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Explaining agricultural growth.

The case of Sweden 1700-1850.[*]

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Introduction

The agricultural revolution is often used as a concept implying a transformation from a stagnant or slow-growing state of production to a fast-growing more productive agriculture. Dealing with changes in historical agriculture, it is important to get production and productivity correct. Through this, causes and explanations of change can be derived and questions like: Was pre-industrial rural society a stagnant society without progress in techniques, productivity or production or was it a progressive society where its members embraced, and strived for, change? What were the decisive factors for growth and transformation?

Although national accounts are of much value, among other things for making it possible to relate growth to state policy, trade regulations and other national factors, it is on regional or local levels that most causes for, and constraints to, growth are to be found. The aim of this paper is to provide explanations of trends and variations in the agricultural production development of southern Sweden from the early eighteenth to the mid-nineteenth century.

Estimating historical production is in most cases a complex task. Researchers have used different methods and different sources and still the production development before the 20th century is highly uncertain for most countries and regions. We use a regional approach estimating production on a micro-level. In our paper we study an area with unique source materials on production, population, prices and taxes. This area is Scania (*Skåne*) in Sweden which contains a variation in some of the most common types of North European agricultural settings in respect to socio-economic and topographic conditions as well as in land management. Using flexible local tithes allows us to estimate annual production for over 2 000 farms with different characteristics and thereby not only estimate the production development during this period but also to compare different types of farms in order to understand what explained growth.

Moreover, in order to explain variation in production and long term growth we have to consider the development of technology and farming methods, but also the broad rural context and its connections to markets and urban life. A number of questions regarding development of agrarian production and productivity must therefore be asked:

- What kind of institutions and institutional settings, such as property rights and state initiatives, promoted growth and which ones were obstacles to growth?
- How profitable were different forms of land management? Were there differences between, for example, peasants[1] and persons of rank?
- Did growth imply specialisation in production?
- How did the enclosure movements, the initial re-allocations of land in the 18th century and the radical enclosures in the 19th century, effect production output?
- What was the role of the markets?

We start by discussing the implications of using tithes as sources for production development. In the empirical part, at first, we measure grain and animal production in southern Sweden 1702 to 1864 and relate this to major debates concerning growth. Finally, we explain differences in economic performances on micro level, elaborating a number of possible determinants in multivariate regression analyses.

Tithes and agrarian production

Earlier research has brought forward two main ways of estimating production and productivity in pre-industrial European agriculture. One is to move from the top-down, to estimate productivity (total factor productivity, labour productivity etc.) using information on rents, prices, wages and population (e.g. Allen 2000; Hoffman 1996; McCloskey 1975). The logic here is that when a farm experiences a productivity increase this implies lower costs and it will reflect itself in higher profits leading to rising rents, at least in a well-functioning lease economy, or it will reflect itself in changes in prices or wages. One potential obstacle in the 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 such information (see Hoffman 1996: chapter 4).

The other approach is to use 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

[1] In this paper the concept of peasant (Swedish: *bonde*) is used when talking about all non-gentry landholders managing farms that were subject to taxes, measured in *mantal*. This means that the peasant group ranged from non-subsistence smallholders to wealthy farmers. The reason we use "peasants" instead of "farmers" is that the peasants formed a specific social group with political representation in the then Swedish parliament and that they therefore were separated socially from other farmers, for example persons of rank. About 90 per cent of all land in Sweden was managed by peasants, either as self-owners or as tenants (Svensson 2006).

cultivated or the agricultural output. This approach, aggregating local micro series and combining them with macro series on land, gives rise to specific problems; different sources exists for different periods of time, and, of course, the problem of how representative the local sources are for national estimates (see Overton and Campbell 1996). Both these ways are highlighted by the discussion of pre-industrial agricultural productivity in England and France, but also for other countries, including Sweden, different methods and sources have been used.

Since the Middle Ages the tithe was an important part of the tax system in most parts of Europe. In some countries this form of taxation on agriculture survived into the 20th century, but was, by then, seldom flexible or dependent on annual production. Originally the whole tithe in principle should correspond to 10 percent of every peasant's production output.

