Estimating agricultural production in Scania, 1702–1881

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Abstract

The Historical Database of Scanian Agriculture (HDSA) is a micro-level database over farm production in the most southern Swedish region of Scania (Skåne) based on flexible tithes. It contains over 85,000 farm level observations of both vegetable and animal production for the period 1702 to 1881. Moreover, this information is supplemented by information on the farmer, the farm, on enclosures, natural conditions, and distances from the farmstead to towns. The database is an open source and this paper provides information on the sources behind the data, the composition of the sample, and the way the database can be used to estimate production. The second part of the paper performs an overall analysis of the agricultural revolution in the area, showing the development over time of the vegetable and animal production, their respective significance, and an estimation of production per capita 1702 to 1865.

Keywords: agriculture, production, database, micro level, Sweden, 18th century, 19th century
JEL classifications: N53, Q12, Y10

Introduction

In the pre-industrial society, agriculture constituted the sector where most people made a living. A rising productivity in agriculture allowed for increasing income within this sector but at the same time it made possible resources also for other sectors. The transformation of agriculture from a relatively low-productive sector to one with higher productivity is therefore of interest when discussing the development of the modern society and the initiation of modern economic growth.

For a long time, lack of sources in Sweden, as in many other European countries, hampered research in the field of quantitative analyses of preindustrial agricultural production. In the Swedish case, for the medieval period almost no sources are available, but for the early modern period there is a somewhat larger supply. Earlier estimations of agricultural production in Sweden have focused on the nineteenth century, although some regional or local studies go as far back as the mid-eighteenth century. A long, coherent, and detailed series over the development in agricultural production on micro level has been one obstacle to assessing and explaining the agricultural revolution in Sweden.

In this paper the Historical Database of Scanian Agriculture is presented. It is a longitudinal micro level database of farm production output in the southernmost part of Sweden, Scania, in the eighteenth and nineteenth centuries. The database is created from detailed tithe registers on farm level, where tithes moved in relation to production. It encompasses both vegetable and animal production and is supplemented by information on the farmers, the farms' property rights, on timing of enclosures of villages and with some geographical information on soil quality and distance to towns. In all, over 2,500 farms are followed and the data covers the period 1702 to 1881. The database enables studies of the agricultural revolution; not only of its pace and development but also in terms of explanation for these patterns, and this publication is part of making the database open for public use.

The paper starts with a section on the concept of agricultural productivity and the different ways this has been approached in previous studies. In the second section the tithe as a measurement of agricultural output is evaluated. Here also the priests' tithe rolls in Scania are presented and the characteristics of the sample and its distribution over time and space are displayed.[1]

In the third section all variables in the database are listed with some explanations. This is followed by a detailed account on how to move from tithes to production, both for vegetables

[1] These two sections are built on Olsson and Svensson 2009, 2011a and 2011b.

and animals. In this part, we also present empirical results on the development of production in Scania during the eighteenth and nineteenth centuries. The final section explains how to access the database and what restrictions that applies.

Measuring agricultural productivity

Agricultural production and its distribution are the basic and single most important historical factors for the well-being of mankind. Insufficient output has led to starvation, while rich harvests have brought about plenty and prosperity. Continual increases in agricultural output have transformed whole societies and continents, with radical changes in people's lives and economic success. Simultaneously, the absence of prolonged agricultural growth in other parts of the world has contributed to their economic stagnation and backwardness. These realities have made much research in agrarian history focus on agricultural growth and its causes.

The sources for estimating production outcomes in preindustrial societies are scarce. Statistics on the agricultural sector in most countries were either non-existent or of dubious quality before the end of the nineteenth century. Consequently, researchers dealing with preindustrial farming have been forced to put a lot of effort into reconstructing reliable data on inputs and outputs. Two main ways of estimating production in pre-industrial European agriculture have been proposed (see Overton, 1996:74). One is to work with aggregates, using information on rents, prices, wages and population (e.g. McCloskey 1975; Hoffman 1996; Allen 2000). The logic of this approach is founded on the simple assumption that each citizen needs food, and that production, at least in the long run, must correspond to consumption. Moreover, increased farm productivity implies lower costs, which will be reflected either in higher profits, leading to rising rents, at least in a well-functioning lease economy, or in changes in prices or wages. One potential obstacle to this approach is that product and factor shares of revenue and costs must be specified, but this can be solved by using farm accounts or other sources containing this information (see Hoffman 1996: chapter 4).

The other approach is to work from bottom up, using farm accounts, probate inventories, tithes or other sources as the main sources for estimating crop yields, crop mixes, total area and the size of the area cultivated or the agricultural output. This approach, aggregating local micro series and often combining them with macro series on land, gives rise to specific problems; different sources exists for different periods of time, and, of course, the question of how representative the local sources are for national estimates (see Overton and Campbell 1996; Broadberry et al 2015). Both these approaches are highlighted by the discussion on preindustrial

agricultural productivity in England and France, but are valid also for most other European countries.

Moreover, depending on the objective of the study and types of sources available, researchers use different measures to describe agricultural development. A first and direct measure is agricultural output. In this tradition, different concepts such as gross production, net production and value-added are intermixed. In the reconstruction of national accounts this has been an important target. Top-down approaches are most often used in this branch of research. Starting from the first "reliable" year of official statistics, backward series are constructed, typically using population statistics and assumptions about average consumption baskets, balanced with estimates of exports and imports, and sometimes further balanced with changes in relative prices (e.g. Schön and Krantz 2015; Federico 2011). Furthermore, individual farm outputs are used on micro level to estimate crude gross production, which then can be aggregated into production series for districts, regions or even countries, and used for further estimations of productivity development. Examples of this approach are works emanating from this database, where tithes at farm level are used to construct gross production for one Swedish region (e.g. Olsson and Svensson 2010, 2016).

Table 1. Measures of historical agricultural productivity

A	*Land and livestock productivity*	
	1.	Crop yield per unit sown
	2.	Crop yield per unit arable
	3.	Livestock output per animal per year
	4.	Total agricultural output (arable and pastoral) per unit area of farmland
B	*Labour productivity*	
	1.	Output per worker employed in agriculture
	2.	Output per worker per unit of time
C	*Capital productivity*	
	1.	Value of output per unit of capital
D	*Total factor productivity*	
	1.	Ratio of total output to a weighted combination of inputs

Sources: Campbell and Overton 1991, p. 11.
Note: The table has been somewhat simplified from Campbell and Overton's original, in that no distinction has been made between individual and aggregate crop yields.

The concept of agricultural productivity implies production output divided by production input. The most important input factors in agriculture are land, labour and capital. Table 1 shows some alternative measures of productivity that have been used in historical literature, here only slightly modified from a presentation by Bruce M. S. Campbell and Mark Overton in 1991. In modern industrialised agriculture, capital is regarded as the single most important factor, and the productive impact of each possible branch of investment (engineering, seeds, fertilisers, pesticides, livestock) is a branch of science in its own right.

In early economic historical literature an often used productivity denominator was yield ratios per unit sown, which is harvest divided by seed, point A1 in table 1. They are expressed in figures like 4:1 and 7:1, and can be estimated quite easy from sources like manorial accounts and other farm accounts across Europe (Slicher van Bath, 1963). As a pure indicator of harvest per seed it can be used as a denominator of variations in agricultural output, especially for short-term fluctuations, but even for comparison between regions and countries (van Zanden, 1999). The problem with isolated yield ratio figures is that they do not tell us how much was sown, or the intensity of land use. A striking practical example is the introduction of a type of early autumn rye in parts of northern Europe in the eighteenth century, which could double yield ratios (typically from 4–7:1 to 9–15:1), but was sown about half as densely in the fields.[2] Without knowledge of the latter, researchers can be led to believe that this implied a major productive breakthrough in agriculture.

The concept of land productivity in modern agricultural statistics is therefore most often measured as yield per arable land or per sown acreage of a certain crop (e.g. tonnes per hectare). As long as land use is not altered this is a consistent measure over time, but if e.g. new crop rotation systems are introduced, the amount of fallow, ley and root crops must be considered. For example, moving from a three-course-system to a classical Norfolk four-course rotation system implies that the fraction of arable land used for grains is reduced from two thirds to half. Consequently, a rise in wheat yields per sown acreage does not necessarily mean a rise in wheat output per total acreage or per farm. Furthermore, change in land use goes beyond changes in crop rotations.

In the classical Ricardian view land reclamation meant diminishing returns, since all the best land was supposedly already used and less pastures meant less fertilizers. Two historical

[2] The famous botanist Carl von Linné mentioned the use of *Larsmässo*-rye in his Scanian Journey 1749. It was sown already around the Lars-day (Sankt Laurentius, Lawrence) August 10. Linné wrote that it was a labour intensive crop; it was first and foremost used on the manorial demesnes and demanded lots of fertilizers and almost "…garden-like cultivation efforts" (Linnaei, 1749: 277–78).

innovations would dramatically change these prerequisites. The first was the abolition of the natural meadow and the introduction of fodder crops in the field rotation system. Besides a considerable increase in the output of grain, roots and grass, it meant that new lands could be cultivated without causing a manure shortage. Its implementation was a long drawn-out process that started in Medieval Northern Italy and Flanders, developed and flourished in the Early Modern Netherlands and England, and was principally introduced in the rest of Europe's central agricultural districts in the eighteenth and early nineteenth centuries (Slicher van Bath, 1963: 178, 239; Grigg, 1980: 153, 147). The second innovation was the introduction of energy from outside the farms, first in the form of fertilizers and finally in form of mechanical power. The former enhanced land productivity substantially, even on poor soils, and, by breaking the natural bond between plants and manure, made farming without animals possible. The latter raised labour productivity to, until then, unimaginable levels, made draught animals superfluous, and eventually reduced employment in agriculture to a small fraction of the population.

This leads us over to the concept of labour productivity. Going back to David Ricardo's law of diminishing returns, marginal productivity in pre-industrial agriculture should be falling, inasmuch as the supply of land is limited and capital investments insignificant. Many studies on historical productivity are founded on this theory, and increased land productivity and labour productivity have been regarded as almost incompatible. This is, however, a debated view. A vast number of studies have dealt with the British agricultural development before and during the industrial revolution. Using different kinds of data and methodologies, most researchers have agreed upon a long-run increase in agricultural productivity. However, when it comes to date specific periods of swift growth, results have been more inconclusive. While some researchers have argued that for example English agriculture did not succeed in enhancing output per acreage without sacrificing labour productivity before the middle of the eighteenth century (Campbell and Overton 1993), others claim that both started to grow, simultaneously, long before that (Kerridge 1967; Wrigley 1985; Allen 2000). Beckett and Turner (2011) find that it was when population increased during the nineteenth century that the real breakthrough in productivity occurred. The most recent estimates (Broadberry et al 2015: 128–29 and 412) show an increasing productivity in both land and labour from the mid-sixteenth century but with a marked increase from the eighteenth century. In any event, with historical data the concept of labour productivity in reality often is rather crude; it is in many cases agricultural output divided by agricultural population or by the agricultural workforce (B1 in table 1).

Some researchers argue that using either labour productivity or land productivity could result in incomplete or, at worst, erroneous conclusions on the agricultural development (e.g. Overton 1996:84; Federico, 2011). This has led to the concept of total factor productivity (TFP) being established in agrarian history (D1 in table 1). TFP, according to Robert Solow (Solow 1957), is the difference between the rates of growth of output and input. It requires information on quantities and the shares of different inputs, which is hard to find for historical agriculture. Most studies of agriculture using TFP have dealt with the period after 1870, or even after 1945, but a few have also estimated earlier periods. This is true for English agricultural development (e.g. McCloskey 1975; Allen 1982) and for Ireland (Ó Gráda 1991). However, a well-cited contribution in this area of research deals with France (Hoffman 1996). Hoffman's approach illustrates one way to circumvent the lack of data on quantities in historical sources by using prices instead. It is fair to say that his work has inspired subsequent TFP-calculations for other European countries.

Tithes and agricultural output

The tithe was formally introduced in the Christian church from the eight century, originally based on the Old Testament (Genesis 14:20 and Deuteronomy 14:22), and in Sweden from the twelfth century. It should consist of ten per cent of each farmer's production output. The tithe was an important part of the tax system in most of Europe in the Middle Ages and well into Early Modern time. The 1960s and 1970s saw some research on tithes, especially in France (Le Roy Ladurie and Goy 1982), and during recent years in Spain (Santiago-Caballero 2014) and Sweden (Leijonhufvud 2001; Olsson 2005; Berg 2007; Olsson and Svensson 2010; Bohman 2010).

A first condition for using tithes as indicators of agricultural output is that they actually varied with the output, that they were flexible and not fixed. The Swedish archives maintain rich such sources – for different parts of the country and for different periods of time. In Sweden outside Scania the tithes to the crown were typically flexible until the early or mid-eighteenth century, and have recently been collected into a database in an ambitious project (Hallgren, et al 2016).

