest t	-0.032***	-0.022*	-0.029**	-0.024*	-0.001	-0.009	-0.001	-0.009	0.001	0.000	-0.000	-0.001
	(0.012)	(0.012)	(0.013)	(0.012)	(0.010)	(0.010)	(0.010)	(0.011)	(0.004)	(0.004)	(0.004)	(0.004)
Log population	-0.057	-0.022	-0.064	-0.062	0.182**	0.231***	0.198**	0.232***	-0.044	-0.040	-0.033	-0.027
	(0.113)	(0.114)	(0.111)	(0.111)	(0.075)	(0.078)	(0.085)	(0.083)	(0.035)	(0.037)	(0.041)	(0.040)
Constant	2.853***	2.932***	2.786***	2.691***	2.025***	1.713***	1.842***	1.648***	1.105***	1.298***	1.060***	1.113***
	(0.761)	(0.798)	(0.744)	(0.805)	(0.505)	(0.513)	(0.588)	(0.545)	(0.232)	(0.239)	(0.275)	(0.261)
Number of observations	281	264	261	252	281	264	261	252	281	264	261	252

Notes: Ordinary least squares estimations. All specifications allow for year and parish dummies (not reported). Standard errors are reported in parenthesis and adjusted for clustering on county-years. *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 4: Current and lagged harvests across parishes, including quadratic terms.

	Dependent variable: log death rate in year t				Dependent variable: log birth rate in year t				Dependent variable: log marriage rate in year t			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Harvest t-2			0.029	0.046**			0.033**	0.023*			0.058***	0.047**
			(0.020)	(0.020)			(0.013)	(0.012)			(0.021)	(0.019)
Harvest t-2, squared			-0.004	-0.006**			-0.003*	-0.002			-0.007***	-0.005**
			(0.003)	(0.003)			(0.002)	(0.001)			(0.003)	(0.002)
Implied maximum or minumim (a)			3.6	3.7			5.7	6.8			4.2	4.6
Harvest t-1		-0.047**		-0.041*		0.034***		0.034***		0.053***		0.053***
		(0.022)		(0.024)		(0.013)		(0.012)		(0.017)		(0.017)
Harvest t-1, squared		0.003		0.003		-0.003		-0.002		-0.004*		-0.004*
		(0.003)		(0.003)		(0.002)		(0.002)		(0.002)		(0.002)
Implied maximum or minumim (a)		7.8		7.0		6.3		6.8		6.2		6.4
Harvest t	-0.035**	-0.018	-0.029**	-0.018	-0.005	-0.013*	-0.007	-0.013	-0.001	-0.015	-0.001	-0.013
	(0.014)	(0.014)	(0.015)	(0.014)	(0.008)	(0.007)	(0.008)	(0.008)	(0.012)	(0.012)	(0.012)	(0.012)
Harvest t, squared	0.003	0.000	0.002	0.000	0.001	0.001	0.001	0.001	-0.001	0.001	-0.001	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Implied maximum or minumim (a)	6.7	17.8	9.1	45.5	2.5	4.9	3.5	6.5	NA	7.5	NA	16.3
Log population	-0.072*	-0.055	-0.089**	-0.079*	-0.008	0.019	0.027	0.030	-0.307***	-0.329***	-0.289***	-0.326***
	(0.041)	(0.043)	(0.044)	(0.045)	(0.031)	(0.034)	(0.033)	(0.035)	(0.044)	(0.045)	(0.049)	(0.049)
Constant	-3.322***	-3.331***	-3.252***	-3.250***	-3.463***	-3.734***	-3.799***	-3.882***	-2.777***	-2.736***	-3.013***	-2.863***
	(0.291)	(0.310)	(0.321)	(0.323)	(0.226)	(0.242)	(0.247)	(0.257)	(0.316)	(0.327)	(0.359)	(0.357)
Number of observations	21288	20018	19689	19342	21323	20048	19729	19381	20467	19239	18916	18572

Notes: Ordinary least squares estimations. All specifications allow for year and parish dummies (not reported). Standard errors are reported in parenthesis and adjusted for clustering on county-years. *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

(a) The implied maximum or minimum refers the the harvest grade at which the effect peaks or troughs. If the value exceeds 6, then the effect is monotomic. NA means there is no maximum or minimum.

Table 5: Current, lagged, and future harvests across parishes, continued on next page