The 1960s and 1970s saw an extensive historical research on tithes in many European countries. The questions at issue were typically agricultural production output and its interaction with demographic change, from the middle Ages until the beginning of the 19th century. The results of this research are mainly regional grain production estimates for the period before 1800. They indicate an increase in agricultural production in the 18th century for major parts of western and central Europe. This development, however, was not in any way uniform (see Le Roy Ladurie & Goy 1982).

The most serious criticism against tithe research and its results is based on the notion that the paid and registered tithes to a certain cathedral or other ecclesiastical institution did not correspond to the entire farm production from the decimants. Other parties, such as local priests or secular interests, could for example claim the surpluses from new crops or from altered land use (Hoffman 1996, pp. 83-84).

For Scandinavia, aggregated tithes on county level in Sweden have been used in a study on agricultural development in the 16th and 17th centuries. Uncertainties about what really is included in these tithe series (number of decimants, change in collection premises, etc.) have led to the conclusion that they can not be used for simple production output estimates (Leijonhufvud 2001). Tithe rolls on individual farm level has, however, been used by Swedish researchers to estimate change in grain production (Helmfrid 1949, Olsson 2005 and Berg 2007).

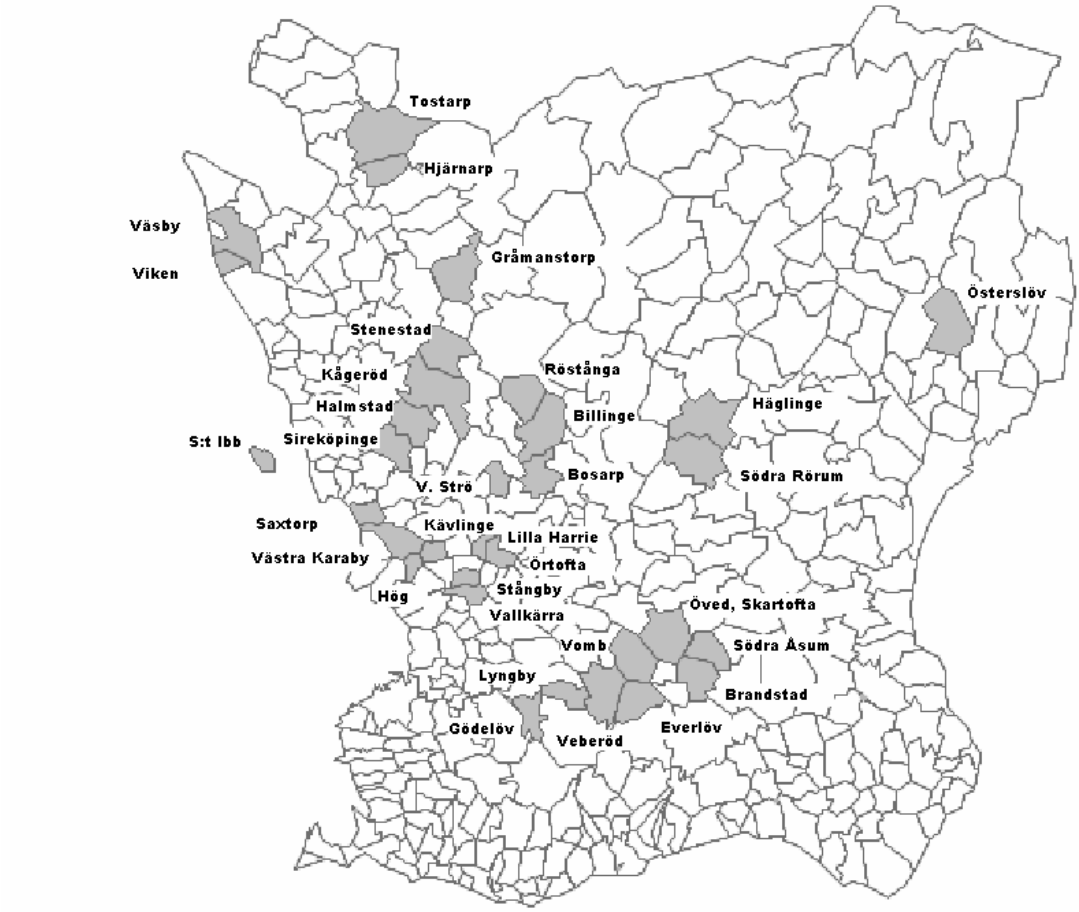
In the southernmost province of Sweden, Scania, grain tithes were divided into three distinct parts, with three distinct recipients: the Crown, the church and the local clergy. The two former parts of the tithes were regulated to a fixed yearly amount per farmstead in 1683, and stayed unaltered until the abolition of tithes in 1904.