After Scania's conquest from Denmark in 1658, it became the main agrarian surplus-producing area in Sweden. As in the rest of Sweden, grain tithes in Scania were paid to the Crown and the church. Two thirds of the grain tithes were set to a fixed amount per farmstead in 1683 and stayed unaltered until the abolition of tithes in 1904. The last third was paid to the

local clergy and in many parishes in Scania, unlike the rest of Sweden, it remained a tax proportional to production, in some cases until the early 1860s. In 1861 it was stated that all tithes should be paid as a fixed amount of grain. As for the animal tithes, all of this went to the local clergy. This means that the farmer should pay one thirtieth of all crop production and every tenth living born animal to the clergyman.

The reliability of the series is strengthened by the fact that the receivers of the payments, the local clergy, were part of the rural community. The clergyman had a farm of his own, often one of the largest farms, in one of the parish villages. In this sense, he had access to good information on the local harvest both by assessing his own production but also by taking a few steps out of his courtyard and observing his neighbours', the tithe-payers', production. The tithe was his personal income and was not to be reported to anyone else. This means that the tithe rolls were registered for his own purposes to administer the collection of his income.[3] There was no incentive to hide or exaggerate any figures. The reliability of the series can also be tested by their degree of co-variance (see below).

Preserved tithe rolls exist for a large number of parishes in Scania. From these we have excluded those where the period of information is shorter than 15 years. We have also excluded all parishes, and periods within parishes, where we suspect that tithes do not vary in relation to production, e.g. where tithes are fixed over consecutive years or when they go from yearly variations into almost fixed amounts in consecutive years. The reason for fixed tithes was either that the clergyman and his tithe-payers settled the tithes to fixed amounts, or that the priest in some way for a shorter period of time gave up controlling the variations in harvests.[4] This leaves us with data from 37 different parishes scattered all over Scania (see Figure 1). These parishes are situated in all different forms of geographical conditions existing in Scania and also display differences in property rights. Together they cover the period 1702 to 1881 and the total number of tithe-paying units is around 2 500, generating a total of more than 85 000 farm tithe

[3] One clergyman in the parish of Västra Karaby wrote on the opening page of his tithe rolls:
"Tithe book for Västra Karaby Parish, created in 1810, in which Wheat is recorded where it is grown, Rye, Barley, Oats, peas, flax, saints' tax, foals, calves, lambs, geese, pigs, chickens, Easter food consisting of bread, poultry and eggs, firewood and manure labour, and cheese milk. The columns for the grain are only consisting of what is paid and where nothing is noted, is yet unpaid. In the columns for the animal tithes applicable, yearly breeding are registered and when the tenth is paid, the previous notes are crossed out. In the remaining columns the number that shall be paid are noted and crossed out, for example chickens 2, firewood corvée 1; but where blank it is unpaid. This tithe book I will keep and register so that I by my sanctity in front of God will be responsible. Västra Karaby November 12, 1810. P. Hansson Pastor Loci."

[4] This latter could happen for example when the clergyman got sick or old, as is evident from combining information on tithes with the biographies on the clergymen (Carlquist, 1954–1962).

payments. No parish is present during the whole of the period, but different parishes exist for different time periods.

Figure 1. Scania and the 37 parishes in the sample

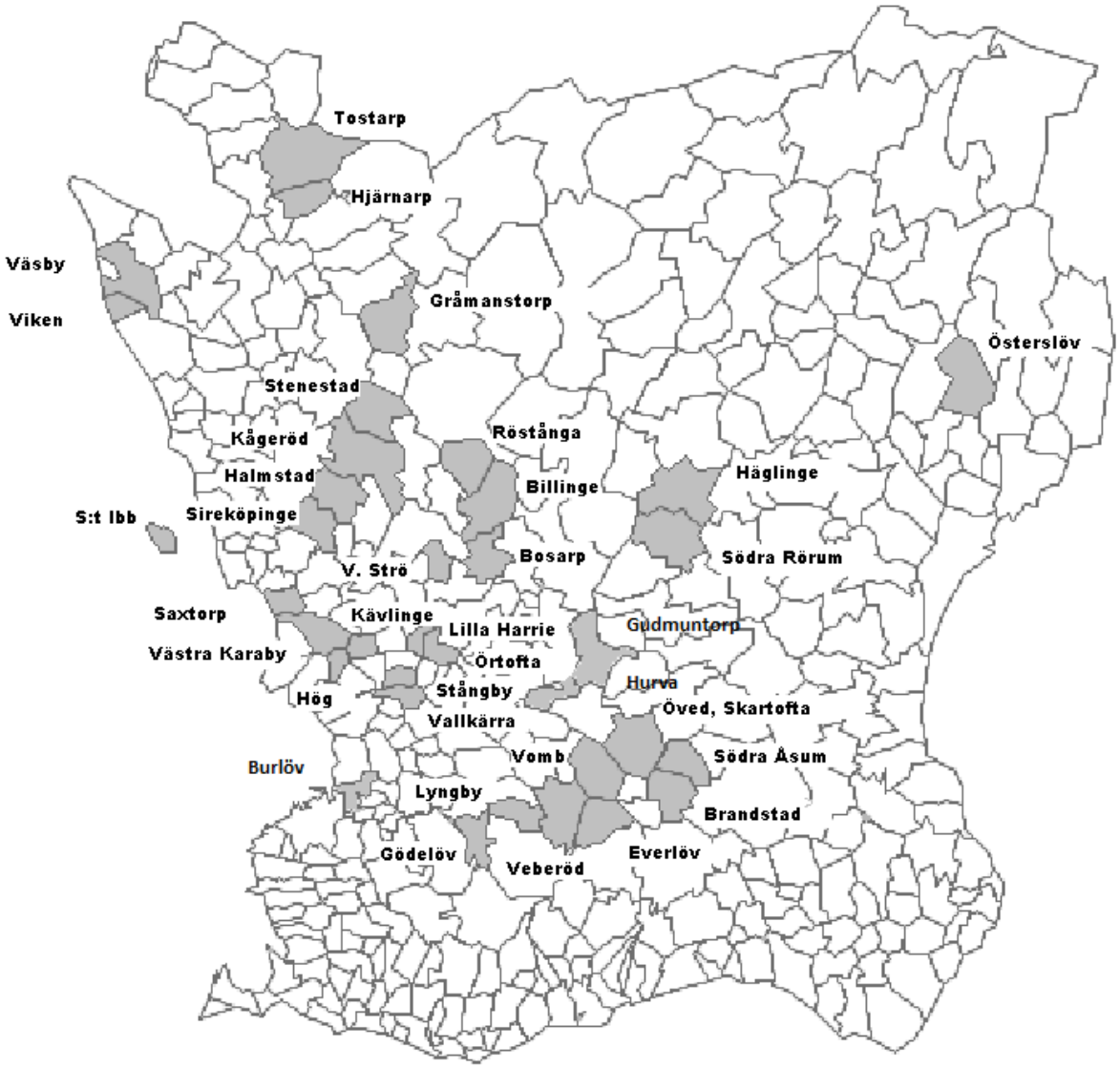


Table 2. The 37 parishes, parish codes and start/stop years for grain tithes.

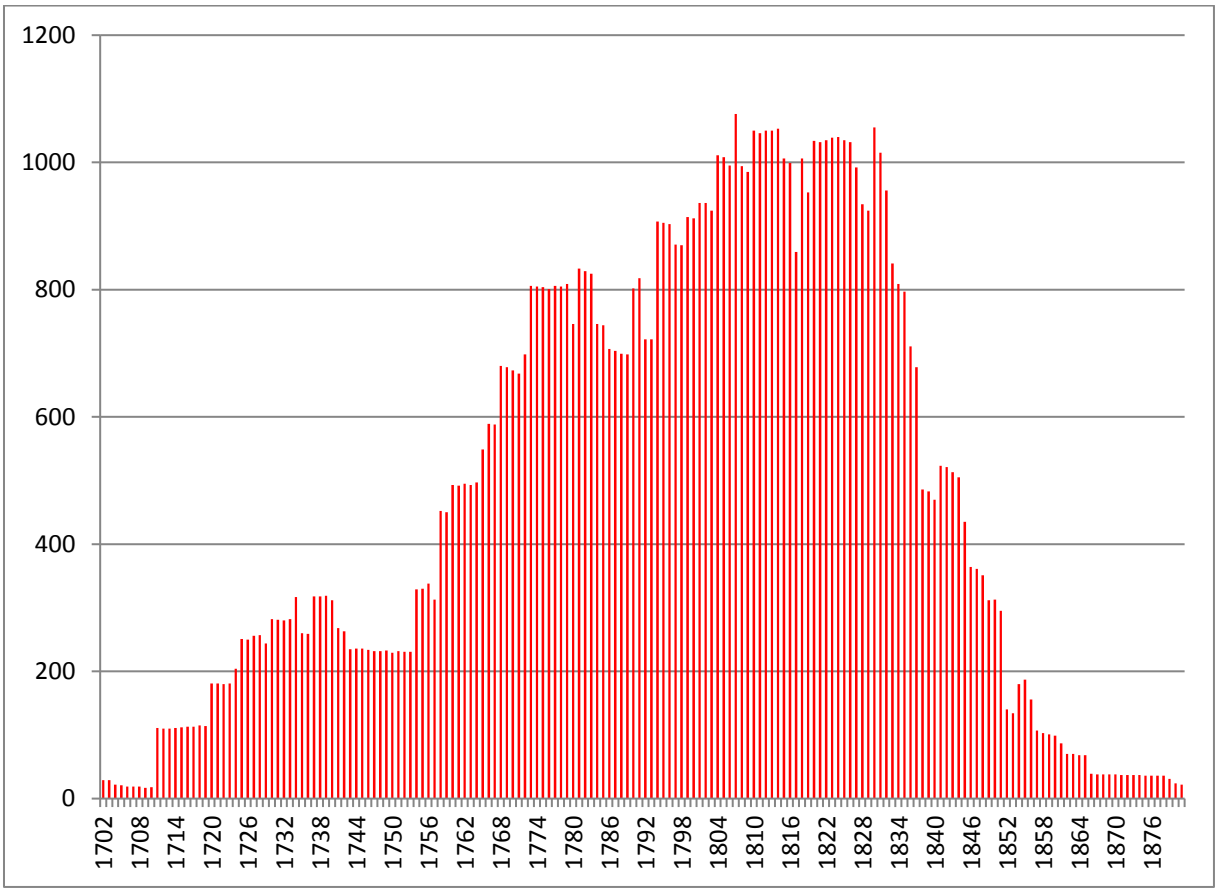
Parish	Parish code	Start prem.	Stop	Start	Stop	Start	Stop final
Billinge	11	1720	1739			1754	1860
Röstånga	12	1720	1739			1754	1860
Brandstad	13	1711	1745			1790	1819
Södra Åsum	14	1711	1745			1790	1845
Halmstad	15	1804					1827
Sireköpinge	16	1804					1827
Hög	17	1734	1796			1799	1803[5]
Kävlinge	18	1734	1796			1799	1803[6]
Kågeröd	19	1794					1837
Stenestad	20	1794					1837
Sankt Ibb	21	1772					1833
Vomb	22	1768	1791	1807	1830	1855	1857
Veberöd	23	1768	1791	1807	1831	1854	1856
Örtofta	24	1760					1850
Lilla Harrie	25	1760					1826
Hjärnarp	26	1758					1832
Tostarp	27	1758					1832
Västra Karaby	28	1791					1845
Saxtorp	29	1810					1845
Skartofta	30	1724	1734			1773	1783
Öved	31	1730	1734			1773	1783
Bosarp	32	1781					1848
Västra Strö	33	1781					1840
Lyngby	34	1737					1779
Gödelöv	35	1737					1779
Södra Rörum	36	1702	1719			1725	1768
Häglinge	37	1702	1719			1727	1750
Väsby	38	1831					1856
Gråmanstorp	39	1833					1851
Everlöv	40	1765	1847			1850	1864[7]
Stångby	41	1766	1785			1794	1802
Vallkärra	42	1766	1785			1794	1802
Viken	43	1831					1851
Österslöv	44	1740					1807
Burlöv	45	1773					1814
Hurva	46	1820	1862			1864	1865
Gudmuntorp	47	1820	1862			1864	1865

The magnitude of the information in our sample is huge, also in an international perspective, covering some 1,000 farms each and every year during the first three decades of the nineteenth

[5] Animal tithes continue to 1820.
[6] Animal tithes continue to 1820.
[7] Animal tithes continue to 1881.

century (see figure 2). Even in periods with a smaller number of farms, the sample is large in this perspective. The weakest part of the sample is the first decade, with only two parishes represented and an average of 21 observations per year. The results for these first nine years are thus less certain. But already in the next decade, from 1711, there are on average 112 annual observations. By the end of the period with grain tithes, 1850–1865, there are on average 136 observations per year.

Figure 2. Number of observations (farms) in the sample by year



Note: 1865–1881 is only animal tithes for one single parish.