	Dependent variable: log death rate in year t						Dependent variable: log birth rate in year t					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Harvest t-2	0.000					-0.000	0.009***					0.011***
	(0.005)					(0.006)	(0.004)					(0.004)
Harvest t-1		-0.027***				-0.019**		0.013***				0.016***
		(0.007)				(0.007)		(0.004)				(0.004)
Harvest t			-0.018***			-0.018***			-0.002			-0.004
			(0.005)			(0.005)			(0.003)			(0.003)
Harvest t+1				0.009*		0.005				-0.005*		-0.003
				(0.006)		(0.006)				(0.003)		(0.003)
Harvest t+2					0.005	0.011*					-0.001	-0.000
					(0.006)	(0.007)					(0.003)	(0.004)
Log population	-0.084*	-0.067	-0.075*	-0.054	-0.063	-0.065	0.033	0.029	-0.009	-0.009	-0.020	0.032
	(0.044)	(0.042)	(0.041)	(0.040)	(0.039)	(0.047)	(0.033)	(0.033)	(0.031)	(0.031)	(0.031)	(0.037)
Constant	-3.328***	-3.336***	-3.319***	-3.572***	-3.496***	-3.387***	-3.807***	-3.790***	-3.462***	-3.447***	-3.384***	-3.847***
	(0.317)	(0.297)	(0.292)	(0.284)	(0.284)	(0.340)	(0.241)	(0.239)	(0.226)	(0.222)	(0.225)	(0.275)
Number of observations	19939	20373	21288	21881	21971	18806	19978	20403	21323	21914	22001	18838

Notes: Ordinary least squares estimations. All specifications allow for year and parish dummies (not reported). Standard errors are reported in parenthesis and adjusted for clustering on county-years. *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level.

Table 5 continued

	Dependent variable: log marriage rate in year t					
	(13)	(14)	(15)	(16)	(17)	(18)
Harvest t-2	0.005					0.008
	(0.006)					(0.006)
Harvest t-1		0.020***				0.024***
		(0.006)				(0.006)
Harvest t			-0.008*			-0.009**
			(0.004)			(0.004)
Harvest t+1				-0.012**		-0.006
				(0.005)		(0.005)
Harvest t+2					-0.003	-0.002
					(0.005)	(0.005)
Log population	-0.283***	-0.316***	-0.306***	-0.318***	-0.297***	-0.314***
	(0.048)	(0.044)	(0.044)	(0.042)	(0.042)	(0.050)
Constant	-2.989***	-2.814***	-2.778***	-2.673***	-2.854***	-2.811***
	(0.347)	(0.319)	(0.316)	(0.305)	(0.305)	(0.364)
Number of observations	19160	19593	20467	21072	21167	18046

Table 6: Weather and harvests.

	Dependent variable: harvest in year t									
	Ordinary least squares					Ordered logits				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Spring temp.	0.518***	0.598***	0.615***	0.253	0.322*	0.869***	1.016***	1.031***	0.388	0.545*
	(0.158)	(0.165)	(0.167)	(0.166)	(0.175)	(0.214)	(0.233)	(0.239)	(0.282)	(0.299)
Spring temp., squared				-0.013**	-0.015**				-0.022**	-0.026**
				(0.006)	(0.006)				(0.011)	(0.011)
Summer temp.		-0.257	-0.262	3.490***	3.440***		-0.463*	-0.443	6.134***	6.120***
		(0.167)	(0.169)	(0.359)	(0.358)		(0.267)	(0.271)	(0.666)	(0.660)
Summer temp., squared				-0.131***	-0.131***				-0.225***	-0.226***
				(0.011)	(0.011)				(0.020)	(0.020)
Spring precipitation			-0.015		-0.201**			-0.013		-0.371**
			(0.027)		(0.091)			(0.041)		(0.149)
Spring precipitation, squared					0.007*					0.012**
					(0.004)					(0.006)
Summer precipitation			0.004		-0.015			0.018		-0.050
			(0.019)		(0.054)			(0.028)		(0.088)
Summer precipitation, squared					0.000					0.001
					(0.001)					(0.002)
Constant	1.977**	5.656**	4.707*	-18.366***	-17.637***					
	(0.864)	(2.566)	(2.683)	(3.143)	(3.424)					
Number of observations	1564	1564	1564	1564	1564	1564	1564	1564	1564	1564
Adjusted R-squared	0.29	0.29	0.29	0.40	0.40					

Notes: Ordinary least squares and ordered logit estimations. All specifications allow for year and county dummies (not reported). Standard errors are reported in parentheses and adjusted for clustering on county-years. *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level. These significance levels refer to a *t* -test for the OLS regressions and a *z* -test for the logit regressions. Weather data is available only for 21 counties left after a 1997-98 merger, whereas harvest data is available for all 24 pre-merger counties. Here we assign the harvest of each pre-merger county carrying the same code as the after-merger county (see Table A.1).

Table A.1: Swedish counties

Before 1997-98 mergers		After 1997-98 mergers		
Name	**Numerical code**	**Name**	**Numerical code**	**Letter code**
Stockholms län	2	Stockholms län	2	AB
Uppsala län	3	Uppsala län	3	C
Södermanlands län	4	Södermanlands län	4	D
Östergötlands län	5	Östergötlands län	5	E
Jönköpings län	6	Jönköpings län	6	F
Kronobergs län	7	Kronobergs län	7	G
Kalmar län	8	Kalmar län	8	H
Gotlands län	9	Gotlands län	9	I
Blekinge län	10	Blekinge län	10	K
Kristianstads län	11	Skåne län	12	M
Malmöhus län	12			
Hallands län	13	Hallands län	13	N
Göteborgs och Bohus län	14	Västra Götalands län	14	O
Älvsborgs län	15			
Skaraborgs län	16			
Värmlands län	17	Värmlands län	17	S
Örebro län	18	Örebro län	18	T
Västmanlands län	19	Västmanlands län	19	U
Kopparbergs län	20	Dalarnas län	20	W
Gävleborgs län	21	Gävleborgs län	21	X
Västernorrlands län	22	Västernorrlands län	22	Y
Jämtlands län	23	Jämtlands län	23	Z
Västerbottens län	24	Västerbottens län	24	AC
Norrbottens län	25	Norrbottens län	25	BD