However, the clergy's grain tithes in many Scanian parishes remained a flexible production tax until the middle of the 19th century. The same goes for the animal tithes, which in its entirety were reserved for the parish priest, together with some other, smaller obligations. The priest held close and elaborate account on each payment and current account on each peasant's animal breeding. This was made possible by the fact that the priest himself was an active farm manager living next door to the peasants paying the tithes. In principle no farm production (except for potatoes in the 19th century, see below) were exempted from priest tithes, not even production outputs from newly reclaimed land.

Table 1. Number of farms in the sample by year (every tenth year)

	Number of farms
1710	18
1720	181
1730	282
1740	312
1750	229
1760	493
1770	673
1780	700
1790	756
1800	869
1810	1 001
1820	933
1830	962
1840	378
1850	273
1860	62

The region of Scania and the 34 parishes in the sample



The data set contains 34 parishes with tithe rolls with about 2 200 decimants. Together they cover the period 1702 to 1864, reaching a total of more than 80 000 annual farm tithe payments. On average 450 farms is present each year (see table 1). The material represents a broad selection of the province's geographic and socio-economic conditions.

For each farm in the sample the yearly tithe payments have been registered into the database.[2] The sample covers 162 years, but no individual farm is present during the whole period. The lengths of observations vary – far from all tithe accounts are preserved, and furthermore, some farms or whole parishes converted flexible tithes to fixed tithes during our period of investigation.

[2] The data is registered in the Historical Database of Scanian Agriculture, Department of Economic History, Lund University, Sweden.

The tithe accounts contain information on individual crops, for most farms rye, barley and oats, which were the contemporary staple crops of Scandinavia. For some farms also wheat, buckwheat, peas or beans are accounted for, displaying the variation in crop production in different areas of Scania. Every thirtieth sheaf from each peasant was annually collected directly from the field to the clergy's barn, and every tenth calf, foal, piglet, lamb and gosling also found its way to the parsonage.

One objection against tithes as sources for production estimates is that they do not reflect changes in land use from arable to pastures, nor the outputs from leys in crop rotation systems (Hoffman 1996, p 83-84). However, this is not a problem in the Scanian case. The sample contains animal breeding as well as outputs in grain production, and possible changes in land use are thus reflected in either of the outputs.

Another objection is that new crops were not included in the tithes. Potatoes were during the 18th century mostly cultivated together with vegetables in the peasant's kitchen garden. But in most parts of Sweden it rapidly moved out into the arable in the century to come (Utterström 1943, Lägnert 1955). The potatoes are seldom reflected in the tithe series. A royal ordinance in 1808 stated that the clergy of Scania, who by then already had benefited well from a rise in peasant productivity, was not entitled to tithes from potatoes, even when it was planted on the fields.[3]

Fortunately it is possible, from other sources, to calculate the potato share of production output for each parish. To overcome the problem with the only crop of importance that was omitted from the tithe series, we add its volume by this share.[4]

Agrarian production development 1702 – 1864

An average peasant farm in the fertile plains of southern Sweden in the middle of the 18th century held about 25 hectares of land, of which about 18 hectares was cultivated. In the more wooded areas the total acreage of the farms could be three times as high, but the arable smaller, often not more than 5–8 hectares.[5] In the latter case, typically, all the fields was cultivated each year, while in the plains one third was bound for fallow. *Mantal* was the major

[3] Kungligt brev den 12 Oct. 1808, *Handbok innehållande...*, p. 543.
[4] See further below.
[5] Derived from Sommarin 1939, p. 25 and Historical Database of Scanian Agriculture.

assessment for taxation in Sweden until 1900. All farms were taxed in terms of *mantal*, which was a rigid measurement of production capacity. When a farm was divided, its mantal was divided between the parts, but the total sum of *mantal* in Scania was almost unaltered between the years 1688 and 1900. In the middle of the 18th century the average farmstead in our sample was taxed 0.37 *mantal*; by 1850 due to farm division the average was reduced to 0.28 *mantal*.