It has been argued that a major problem using tithes is that they do not reflect the entire production (Hoffman 1996, pp. 83–84). New crops and production from newly reclaimed land could have been exempted or paid to another tithe-holder. For Scania, in principle all production was included in the tithe payment, including that from reclaimed land. The crop tithe was collected un-threshed, in stooks and sheaves (*travar* and *neker*) of grain, varying with the local production patterns. For most farms the staple crops – rye, barley and oats – were collected, but for some farms wheat, buckwheat, and peas or beans were included as well. The only exception

was potatoes that until around 1800 mainly were cultivated in the farmsteads' small garden (Utterström 1943; Lägnert 1955). When the authorities first noticed that potatoes more generally was grown in the arable fields, a royal decree was sent out, stating that it was exempted from the tithe for the clergy in Scania.[8] Consequently, we must estimate the potatoes from other sources, more on that below.

A possible objection against tithes is that they often do not reflect changes in land use from arable to pastures. However, since animal breeding also was included in the tithes, this is not a problem. The calves, foals, piglets, lambs and goslings born each year were registered with indications when the clergyman took his share, i.e. every tenth born animal of each species. This means that any conversion of production from vegetable to animal or vice versa should be reflected in the tithes.

The variables

The database is organized as a panel dataset, with one farm's characteristics and production output for one year on one row. Each farm has a unique identifier, "individnr", and this is created each time a farm appears in the dataset for the first time or when a farm is split into two new farms. Besides the output in terms of vegetable and animal production, the database consists of information on the farm's specificities, on the cultivator, as well as some variables on village and parish level (see table 3).

Table 3. The variables in the database.

Variable name	**Content and coding**
year	Production year for the tithe payment
socken	Parish name (text)
parish	Unique parish code, 01–99 (see separate code file on the website)
by	Village name (text)
village	Unique village code, 01–99 (see separate code file on the website)
Farm	Contemporary identification number in the village, 01–99 (*hemmansnummer*)
farmpart	If farm undivided 1000, otherwise 1100, 1200, 1300, or after further partition 1110, 1120, 1210, 1220…
individnr	10-digit unique identifier: parish (2 digits) + village (2 digit) + farm (2 digits)+ farmpart (4 digits)
mantal	Farm size as taxation value. *Mantal* was the major assessment for taxation in southern and central Sweden until 1900. It was supposed to correspond to the amount of land needed to support a peasant family (for Scania, in 1688). All farms in Sweden were taxed by this measurement, except for small crofts and cottages. The *mantal* was rigid; the farm kept its *mantal*,

[8] The argument was that the local clergy already had benefited well from rising productivity and was not in need for income from potatoes as well. (Royal decree, 12 Oct. 1808, *Handbok innehållande* ... p. 543).

	no matter the production development. If a farm was divided, its *mantal* was divided between the parties, but the total sum of *mantal* in Sweden and in Scania was almost unaltered between 1688 and 1900. On the fertile plains a farm taxed one-third of a *mantal* could consist of 20 hectares, while in the forests an equally taxed farm could be 100 hectares in size. In the middle of the eighteenth century the average farmstead in our sample was taxed 0.37 *mantal*; by 1850, due to farm division, the average had reduced to 0.28. **Note**: To use this variable, please see variable "mantalkorr" below.
hotype	1. Farm with *mantal* (see above)
	2. Croft or cottage that pays tithes
	3. Mill with *mantal*
retirement	0. Farm with no retirement sub-farm
	1. Retirement sub-farm
	2. Farm with retirement sub-farm
	NB: The farm and the retirement sub-farm have the same Individnr
landtype	Type of property right in contemporary fiscal terms
	1. Owned by the crown (*krono*)
	2. Owned by the peasant farmer (*skatte*)
	3. Manorial, located outside the manor's parish (*utsockne frälse*)
	4. Manorial, located in the manor's parish (*insockne frälse*)
	5. Manorial of origin but sold to the peasant farmer (*friköpt frälse*)
	6. Manorial demesne (*säteri*)
taxorg	To whom the farm payed tax, only valid for landtype 1 and 2
	1. Allotted to the cavalry (*rusthåll*), by providing for a man-at-arm, horse and equipment, normally joint with two-three other farms
	2. Tax paid as support to cavalry allotment (*augmentshemman*)
	3. Paid the tax in the form of working days to an officer (*arbetshemman*)
	4. Farm inhabited by a civil or military servant (*boställe*)
	5. Paid tax to the local priest (*predikostols-, annex-* or *mensalhemman*)
	6. Paid tax to the cathedral or other church institution (domkyrkohemman, etc)
	7. Paid tax to the academy, school or hospital (*akademi-, skol-* or *hospitalshemman*)
	8. Paid tax to the cavalry officers wage or horses (*kavalleriets löne-, fördels-* or *hästhemman*)
	9. Paid tax directly to the crown, or for other purposes (*kronan behållne, övriga*)
organisation	Type of management
	1. Cultivated by a peasant farmer; owner or tenant
	2. Cultivated by a tenant; the owner is a peasant farmer
	3. Manorial demesne (*säteri* or *plattgård*)
	4. Cultivated by servants; the owner is not present
	5. Cultivated by persons of rank
cultivator	The name of the cultivator (text)
birthyear	The year of birth of the cultivator
cultivchange	0. Year with no change of cultivator
	1. Year with a change of cultivator (only the year the change takes place)
widow	0. The cultivator is not a widow
	1. The cultivator is a widow
areal	Village area in square meters

n1 – n10	Natural condition in 10 columns (n1, n2 ...) Share of the land by soil quality (where 10 is the best) in accordance with modern soil quality analysis (following Göransson 1972 and Bohman 2010).
storskifte	Early enclosure movement. Redistribution of arable strips in the village without abandoning the open field system
	0. Not redistributed
	1. Redistributed
	2. Redistributed more than once
enskifte	Radical enclosures, abandoning the open field system and privatizing the commons
	0. The farm was solitary from the start
	1. Open field system
	2. Enclosed (*enskifte* or *laga skifte*), indicated from the year of enclosure and onwards
enclmove	When a village was enclosed, some peasants had to move out to their enclosed land, while others could stay in the village
	0. Did not move
	1. Moved
rye	In stooks (*travar*)
winterrye	In stooks (*travar*)
springrye	In stooks (*travar*)
summerrye	In stooks (*travar*)
barley	In stooks (*travar*)
mixedgrain	In stooks (*travar*)
oats	In stooks (*travar*)
wheat	In stooks (*travar*)
buckwheat	In stooks (*travar*)
buckwhgroats	*Skeppor** (0.425 liters)
beans	In stooks (*travar*)
peas	In stooks (*travar*), in parish 24 in *lass*
flax	*Skålpund** (0.425 kilos)
hemp	*Skålpund** (0.425 kilos)
potatoes	Barrels (165 liters)
turnips	Barrels* (165 liters)
foals	Number of breeds every year
calves	Number of breeds every year
lamb	Number of breeds every year
geese	Number of breeds every year
kid	Number of breeds every year
pigs	Number of breeds every year
porksides	Number produced
note1 and 2	Additional text
Mantalkorr	Corrected *mantal* for parishes 13, 24 and 30, otherwise identical to "mantal"
Bygd	Agricultural regions based on Campbell (1928). Some adjustments have been made in accordance with Bohman 2010, p. 54–60.
	1. Plains
	2. Intermediate
	3. Forest
PRICES:	Annual prices for 1702-32 from Bengtsson & Dribe (1997) and from 1732 onwards from Jörberg (1972)
Calvesprice	Price of cows, annual (for Halland's county)
Foalsrela	Set to 1.5

lambrela	The relative price of sheep to cows (for Halland's county)
geeserela	The relative price of geese to cows (for Halland's county)
pigrela	The relative price of pigs to cows (for Halland's county)
relaprye	The price of rye relative to the average price of rye and barley.
relapbarley	The price of barley relative to the average price of rye and barley.
relapoats	The price of oats relative to the average price of rye and barley.
relapwheat	The price of wheat relative to the average price of rye and barley.
relappeas	The price of peas relative to the average price of rye and barley.
relapbuck	The price of buckwheat relative to the average price of rye and barley.
relapbeans	The price of peas [sic!] relative to the average price of rye and barley.
potmultipl	A multiplier reflecting the share of total production on parish level constituting of potatoes
Karlshamn_distance	Distance from village center to Karlshamn town, in kilometers (values>0 only for parish 44)
Helsingborg_distance	Distance from village center to Helsingborg town, in kilometers (0 for parishes 44–47 due to no information)
Landskrona_distance	Distance from village center to Landskrona town, in kilometers (0 for parishes 44–47 due to no information)
Malmö_distance	Distance from village center to Malmö town, in kilometers (0 for parish 44 due to no information)
Ystad_distance	Distance from village center to Ystad town, in kilometers (0 for parishes 44–47 due to no information)

* = The units are not specified in the sources, this is a reasonable assumption.

Using the HDSA

The conversion from stooks to hectolitres

The parish priest collected the tithe directly from the field (e.g. Branting, 1825; Sandstedt 1986: 17 and 24; examples from the tithe registers themselves in HDSA), before threshing, in the units of stooks (*travar*) and sheaves (*nek*). In the dataset, the unit is stook (decimal), the sheaves has been converted to stooks in the relation 20 to 1, except for the forest parishes, were the relation was 24 to 1.[9]

Since a stook is neither a weight nor an exact volume measure, we must elaborate on it. For this purpose we have collected threshing registers, and other indicators of the conversion from harvested volume to threshed volume, from manorial archives, church archives and probate inventories. As can be seen in table 4, there were huge differences between the plains and forests for many crops. While 0.70 hectolitres barley was threshed from a stook in the plains, only 0.33 were threshed in the forest. This finding is corroborated by earlier findings on differences in stook size and output for different parts of Scania (Weibull, 1952: 34). Conclusively, we have diversified the threshing values by agricultural region – for plains, intermediate and forest – in accordance with their median values in table 4.

[9] Weibull 1952 noted this difference, which we have confirmed when working with the archival sources.

Table 4. Threshing values in south Sweden 1664–1827, hectolitres per stook

	Wheat	Rye	Barley	Oats	Mixed grain	Peas & beans	Vetch
Median	0.41	0.55	0.64	0.83	0.30	0.50	0.86
Mean	0.44	0.54	0.65	0.83	0.29	0.70	1.09
No of observations	88	321	299	279	27	40	46
Variation coefficient	6%	9%	7%	7%	2%	23%	33%
Median, Plains	0.52	0.58	0.70	0.86	0.39	0.71	1.16
Intermediate	0.38	0.41	0.58	0.87	0.39	0.71	0.73
Forests	0.30	0.38	0.33	0.37	0.30	0.25	0.73

Sources: Manorial archives see Olsson 2002: 359–363; Church archives of the 37 parishes in the database; probate inventories, see Bergenfeldt, Olsson & Svensson 2013.

As we have seen, the priest tithes consisted of one thirtieth of each farmer's total output. So by multiplying by thirty we have created farm level production series, crop by crop, in hectolitres.

Creating vegetable production series on farm level

The weight and value of the threshed crops differed as well, which is reflected in the prices. In order to calculate the total grain production, we multiply each crop's output with its relative price as compared to the average price of rye and barley for each year. We then sum up all grains for each farm each year into total grain production.[10]

Since potatoes were not part of the tithes we add them using supplementary sources on parish level. From the year 1802, the yearly censuses on mortality made by the Tabular Commission contained information on seed and yields for all crops, including potatoes, by parish. We calculate the share of potatoes in the total harvest for each parish and add it to the individual farm's production by this share. Since some parishes had a small potato production already in 1802, we set the first possible year for potato production to 1790 and extrapolate backwards a linear trend from 1802 to 1790. The notes on agricultural production in the Tabular Commission end in 1821 and the next record of parish vegetable production is to be found in the official statistics for 1866 (BiSOS, Jordbruk). So, from 1821 to 1866 we assume a linear development of the share of potatoes in total vegetable production and add that share to each farm's production. By adding the potatoes we have created a complete series of vegetable production on farm level.

[10] For two parishes, Hög and Kävlinge, the tithe series have no information on oats. Since we know from other sources, and from the tithe registers of all surrounding parishes, that oats were grown also in these parishes we add the same share as in those surrounding parishes to the total grain production for Hög and Kävlinge.

Creating a series over the development of vegetable production for all parishes

Using the tithes, the threshing accounts, weighting each crop by its relative price, and adding potatoes we have thus calculated the total amount of vegetables in rye/barley equivalents produced on each farm in hectolitres. This is sufficient to display the total production on these farms. However, to create a joint series of the development of vegetable production over time we need to establish the average level of production for each year.