Note: The spelling of some of the county names have changed since the Hellstenius' harvest data were published in 1871. In particular, names spelled with the letter "ä" today were often spelled with an "e" in the 19th century. Map 1 shows the location of the modern-day counties by letter

Table A.2: Monthly patterns during the years 1891-1900.

Month	Death rate	Birth rate	Marriage rate
January	19.99	28.53	2.14
February	19.41	28.16	3.32
March	18.75	28.76	4.46
April	18.78	27.64	6.50
May	17.70	26.41	5.67
June	15.61	26.32	6.35
July	13.95	25.85	3.85
August	10.03	25.61	3.25
September	12.86	29.40	4.16
October	13.72	26.17	9.48
November	15.33	25.66	9.74
December	17.40	27.33	12.23

Notes: Rates are per 1,000 people and refer to the whole of Sweden. The source is BISOS (1904, pp. xv and xxii).

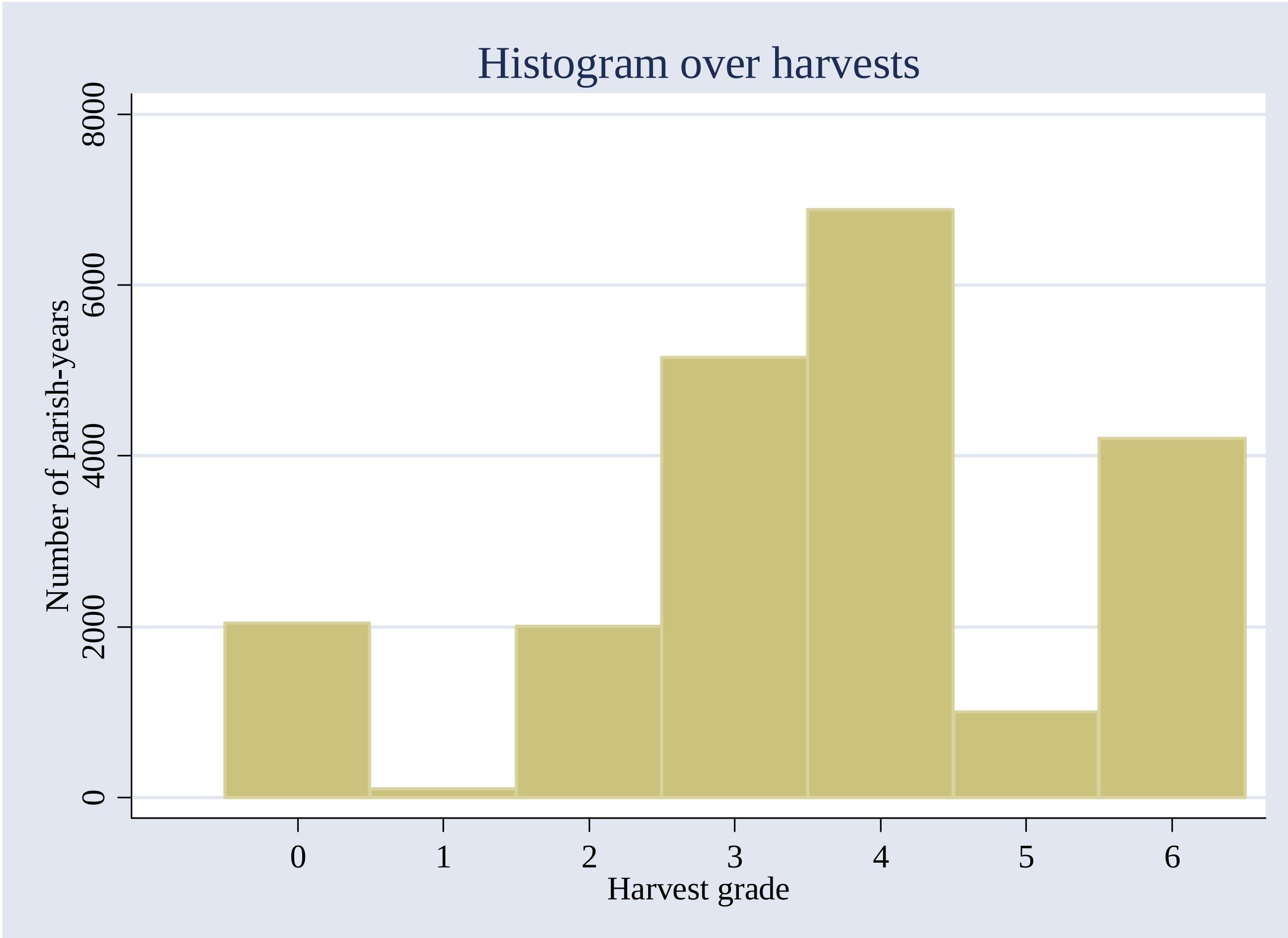


Figure 1. Histogram over harvest grades.