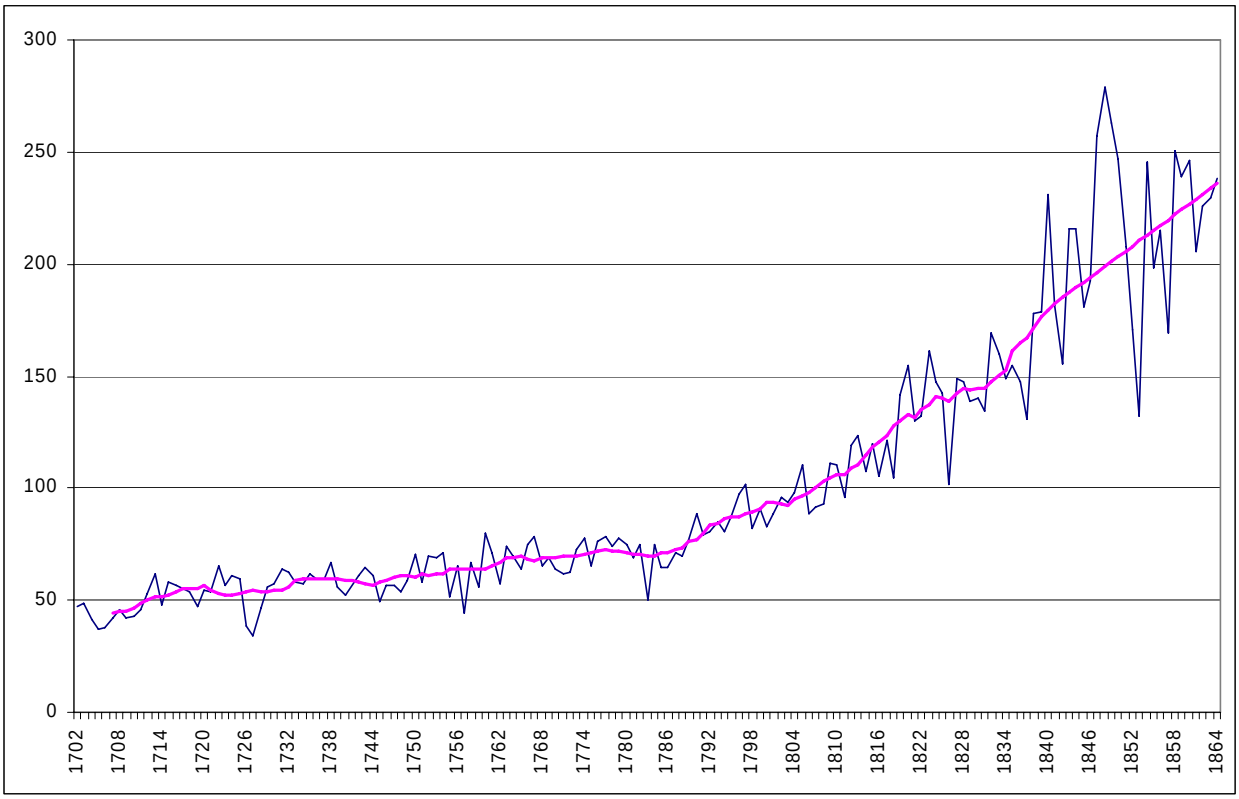
Grain production development is shown in figure 1. It is measured in hectolitres per average farmstead, but we deal with the same area units over time, in spite of farm divisions and consolidations; it is a total area productivity estimate.[6]

Looking at the short term variations in output, it is obvious from figure 1 that volatility increased after 1840. Measured in twenty-year intervals the variation coefficient was at its lowest in the 20 years preceding the 1840s (12 percent), after have ranged from 13 to 16 percent in the 18th century. The variation coefficient for the last 24 years in the sample is 20 percent. This period is characterized by a strong increase and sharp annual turns, due to the tremendous rise in output in the 19th century. The worst years after 1826 were all better than the best years before 1819.