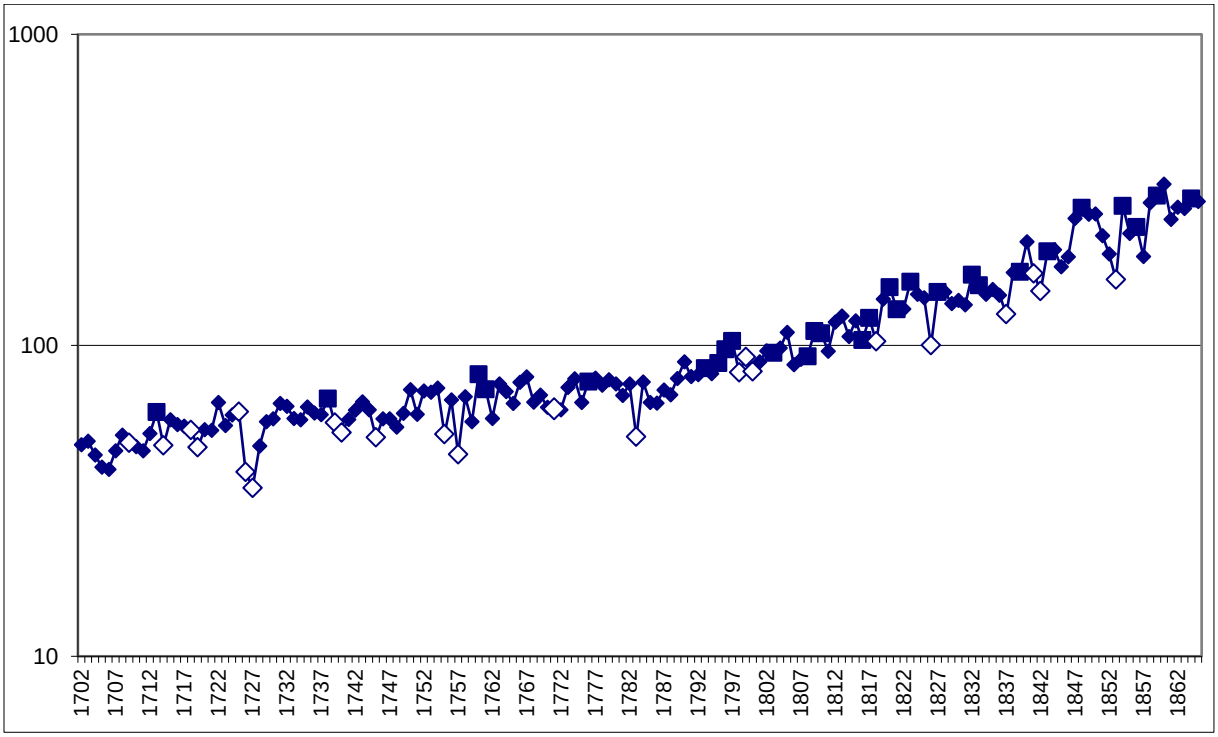
The first thing to do is to adjust for farm size by dividing the production with the *mantalkorr* variable (for explanation, see above in table 3) for each farm. Then the average production for each parish is calculated for each year which creates 37 parish series of production. Since not all parishes are present in the database during all years the parish series are linked by a chain method; when a parish appears for the first time its average production level in the first five years is compared to the existing series level, and adjusted accordingly. The absolute level of the series is finally adjusted by the actual averages in production for the years 1799–1809.

The fact that parishes and farms are moving in and out of the sample calls for a check on consistency over time to exclude compositional effects. This is accomplished by using the two most decisive factors for production level (besides farm size, which is already corrected for): natural conditions and property rights. This check reveals that the sample is highly consistent in both these respects, but with less consistency for the period 1702–1729 and in the 1860s (sees Olsson and Svensson 2016, p. 59–60 for more on this).

This exercise results in a long-term series over vegetable production in Scania 1702 to 1865 (figure 3 and all Scanian figure in Appendix II) which reveals that our calculated bad harvest years, as well as the good years, correspond well with contemporary qualitative sources, harvest reviews (*skördeomdömen*). These sources are perfectly independent of each other, and the comparison gives a good quality proof of the fluctuation in the aggregated series. Moreover, it rehabilitates the contemporary qualitative harvest reviews, which often has been questioned.

Another indicator of the quality of the series is their co-variation. After hard trend eliminations, through first differences, the average correlation coefficient between the 37 parish series remains 0.55. This is probably as high as it can get, given the variations in weather, soil conditions, and farming practices (for more discussion on the quality of the series, see Olsson and Svensson, 2009, 2010, 2011 and 2016).

Figure 3. Production estimates 1702–1865, hectolitres per farm (logarithm scaling). Bad and good harvests from qualitative sources marked.



Sources: Productions estimates: Olsson and Svensson (2017). Qualitative sources on good (■) and bad (◊) harvests: Weibull 1923; Sommarin 1917, appendix 1; Hellstenius 1871.
■ = 1713, 1738, 1760, 1761, 1776, 1793, 1795, 1796, 1797, 1803, 1808, 1809, 1810, 1816, 1817, 1820, 1821, 1823, 1827, 1832, 1833, 1839, 1843, 1848, 1854, 1856, 1859, 1864.
◊ = 1707, 1714, 1718, 1719, 1725, 1726, 1727, 1739, 1740, 1745, 1755, 1757, 1771, 1783, 1798, 1799, 1800, 1818, 1826, 1837, 1841, 1842, 1853.
Note: For non-logarithm scaling, see the first figure in Appendix II.

Animals

From its Danish past Scania inherited developed market opportunities for oxen exports to continental Europe. But the oxen export was, according to Danish laws, an exclusive privilege of the nobility. The burghers were only allowed to sell oxen bred by others then themselves. This monopoly was renewed in a royal Swedish ordinance 1694 and was not revoked until 1809 (H:son Wachtmeister 1886, p. 190–193). The cattle plagues, warfare and export bans in the 18th century did, however, reduce the importance of the noble cattle exports.

So, in contrast to cereals, there were no considerable peasant exports of animal produce from Scania during the period of investigation.[11] Of course there were sales of butter and living

[11] With "export" is here meant all sales outside the region Scania. Until the 1820s an export ban was upheld, it was prohibited to sale grains outside the Swedish realm.

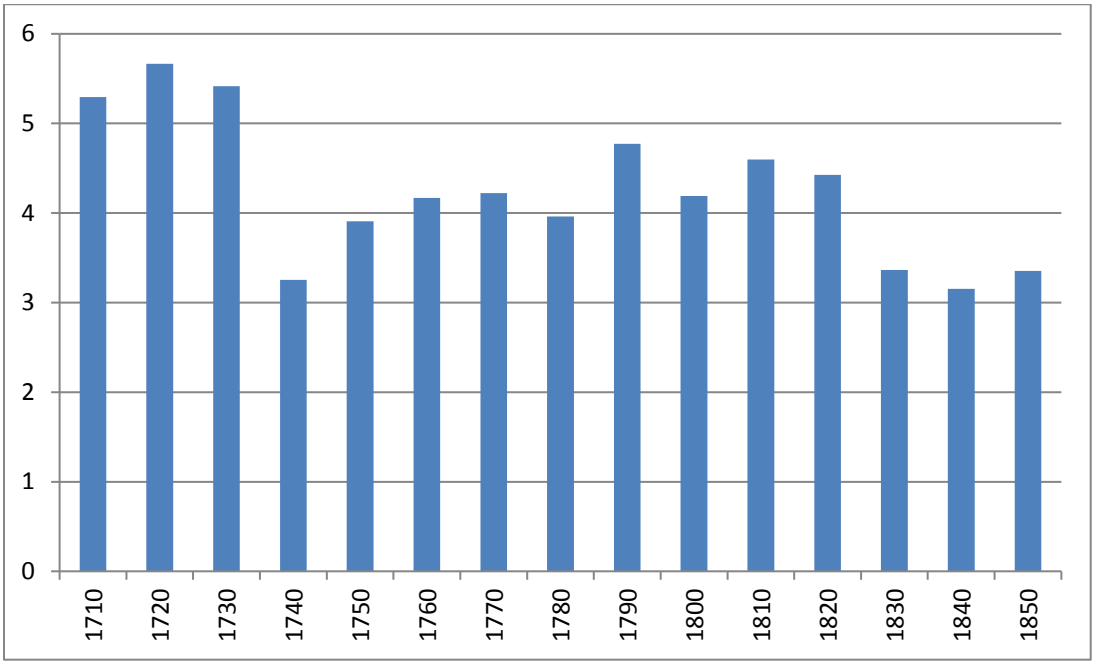
animals within the countryside and to the close towns, but the towns in south Sweden were small and could not correspond to major commercial efforts from the farmers.

Peasants' animal breeding could have three potential areas of use: First, part of the peasant capital stock as draught animals or breeding-stock, second, food for the household, and third, animals for sale. The often unknown balance between the three applications makes animal breeding hard to define as a simple part of agricultural output. While the first point must be considered as investment in peasant capital stock, the other two is part of the gross output. Furthermore, their potential net outputs, in terms of milk, meat and wool, is blurred by factors as premature mortality and recycling of part of its produce into the livestock. Net outputs can be estimated with different weights and parameters (Turner 1991, p. 412). In the 18th century Scanian case, many of these parameters are unknown. We will refrain from making a more or less accidental estimation of this and focus on the number of animals born.

Regarding the animals, the priest only accounted for surviving animals. By multiplying the number of animals born each year, on each farm, with its values as mature for the actual year, we get a consistent gross output value to compare over time and with the farms' grain production. For all parishes but four, information on calves and foals born each year was registered by the priest. Hence, measuring the production of these animals is straightforward. However, for half the sample information on lamb and geese is present while the other half lacks actual numbers born. Instead the peasants paid a fixed amount each year for small animals in these parishes. This lack of information is corrected for by adding an average "lamb-and-geese-share" from parishes with similar natural conditions. We attain the total animal production by converting all animals to cow units, through their price differences year by year. Horses commanded about one and a half times a cow while lamb commanded about one ninth of a cow and geese about one twentieth of a cow (Jörberg 1972).

The animal production per farm in the Scanian parishes is displayed in figure 4. The overall trend is decreasing over time, which together with the results from the estimation on grains and potatoes indicates an increased specialisation in vegetable production. The average cow units born every year were almost as high in the wooded areas as on the plains, but somewhat lower in the brushwood districts where there was neither a large demand for draught animals, nor vast areas for grazing.

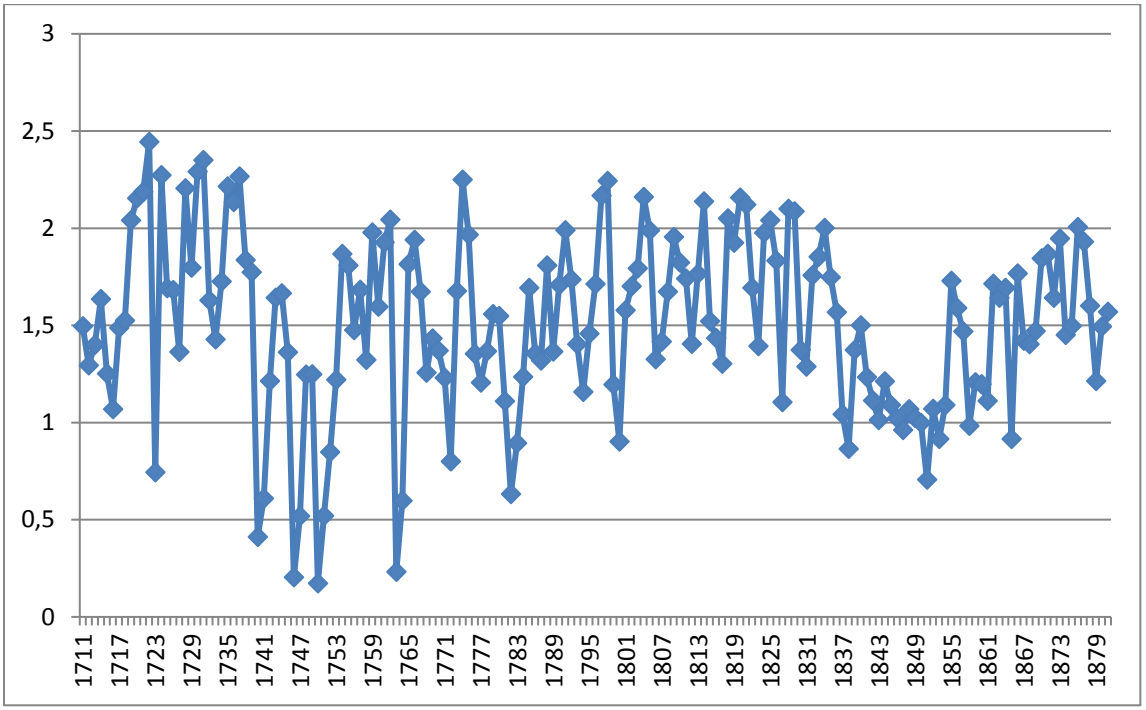
Figure 4. Animal production by decade, 1711–1865, cow units per farm.



Source: Olsson and Svensson 2017.

The fall in the overall trend was mainly due to a decreased production of animals from around 1740, but why did the peasants lower their animal production in the 1740s? In order to answer the question we turn to the number of calves born each year (figure 5). Unlike the other animals, the same pattern as for the total production is evident for calves, but even stronger. Before and after the general fall in production, we observe some years with a very low number of calves born, 1723, 1740, 1746, 1750, 1763 and 1772. These years coincide almost exactly with the years following the outbreak of the cow plague/rinderpest that haunted Skåne during the eighteenth century; the plague is reported to have taken place in 1722, 1745–46, 1749–1752, 1762 and 1767–1772 (Weibull 1923). The reason for the lowered animal production thus mainly originated from fewer cows giving birth to calves and this presumably made peasants invest less in cows during this period, a fact that explains why the production never reached the same levels as in the 1720s and 1730s again.