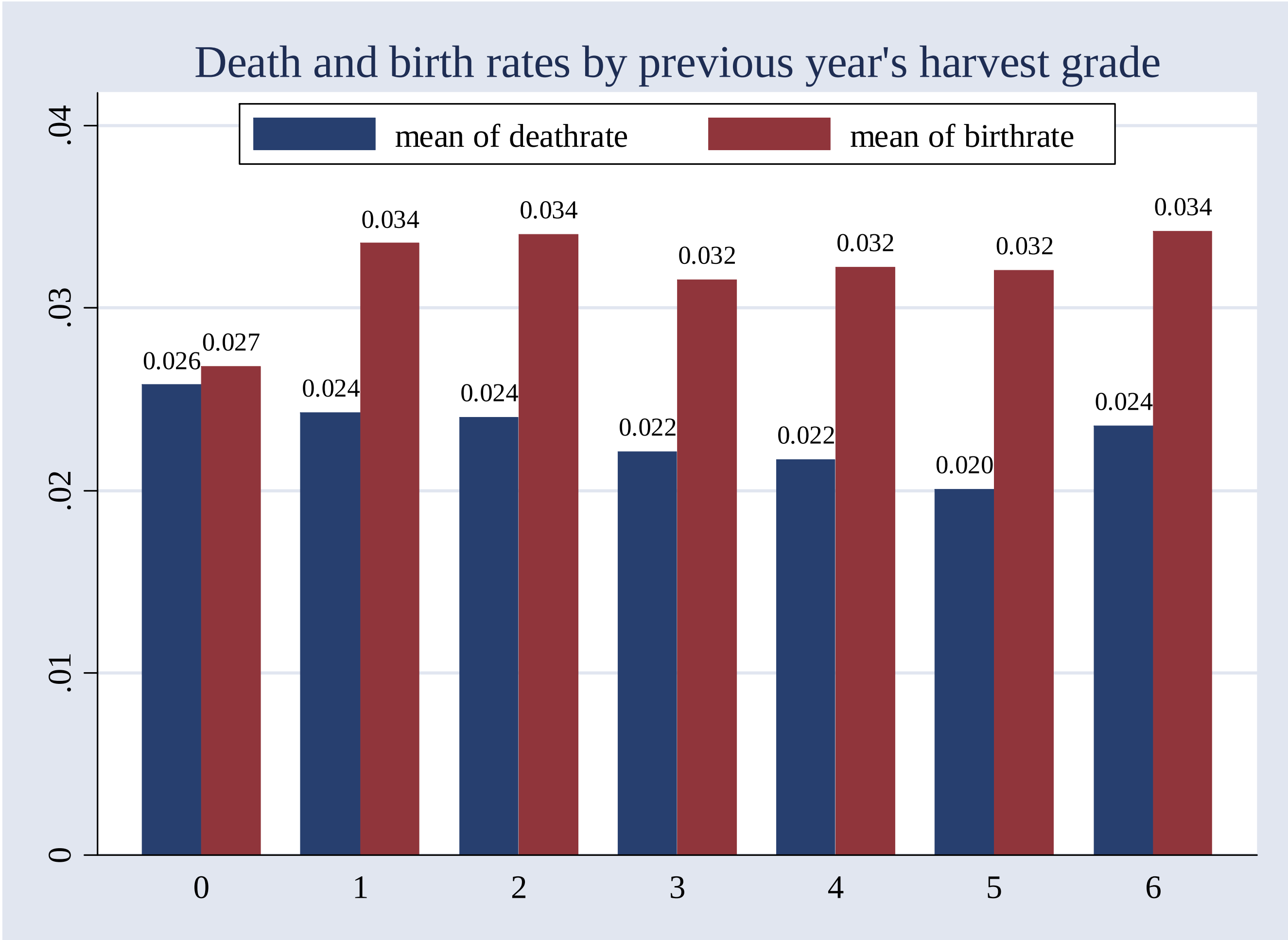


Figure 2. Mean of birth and death rates by harvest grades in the previous year.