The most important explanatory variable for short term variations in agriculture is temperature and humidity. The weather will not be elaborated in any deeper respect in this article, but two important observations are noticeable, that also strengthen the liability of the dataset. Firstly, there is a strong short term correlation between different parishes in different parts of Scania. It is not rare that villages situated 50–100 km apart from each other display correlation coefficients between 0.65 and 0.85. The mean coefficient for 293 pair wise estimations is 0.56 and in spite of "hard" trend elimination, through first differences, it remains 0.54. The strong short term covariance on semi-aggregate level displays that yearly fluctuations in climate had a similar, but far from identical, impact on production outcomes

[6] Here the crop production is estimated, but the animal production is controlled for. The animal breeding's share of total production value was normally only 15–20% (see Olsson and Svensson 2008b). Production of foals and partly calves must, however, be regarded as investments in farm capital and not production outcomes. Grain production was predominant already in the 18th century, due to factors like Scania's natural conditions, its lack of major cities and the cattle plagues. The 19th century saw a further decrease in animal gross output due to change in farm capital composition: New and better ploughs reduced the need for draught animals (Olsson 2005, p. 129–130.

Figure 1. Grain production estimates 1702–1864, with trend (hectolitres per farm).



Source: Historical Database of Scanian Agriculture.
Note: Trend with 11 years moving average, except for the last 23 years, which has been smoothed with a simple linear trend through 1841 and 1863.

for farmsteads with varying natural conditions. It also displays that the clergies' tithes, as they were registered per farmstead, varied with these fluctuations.

Secondly, bad harvest years, as well as good ones, tend to correspond with contemporary qualitative sources. It is obvious that almost all reported years of bad harvests correspond with crop failures in our estimated outputs (Olsson & Svensson 2008b). Good harvests where more randomly reported in the 18th century, but even so, we find a surprisingly high amount of years with correspondence. These findings shed new light on the contemporary harvests judgements, often strongly criticised by researchers, as well as they again strengthen the liability of Scanian priest tithes as reflectors of variation in agricultural output.

Turning to long term development we find periods of strong growth, but also periods of stagnation. The mean annual growth rate for the period 1702–1864 was 1.0 percent, before 1780 more modestly 0.6, and after that 1.4.[7]

Our point of departure is that the peasants at any point in time, given its technological, institutional and commercial prerequisites, were optimizing their grain outputs This meant that the 18th century Scanian agriculture still were balancing on the edge of its traditional ecological potential, threatening to impoverish the soil's nitrogen potential. The innovations before the 19th century radical enclosures did not remove this fundamental production obstacle, but led to improvements in farming techniques, better drainage and more efficient allocation of plots.

The trend curve with moving 11-years averages helps us to reveal the secrets of the eventful 18th and 19th century peasant agriculture. A first stagnant period in the beginning of the 18th century occurred during the Great Nordic War. The war affected the peasantry of Scania in forced enlistments to the army and levied tax burdens. Battles between Swedes and Danes took place in Scania 1709–1710, but mainly affected the town of Helsingborg and its nearest vicinity (Johannesson 1971, pp. 310–13).

From 1711 till the end of the 1730s a first growth period took place, which also can be seen as a recovery after the decrease in the beginning of the century. Moreover, in terms of peasant prosperity, the growth in grain production was counteracted by serious cattle diseases, that strongly reduced the livestock. The 1740s again saw a stagnant period. This is connected to harvest failures and cattle plagues and might be an explanation for the rising concerns from the government in Stockholm and its officials for the productivity in Scania, by then the only major grain surplus district in Sweden. A rising attention for farming techniques, drainage and consolidations of scattered field strips took place. This led to some early initiatives for reallocations of land within the villages in the plain lands. This was e.g. the case 1748-1749 in Hög, and 1752 in Västra Karaby, two of the villages in our sample. Besides the insight that better drainage and land consolidation was necessary, the motives for the peasant to reallocate land were justice. In these early enclosures the peasants most often favoured the principle "reallocation by tax and rent burden". From 1766 a royal ordinance finally stated that "present

[7] The annual growth rate of population in the selected parishes was 0.66 for the first period and 0.86 for the second period showing that production increased much faster than population after 1780.

land possession" for each peasant should be the principle for reallocations (Olsson 2005, pp. 110–111).