Figure 5. Calf production 1711–1881, number of living calves born per farm.



Source: Olsson and Svensson 2017.

So, from the 1740s we discern a slow recovery in total animal production. From the 1820s, on the other hand, there was a falling trend again until the early 1850s, implying less investment in animals. There are several factors that might explain this development. The reclamation of meadows and wasteland for arable purposes, following the increased specialisation in grain production, lowered the food supply for animals, which decreased the number of animals closer to the minimum level of draught animals, both horses and oxen. With the introduction of more efficient ploughs in the nineteenth century it was possible to cut down on the draught animals as well, and improved roads lowered the number of horses needed for transports (Gadd 1983; Olsson 2005). Not until the second half of the nineteenth century, with the increased international competition in the grain market, this trend was reversed.

Composition and development of production over time

The previous sections have analysed the vegetable and animal production separately. By using prices, we can now establish the value shares of each part of production over time.

From table 5, it stands clear that vegetable production dominated in this area of Sweden. Furthermore, animals' share of total production value was decreasing from the eighteenth century; with normally between 20–25 percent of the farms' gross production, towards the

historical low 1850s, when it only held 7 percent. The substantial decrease in animal share of output value that started in the 1820s was dependent on reductions in need for draught animals; lamb and geese are almost constant.

Table 5. Animal and vegetable share of farm production output value 1720–1860, per cent (10-year centred averages).

	Share of output value	
	animal	*vegetable*
1720	23	77
1730	25	75
1740	20	80
1750	22	78
1760	20	80
1770	21	79
1780	23	77
1790	21	79
1800	20	80
1810	17	83
1820	15	85
1830	13	87
1840	8	92
1850	7	93
1860	9	91

Source: Olsson and Svensson 2017.

Due to Scania's natural conditions, its lack of major cities, the cattle plagues and the historical restraints on peasant oxen sales, the grain production was predominant already in the 18th century. The nineteenth century decrease in animal gross output can hardly be explained by an actual decrease in the production for consumption and sales, but a change in farm capital composition. Peasant animal breeding had different outcomes and was dependent on different factors than peasant grain production. This reveals the double nature of calf and foal production – an important part of farmers' capital, and at the same time a produce for consumption or for sales. But our result also reveals a pattern of specialisation in vegetable production in the 19th century.[12]

The pattern found is of course also related to the development of prices for vegetable and animal products. The general trend 1720–1860 is that animal prices increased faster than grain prices, e.g. the calf price index about doubled as compared to rye and barley index. So, the price trends actually strengthens our argument on grain specialisation.

[12] For a more detailed study of agrarian specialisation in Scania, see Bohman 2010.

Finally, turning to the overwhelmingly part of the production, vegetable production and its long-term development, we find periods of strong growth, but also periods of stagnation (figure 3). The mean annual growth rate for the whole period was 1.1 percent, before 1789 a more modest 0.5, and after that almost 1.8 (table 6). Crop production more than quadrupled for an average farm in Skåne from the early eighteenth until the middle of the nineteenth century. But population increased as well[13]; during the first 86 years of our study population grew somewhat faster than production, indicating falling labour productivity and living standards. But from 1789 and onwards the pattern reversed; in spite of an accelerating population increase, production grew almost twice as fast.

Table 6. Annual population growth and grain production growth for 37 parishes in south Sweden 1702–1865 (percent)

	Population	Production
1702–1780	0.69	0.51
1781–1865	0.94	1.79
1702–1865	0.81	1.11

Sources: Production: Olsson and Svensson 2017; population: Palm 2000.

The difference between growth in production and population could be seen as a crude measure of change in labour productivity.[14] In the later period output per worker grew annually by 0.85 percent (1.79–0.94). But, as earlier research has pointed out, the fact that production increased faster than population could primarily be due to an increase in hours worked rather than to rising labour productivity in a strict sense. When new crops were introduced and investments were made in land reclamation, particularly after the radical enclosures, the work season was prolonged and, following this, a large part of the growth in production was caused by more hours worked per person (Gadd 1983; see also Schön 1995).

[13] The population growth in Sweden was about 0.5 per cent per year during the period 1731 to 1811 and about 1.0 per cent per year 1811 to 1871 (Bengtsson 2000), which indicates that the sample population did not differ in any important respect from the average Swedish population.

[14] Total population growth is possible to use in this respect, since alternative occupations to working on the farms for which we have estimated production output were very sparse. In all parishes, agriculture held a total dominance in terms of occupations until the second half of the nineteenth century, when rural industry made its entrance into the rural economy. There were of course other professions than farmers and farmhands; in every parish there were a few artisans, such as smiths, some tailors and shoemakers (van de Putte and Svensson 2010). However these groups formed a very small minority of the inhabitants.

Accessing the database

The Historical Database of Scanian Agriculture can be accessed freely through the website of the Department of Economic History at Lund University, Sweden. The data is delivered in two different formats:

First, a panel dataset encompassing all farms with their output and their characteristics, alongside village and parish variables are found in a STATA-file. The file consists of 85,906 observations, where each observation is one farm for one year. In addition to this a STATA do-file is provided with the calculations made on converting tithes into hectolitres based on the assessments, assumptions and decisions made in this article.

Second, an excel-file is provided with the calculated overall Scanian vegetable production series and the parish series of vegetable production.

The reference when using the database is: Olsson, M and P. Svensson (2017) *Historical Database of Scanian Agriculture*, version 3.0. Lund: Department of Economic History (please see website for potential update of the database and accordingly new version number).

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Bosarp Church Archives OIII:1 (with Västra Strö)

Brandstad Church Archives LV:1

Burlöv Church Archives LV:1; PI:1

Everlöv Church Archives LV:1–3

Gråmanstorp Church Archives LV:1

Gudmundtorp Church Archives LV:1 (with Hurva)

Halmstad Church Archives OIII:1 (with Sireköpinge)

Hjärnarp Church Archives LVc:1–7 (with Tostarp)

Hög Church Archives LV:1; DI:1 (with Kävlinge)

Kågeröd Church Archives L:1 (with Stenestad)

Lyngby Church Archives LV:1 (with Gödelöv)

Sankt Ibb Church Archives LV:1

Skartofta and Öveds Church Archives LV:1

Södra Åsum Church Archives LV:1

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Land registers (*Jordeböcker*), The Regional Archives, Lund

Poll-tax registers (*Mantalslängder*), *Häradsskrivarnas arkiv, Malmöhus läns landskontor*, The Regional Archives, Lund and *Kammararkivet*, Swedish National Archives

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Appendix I

Published work using the Historical Database of Scanian Agriculture

Articles in peer-review journals

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OLSSON, M. (2007), Skatt på jord i Skåne 1660–1900, *Ale. Historisk tidskrift för Skåne, Halland och* Blekinge, 3, p. 17–27.

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BOHMAN, M. (2010), *Bonden, bygden och bördigheten. Produktionsmönster och utvecklingsvägar under jordbruksomvandlingen i Skåne ca 1700–1870*. Lund Studies in Economic History 52 (Doctoral Dissertation). Lund: Media-Tryck.

OLSSON, M and P. SVENSSON, eds. (2011), *Growth and Stagnation in European Historical Agriculture*. Rural History in Europe, 6. Turnhout: Brepols Publishers.

BERGENFELDT, F. (2014), *Roads to Market. Transport and Agricultural Change – the case of southern Sweden, 1750–1850*. Lund Studies in Economic History 66 (Doctoral Dissertation), Lund: Media-Tryck.

Book chapters

OLSSON, M. and P. SVENSSON (2009), Peasant economy – markets and agricultural production in southern Sweden 1711–1860, in V. Pinilla (ed.) *Markets and Agricultural Change in Europe from the 13th to the 20th Century*. Rural History in Europe 2, Turnhout: Brepols publishers, p. 75–105.

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SVENSSON, P. (2013), Land Market, Property Rights, and Agricultural Transformation in southern Sweden 1680–1870, in G. Béaur, P. Schofield, J-M. Chevet and M-T Perez-Picazo (eds.) *Property Rights, Land Markets and Economic Growth in the European Countryside (Thirteenth-Twentieth Centuries)*. Rural History in Europe 1, Turnhout: Brepols Publishers, p. 455–473.

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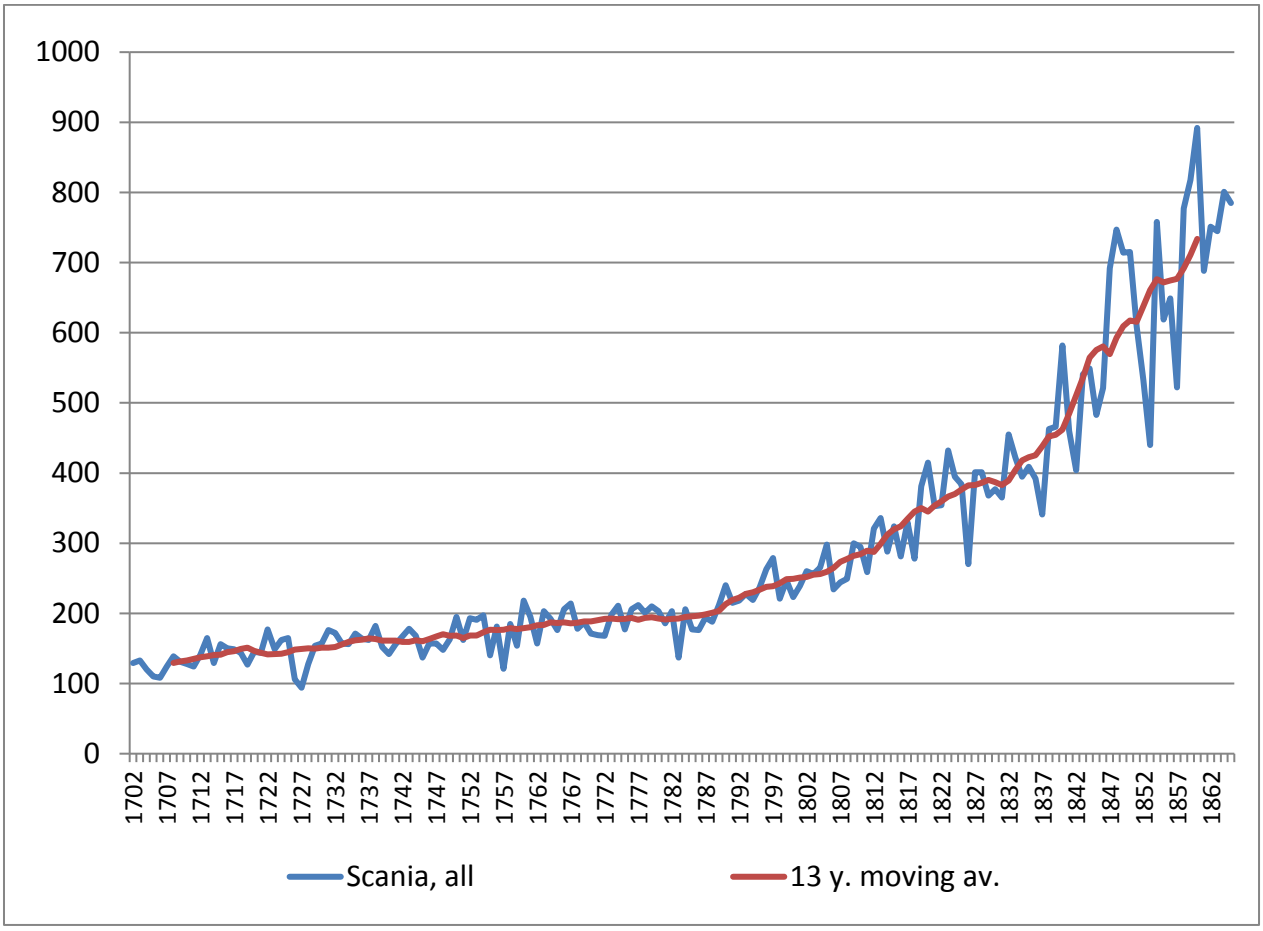
Appendix II

Crop production series (hectolitres per *mantal*)

The series can be found online at the web site of Department of Economic History, Lund University, in the excel file *Scanian crop production series*. The graphs represent the authors' **interpretation** of the production outcome according to the sources, at time of writing, in January 2017 (updates may occur).