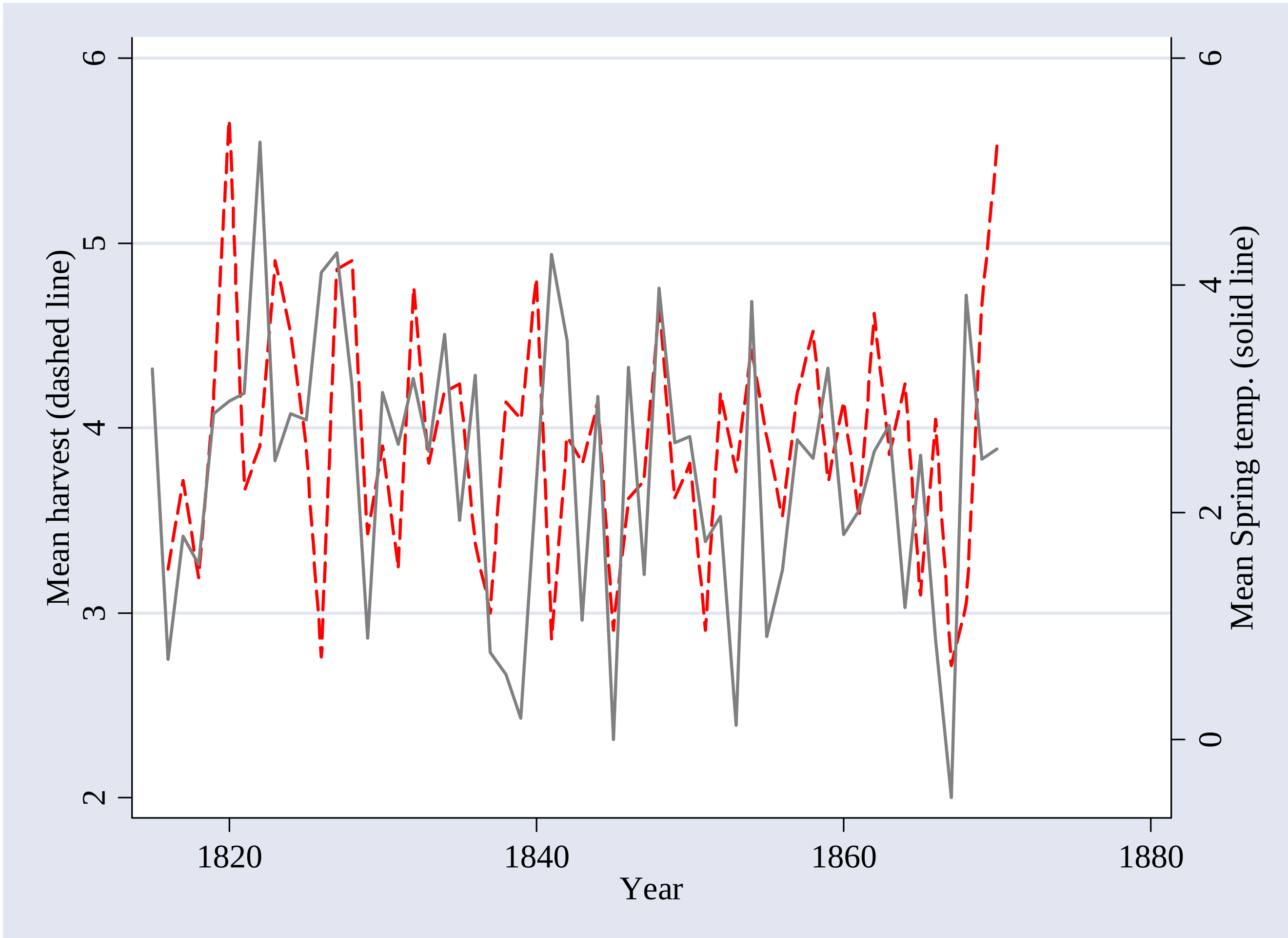
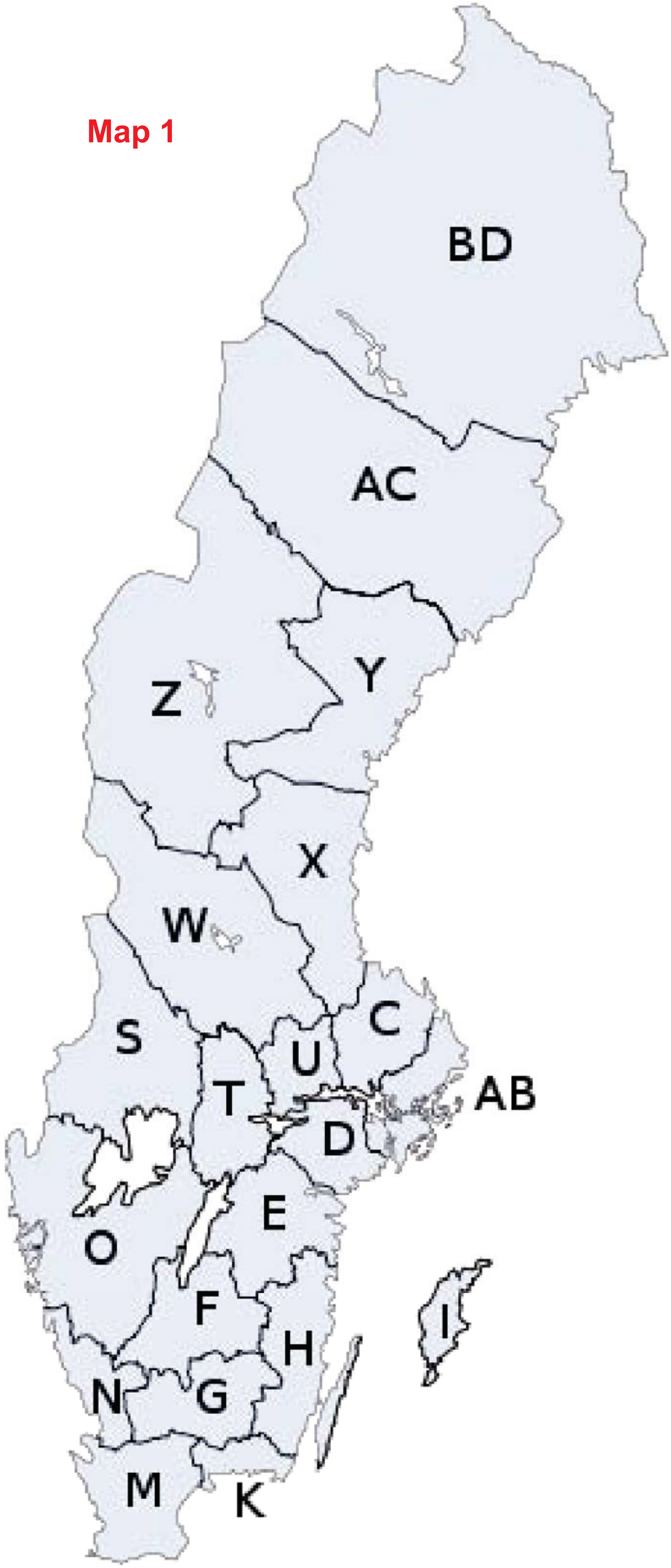