The 37 parish series are organised in alphabetical order, most often pairwise. Two parishes most often formed a pastorship, and that is how they appear in the church archives.
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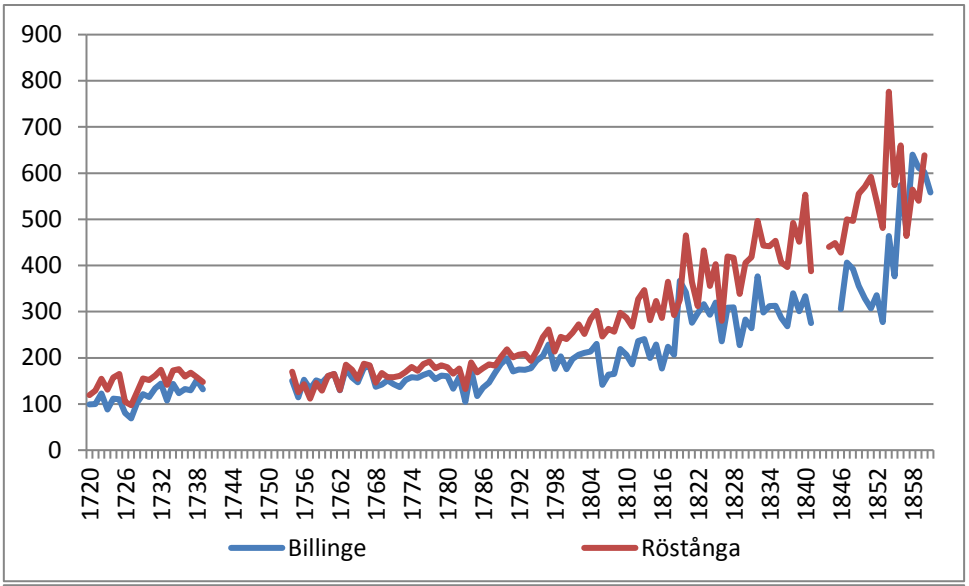
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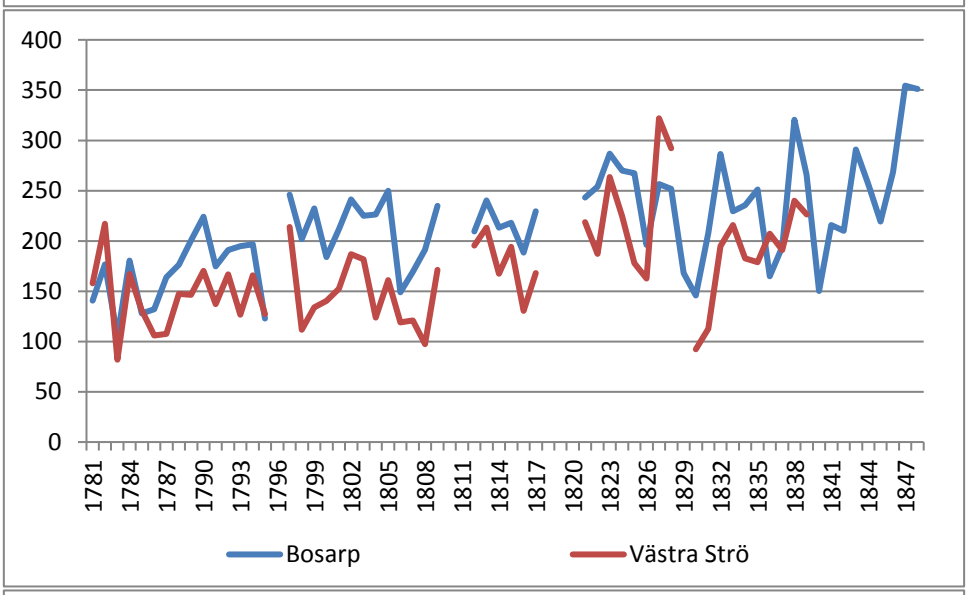
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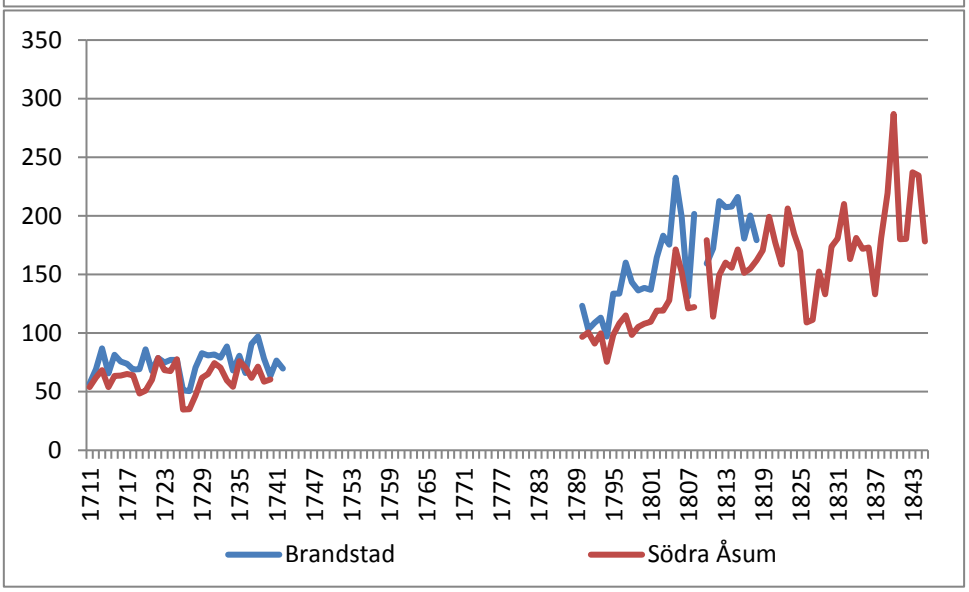
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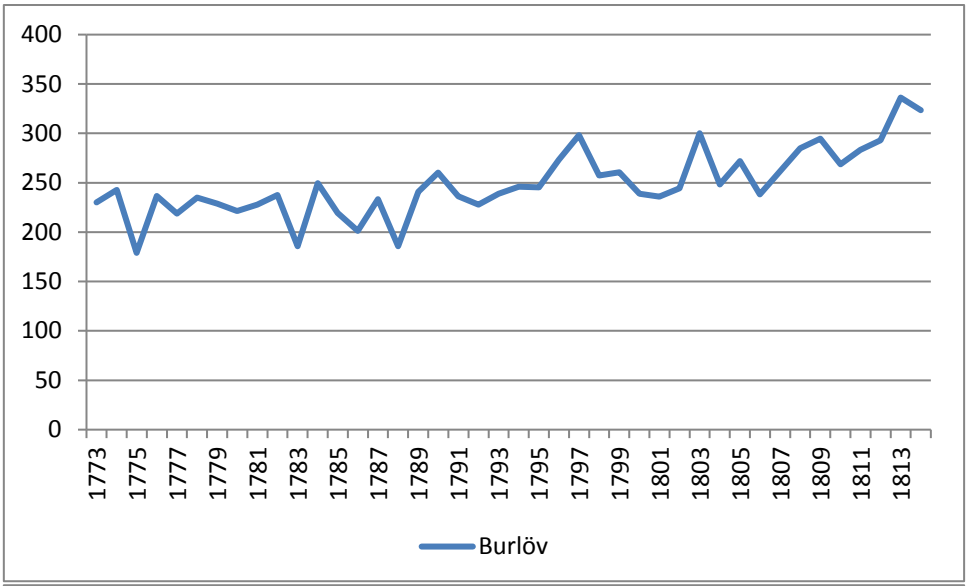
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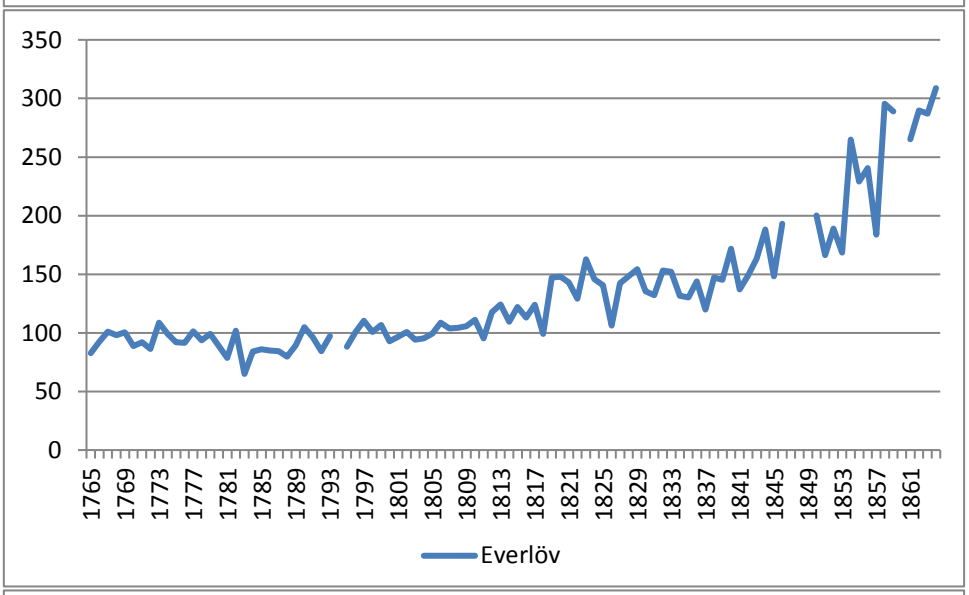
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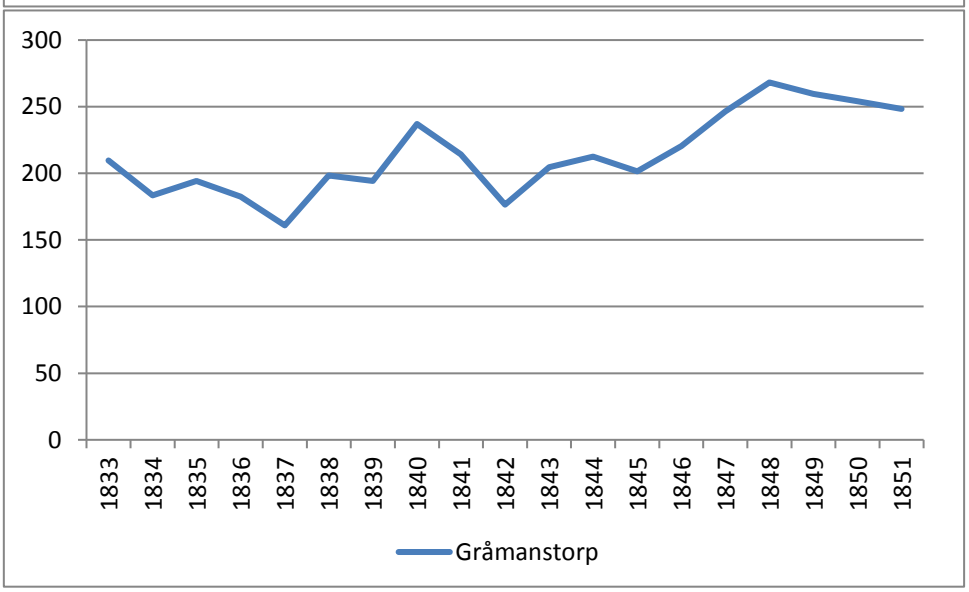
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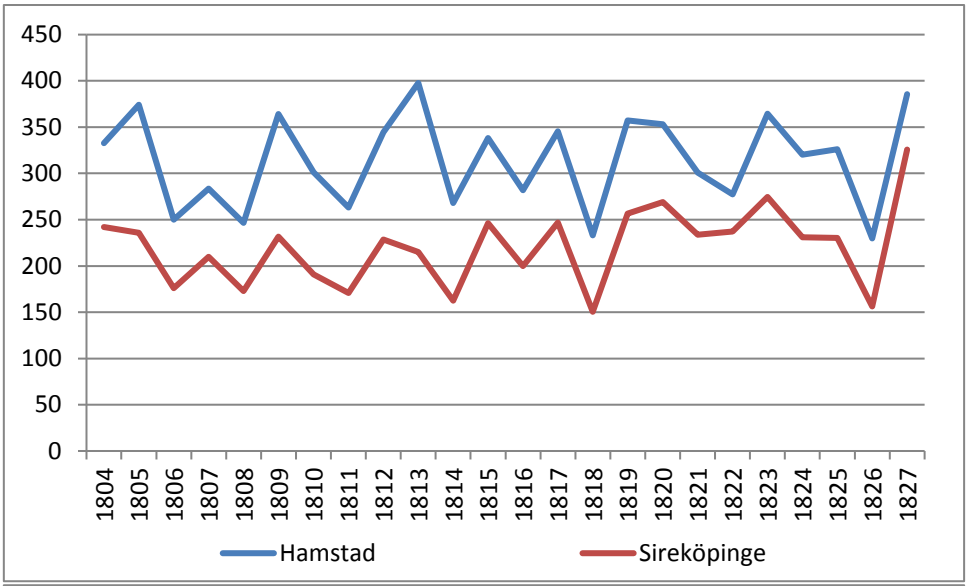
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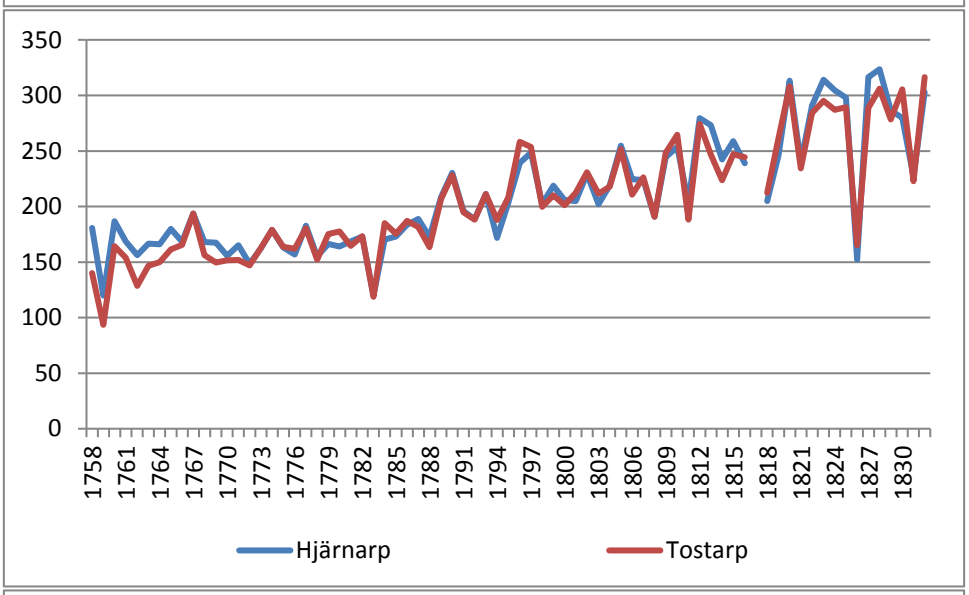
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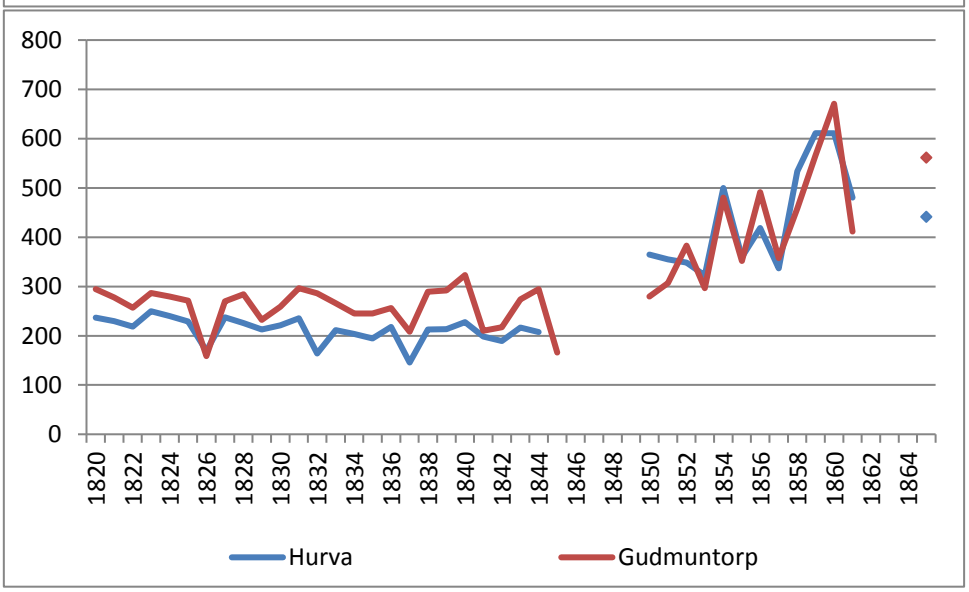
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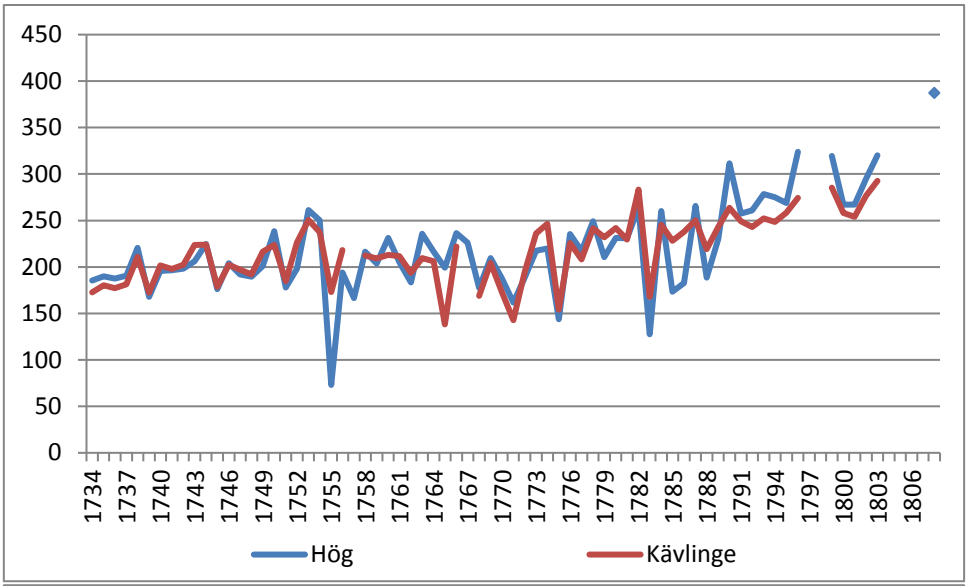
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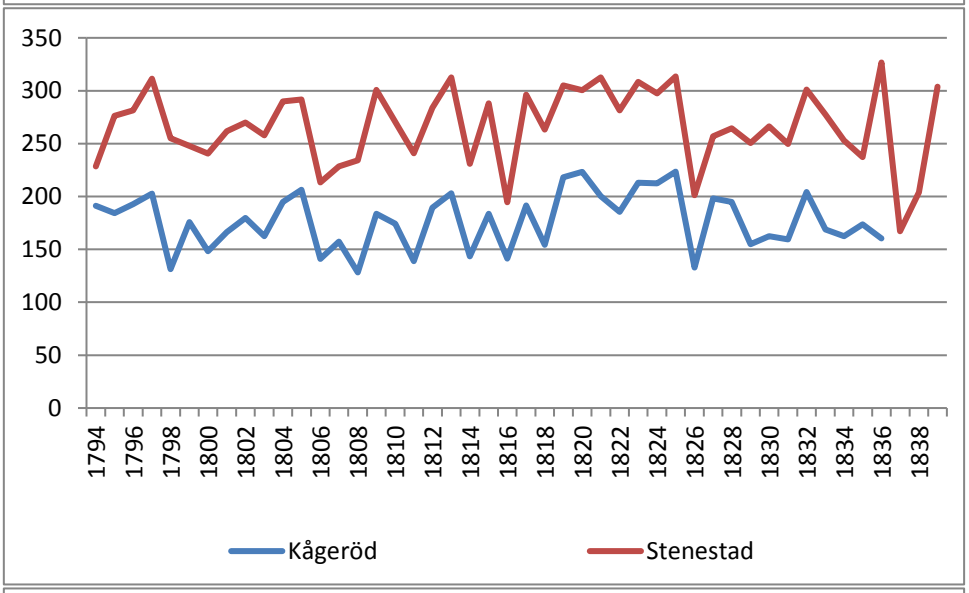
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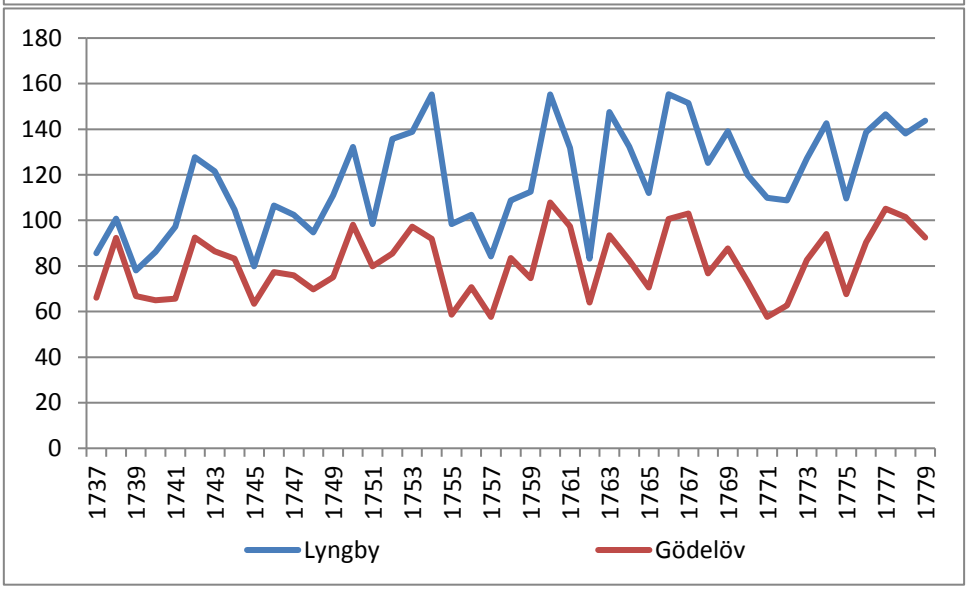
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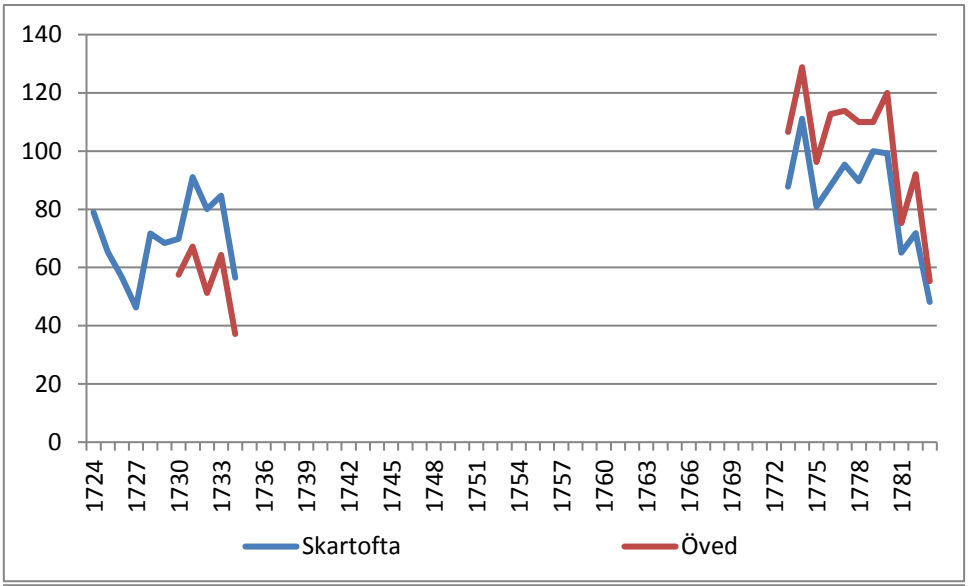
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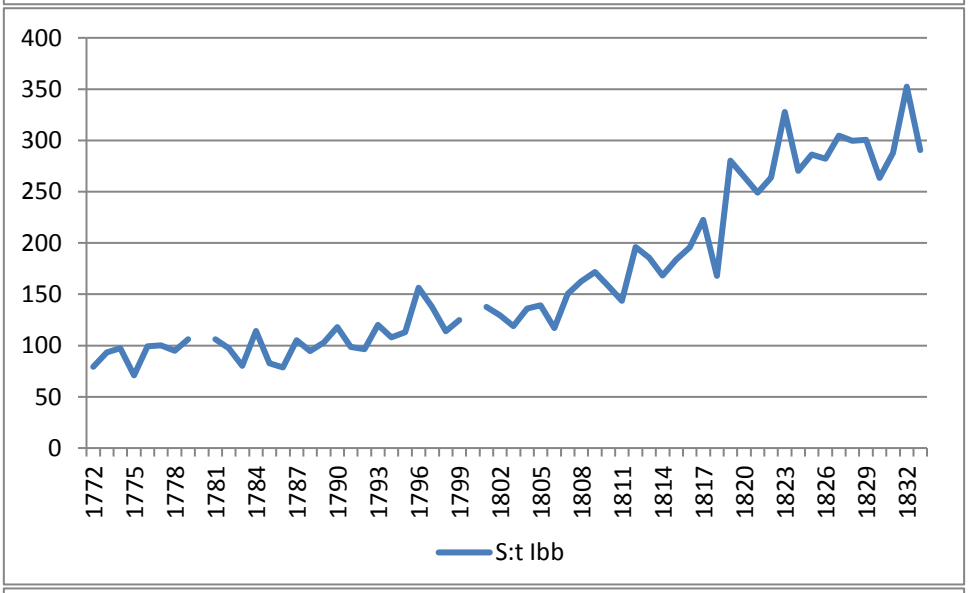