Figure 3. Timelines of country-wide averages of spring temperature and harvest grades 1815-1870. The correlation coefficient is approximately 0.25.

Map 1



Tab. N:o 4. Skörden, länsvis, 1749—1870.

(Siffrorna enligt skörde-skalan, pag. 81; af typografiska skäl äro de romerska siffrorna utbytta mot andra.)

	1749.	1750.	1751.	1752.	1753.	1754.	1755.	1756.	1757.	1758.	1759.	1760.	1761.	1762.	1763.	1764.	1765.	1766.	1767.	1768.	1769.	1770.	1771.	1772.	1773.
Stockholms län																									
Uppsala d:o													3		4	3									
Södermanlands d:o																									
Östergötlands d:o								o		6				3	I	2							2		
Jönköpings d:o																									
Kronobergs d:o			6																						
Kalmar d:o															3										
Gotlands d:o																									
Blekinge d:o																									
Kristianstads d:o																									
Malmöhus d:o									o			6													
Hallands d:o																									
Göteborgs och Bohus d:o										6		2											o		
Elfsborgs d:o														o											
Skaraborgs d:o																									
Vermlands d:o			6	3				5																	
Örebro d:o				6				I																	
Vestmanlands d:o																									
Kopparbergs d:o																									
Gefleborgs d:o																3									
Vesternorrlands d:o	6																								
Jemtlands d:o	6																								
Vesterbottens d:o	6																								
Norrbottens d:o	6																								

	1774.	1775.	1776.	1777.	1778.	1779.	1780.	1781.	1782.	1783.	1784.	1785.	1786.	1787.	1788.	1789.	1790.	1791.	1792.	1793.	1794.	1795.	1796.	1797.	1798.	1799.	1800.	1801.	1802.	1803.	1804.	1805.	1806.	1807.	1808.	1809.
Stockholms län			4	5	4	4	2	o	4	I	4								2	4	6	6	4	4	2	2										
Uppsala d:o		2	4	5	4	4	2	o	4	I	4	2								4	6	6	4	4	2	2										
Södermanlands d:o		o	6	5	4	6	2	o	4	I	3	3		5				6	3	4	6	6	5	4	2	2										
Östergötlands d:o		2	6	5	4				4	o	6	2	2				6		3	4	4	6	6	4	2	2										
Jönköpings d:o		6	6	4	4				4	o			2						4	4	4	6	6	4	2	2										
Kronobergs d:o		6	6	4	4					o									4	4	2	6	5	4	2	2										
Kalmar d:o	6	2	6	5	4	4		2	4	2	6	2	2	6		4	6	6	2	5	2	4	6	4	2	2										
Gotlands d:o	6	o	2	6	6	3	2	2	4	o	5	3	3	6	5	4	6	6	4	6	6	6	6	6	2	2										
Blekinge d:o																			2	4	2	6	6	4	2	2										
Kristianstads d:o																			4	5	2	6	6	5	4	2										
Malmöhus d:o																			4	6	4	6	6	6	4	4										
Hallands d:o		3	4	4	2		4			o		3	4	6	2	4	5	4	4	6	2	4	6	4	2	2										
Göteborgs och Bohus d:o		3	4	4	6		4			2		2	4	6	2	4	4	5	5	4	2	6	4	3	2	2										
Elfsborgs d:o	6	4	4	4	4			o	3	2	6	3	3	6	o			4	4	4	2	6	6	4	2	2										
Skaraborgs d:o	6	4	4	4	4			o	4	2	6	3	3	6				4	4	4	2	6	6	3	2	2										
Vermlands d:o		4	3	4	6	5	6	o	o	4	6	I	2	6	3	5	6	4	5	4	2	6	6	3	2	2										
Örebro d:o		3	4	4	4	6	2	2		2	3	3	4	6				4	4	4	6	5	6	4	2	5										
Vestmanlands d:o	4	3	5	4	4	4	2	2	4	I	3	3	4	6		2		4	4	4	6	6	6	6	2	5										
Kopparbergs d:o	4	6	6	6	3	6	2	2	6	o	o	3	6	6		6		4	5	4	6	4	4	6	4	2										
Gefleborgs d:o	6		6			6			2	I		2	6		6	6		6	6	2	6	5	5	6	5	2										
Vesternorrlands d:o	6		6		6	6	4	4	2	6	2	4	6		6	6		6	6	6	6	6	6	4	6	4										
Jemtlands d:o	6		6			6	4	4	2	6	2	4	6		6	6		6	6	6	6	6	6	4	6	4										
Vesterbottens d:o	6		6		6	6	2	4	2	2	2	4	6		6	6		6	6	5	6	2	6	2	6	6										
Norrbottens d:o	6		6		6	6	2	4	2	2	2	4	6		6	6		6	6	5	6	2	6	2	6	6										