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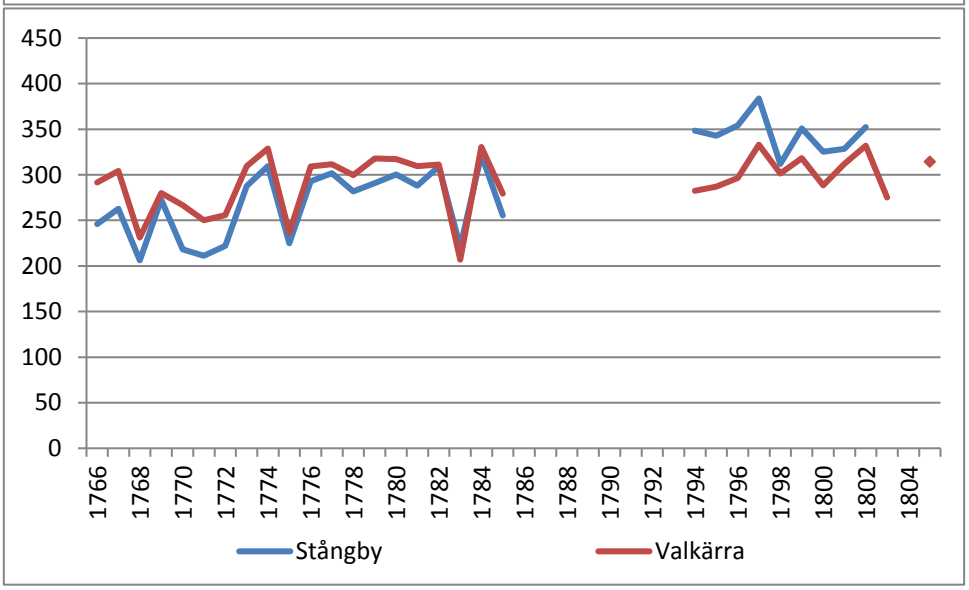
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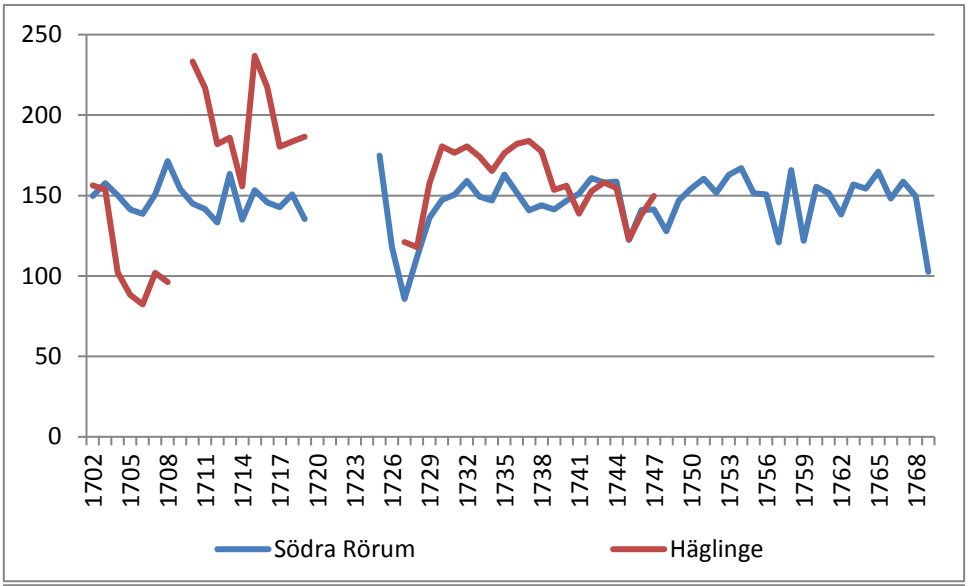
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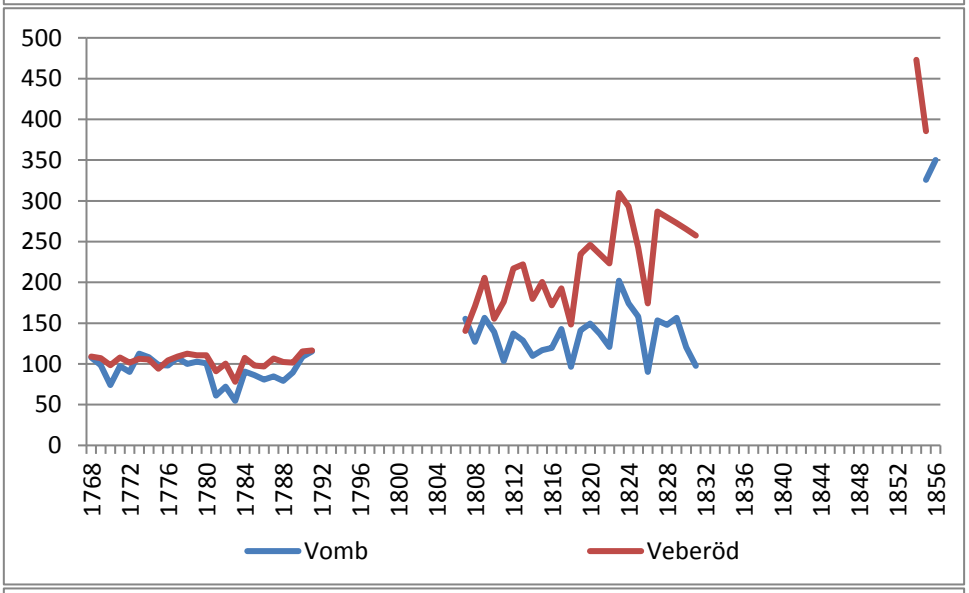
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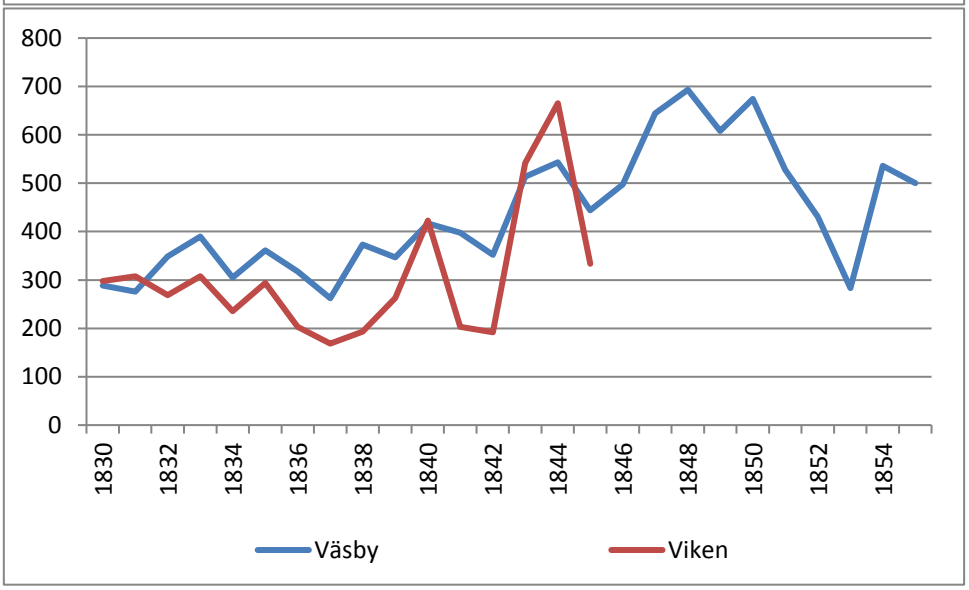
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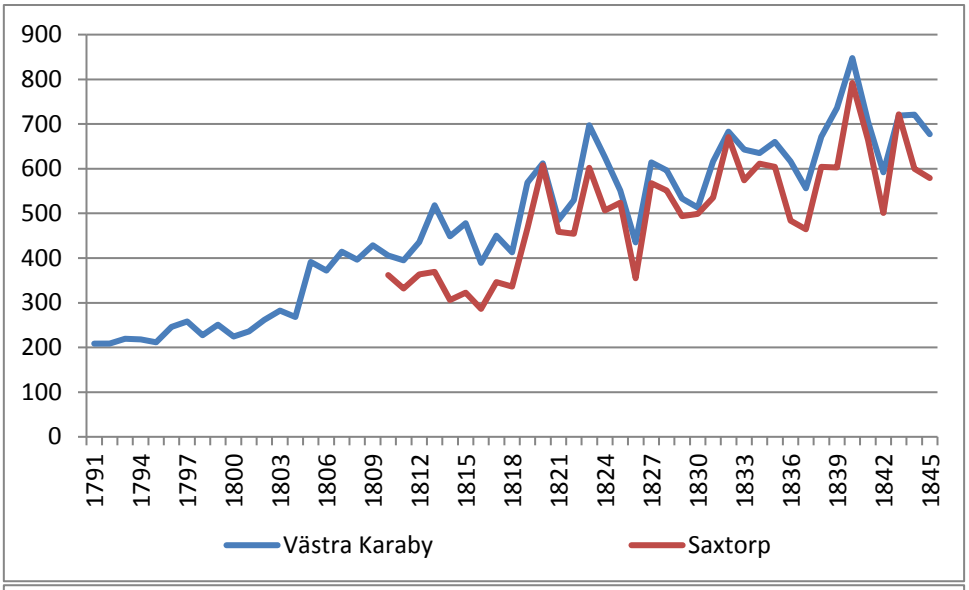
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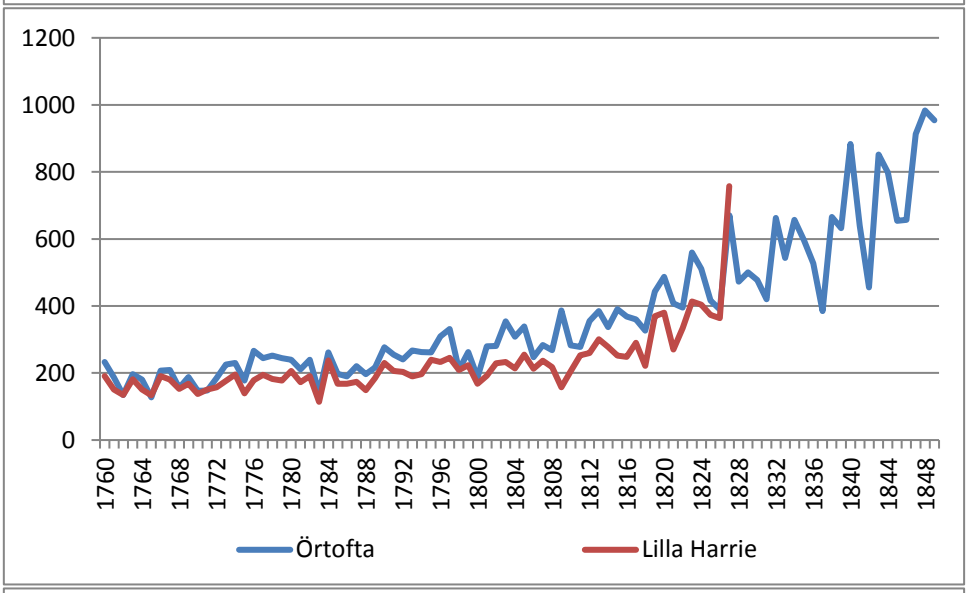
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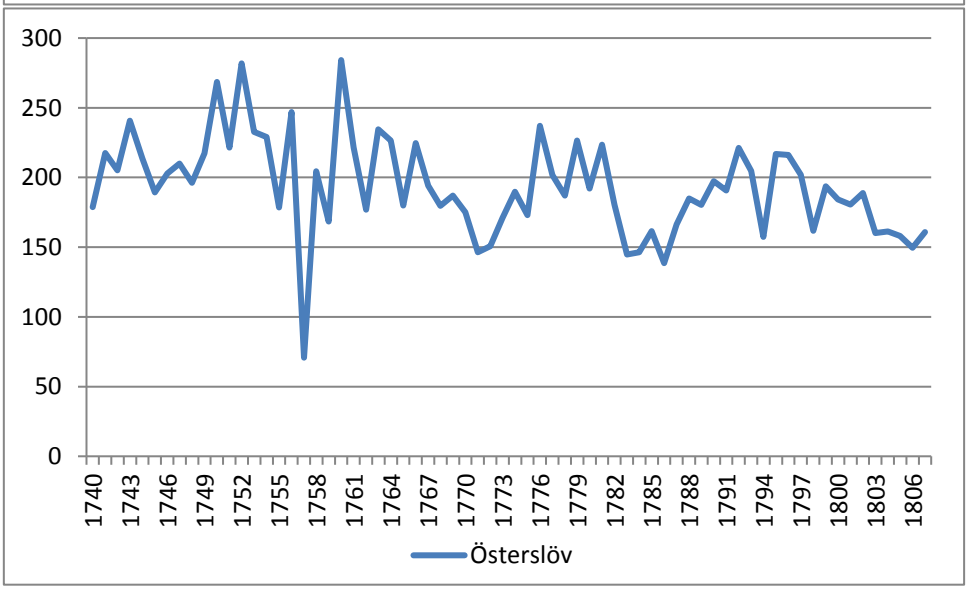
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