	1810.	1811.	1812.	1813.	1814.	1815.	1816.	1817.	1818.	1819.	1820.	1821.	1822.	1823.	1824.	1825.	1826.	1827.	1828.	1829.	1830.	1831.	1832.	1833.	1834.
Stockholms län							4	6	o	3	6	4	3	6	4	4	4	4	6	4	4	6	6	4	4
Uppsala d:o							6	3	o	4	6	6	3	6	6	4	3	6	3	4	6	6	6	4	6
Södermanlands d:o							4	3	o	3	6	5	4	4	4	4	3	6	5	3	4	4	6	5	3
Östergötlands d:o							6	6	6	4	6	4	4	4	4	4	2	6	5	4	4	4	6	6	3
Jönköpings d:o							4	4	3	3	6	4	4	6	4	4	o	6	6	4	6	4	6	4	3
Kronobergs d:o							o	4	4	3	6	4	4	6	4	4	o	4	4	4	3	4	6	4	3
Kalmar d:o							4	6	6	6	6	4	3	4	5	4	2	3	4	3	6	4	5	4	3
Gotlands d:o							4	6	6	4	6	6	4	6	3	6	4	3	3	3	5	5	6	5	3
Blekinge d:o							6	6	4	6	6	4	3	6	4	4	3	4	6	3	3	2	4	4	3
Kristianstads d:o							6	6	6	4	6	5	4	6	5	5	2	6	6	6	3	2	5	5	3
Malmöhus d:o							6	6	6	4	6	6	4	6	5	4	3	6	5	4	4	4	6	6	5
Hallands d:o							o	3	3	4	6	5	2	6	6	3	o	6	4	4	3	o	6	5	3
Göteborgs och Bohus d:o							6	4	3	6	4	5	4	6	4	4	4	5	6	4	4	5	6	4	3
Elfsborgs d:o							o	4	3	4	6	4	3	5	4	3	3	6	4	o	3	2	5	4	3
Skaraborgs d:o							o	o	3	4	6	4	4	6	4	4	6	6	3	4	2	4	6	3	3
Vermlands d:o							o	o	3	3	5	3	3	4	3	3	o	6	5	4	3	4	6	4	3
Örebro d:o							6	6	4	6	6	6	3	4	4	3	3	6	6	4	3	5	6	5	4
Vestmanlands d:o							4	3	o	3	6	4	3	6	6	3	3	6	5	4	6	5	6	4	4
Kopparbergs d:o							o	o	3	4	6	4	4	4	6	3	4	5	5	4	3	2	4	3	5
Gefleborgs d:o							o	o	3	4	6	3	3	5	6	4	3	5	6	3	3	2	4	3	6
Vesternorrlands d:o							4	4	3	6	6	o	6	5	6	4	4	4	5	4	4	2	5	3	6
Jemtlands d:o							o	o	4	4	4	o	6	3	3	4	4	4	4	3	2	o	o	3	6
Vesterbottens d:o							o	4	3	4	6	o	6	3	4	4	3	3	4	2	3	o	o	o	6
Norrbottens d:o							4	4	3	4	4	o	6	3	4	5	6	4	6	o	3	o	o	o	6

	1835.	1836.	1837.	1838.	1839.	1840.	1841.	1842.	1843.	1844.	1845.	1846.	1847.	1848.	1849.	1850.	1851.	1852.
Stockholms län	5	4	4	4	4	5	2	4	4	3	o	4	5	4	5	4	3	4
Uppsala d:o	6	4	4	4	4	5	2	4	3	2	o	4	6	5	3	4	3	4
Södermanlands d:o	6	4	4	3	4	5	2	4	4	3	3	4	5	5	4	3	3	4
Östergötlands d:o	6	6	4	4	5	4	2	4	3	4	3	4	6	6	6	3	4	4
Jönköpings d:o	6	3	2	4	4	6	3	3	3	5	4	3	3	5	4	4	3	5
Kronobergs d:o	5	4	3	5	4	4	3	4	3	4	3	3	3	5	4	4	3	3
Kalmar d:o	5	3	4	4	4	6	2	4	3	5	3	3	3	5	4	3	4	3
Gotlands d:o	4	4	3	4	5	5	3	3	3	5	o	o	5	5	4	4	5	4
Blekinge d:o	4	4	3	4	4	4	o	4	4	4	3	3	3	4	4	4	3	4
Kristianstads d:o	4	4	3	6	5	4	o	4	4	4	4	4	3	5	5	4	3	4
Malmöhus d:o	5	4	3	5	6	5	3	3	6	5	4	4	5	6	5	5	4	5
Hallands d:o	4	3	2	5	4	5	3	3	3	5	4	3	5	5	6	4	2	5
Göteborgs och Bohus d:o	6	4	2	5	4	4	2	3	4	5	4	3	5	5	4	4	3	4
Elfsborgs d:o	5	3	2	4	4	4	3	3	4	5	4	3	5	5	4	4	3	4
Skaraborgs d:o	5	4	3	4	4	5	3	4	3	5	3	3	3	5	3	3	3	5
Vermlands d:o	4	4	2	4	3	5	3	4	3	6	3	3	2	6	3	3	3	4
Örebro d:o	5	4	4	4	4	5	3	4	4	3	4	4	5	5	4	4	3	4
Vestmanlands d:o	4	4	4	4	3	5	3	4	4	3	o	4	5	6	3	3	3	4
Kopparbergs d:o	4	3	2	4	4	5	3	4	4	3	3	4	2	4	3	3	3	5
Gefleborgs d:o	3	3	2	4	3	5	3	4	4	3	3	4	2	4	3	4	3	4
Vesternorrlands d:o	4	3	3	6	4	5	3	6	4	5	5	4	2	4	4	4	3	5
Jemtlands d:o	3	3	3	3	4	5	6	6	6	4	4	4	2	3	o	5	3	5
Vesterbottens d:o	o	o	3	3	4	4	4	4	4	4	4	5	2	3	o	4	o	4
Norrbottens d:o	o	o	2	4	4	4	5	4	4	6	4	6	2	3	3	4	o	4

	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.	1868.	1869.	1870.
Stockholms län	3	3	4	3	5	4	4	6	3	6	4	4	4	3	3	3	6	6
Uppsala d:o	3	5	4	3	5	5	4	4	3	4	3	5	4	4	4	3	4	5
Södermanlands d:o	3	3	4	6	5	4	3	4	3	6	3	5	3	5	3	5	5	6
Östergötlands d:o	4	5	4	3	4	6	4	4	3	4	4	6	3	5	4	3	6	6
Jönköpings d:o	3	4	4	4	3	5	3	4	3	4	3	4	3	4	3	I	6	5
Kronobergs d:o	3	4	4	6	4	5	3	4	4	5	4	5	3	5	3	o	5	5
Kalmar d:o	3	6	4	4	4	4	4	4	3	4	3	6	3	4	3	3	6	6
Gotlands d:o	3	6	4	6	4	3	3	6	3	6	6	4	3	4	3	3	6	6
Blekinge d:o	3	5	4	5	2	3	2	4	4	4	4	5	4	4	3	3	6	5
Kristianstads d:o	3	6	4	5	4	4	4	4	4	4	4	4	3	4	4	3	5	4
Malmöhus d:o	3	6	4	6	4	4	6	5	5	5	5	6	3	3	4	3	6	4
Hallands d:o	2	4	3	6	3	4	3	3	3	4	4	5	3	4	3	3	6	5
Göteborgs och Bohus d:o	3	5	5	4	4	5	3	3	3	5	4	5	3	5	4	3	6	5
Elfsborgs d:o	o	4	4	3	3	5	3	6	3	5	4	4	3	5	4	I	6	6
Skaraborgs d:o	3	4	5	3	3	6	3	4	3	5	5	4	3	4	3	3	5	5
Vermlands d:o	4	4	4	4	4	5	3	3	3	6	3	3	4	3	2	3	3	6
Örebro d:o	4	4	4	4	4	6	6	4	3	5	4	5	4	4	3	3	6	6
Vestmanlands d:o	3	3	4	3	5	5	4	3	3	5	3	4	4	4	3	3	5	5
Kopparbergs d:o	4	3	4	I	4	4	5	3	4	5	3	4	4	4	3	3	3	5
Gefleborgs d:o	4	3	4	2	5	4	4	3	4	6	4	3	4	4	3	3	3	6
Vesternorrlands d:o	6	6	4	3	5	6	4	5	4	4	4	3	3	4	I	4	3	6
Jemtlands d:o	6	6	4	I	5	5	4	4	4	3	4	3	o	5	I	5	I	6
Vesterbottens d:o	6	4	4	o	5	4	2	6	4	3	3	I	o	4	o	4	3	6
Norrbottens d:o	6	4	3	o	4	4	4	5	5	3	6	3	3	3	I	3	3	6