In the 18th and 19th centuries real tax burden was decreasing for the freeholders and tenants under the Crown in Sweden. With rising prises in the mid 18th century this development accelerated, and created new incentives for peasants to raise production. The growth period was only interrupted with a short stagnant period in the 1780s, shortly after the "coin conversion" in 1776, which meant doubled land taxes from one year to another for some peasants. This was, however, more an incidental interruption in the overall real tax reduction, than a serious blow to the peasant economy (Olsson 2005). There was also a major harvest failure in 1783, which was followed by a severe winter, a fact that might have had negative effects on production also for the following years.

The intense growth period lasted until 1824. The early form of reallocations of land, and from 1803 the radical enclosures, was running continuously in the villages. Sometimes they led to temporary stagnations or drops in farm production, but were soon to be followed by even higher rates of growth.

The period 1825–1833 saw a weakening in farm production growth. Grain prices had been falling or stagnant from 1820. For many farms this can be characterized as an adjustment period. Many villages that had not gone through radical enclosures 1803–1819 did so after a new enclosure act in 1827. The enclosed farmsteads took important steps towards a new farming system, which were to raise production dramatically: The abolition of the fallow and integration of fodder plants and potatoes in their crop rotation system. The following growth period was a harvest time from these adjustments, and from rising grain prices.

Determinants of agricultural output

The overall estimation of the crop production indicated phases of growth and stagnation. Some of these results are new findings, while others correspond to earlier notions of the agricultural development. However, we will further discuss factors that earlier research have put forward on what caused the growth in agricultural production by estimating a regression

model of the crop production using a panel data approach. All farms with crop production,[8] 2 125 farms providing over 71 000 observations, are included in the regression and the independent variables are used to explain variations within the specific farms over time, as well as variation between farms.[9]

The dependent variable is crop production, in grains and potatoes. The mean value of this variable, for the whole period, was 54 hectolitres per farm. The independent variables are farm size, type of ownership, type of management, early enclosures and nineteenth century radical enclosures, and natural conditions expressed in whether the farm was situated in the plains, in the intermediates or in the wooded parts of the province. Moreover, we use dummy variables measuring the impact of deregulation of trade in 1775, 1810 and 1828 respectively.

Table 3. Descriptive statistics of the sample, per cent of observations

Variable		**1702-1864 per cent**
Type of land	Freehold land	37
	Crown land	21
	Manorial land 1 (ins)	25
	Manorial land 2 (uts)	17
Manager	Peasant	95.4
	Tenant to peasant	2.4
	Demesne	0.4
	Servants	0.6
	Person of rank	1.2
Early enclosures	Not enclosed	71
	Enclosed	26
	Re-enclosed	3
Radical enclosures	Solitary unit	5
	Not enclosed	79
	Enclosed	16
Natural conditions	Plains	17
	Intermediate	44
	Woods	39
N		71 568

[8] Only farms with taxed *mantal* can be used in this analysis. This excludes crofters that represent less than 3 percent of the observations.

[9] The panel data approach could be characterised as estimating cross-sections over time. This allows us to both analyse variations within the specific farms over time and variations between the farms.

Table 4. GLS-regression of crop production in hectolitres 1702–1864, random effects

Category	Variable	Coefficient	Std. error	Z	P>z
Farm size	Size in *mantal*	102.11	3.18	32.09	0.000
Land ownership	Freehold	r.c.			
	Crown	-8.57	.60	-14.38	0.000
	Manorial 1	-10.56	1.07	-9.88	0.000
	Manorial 2	-7.54	.97	-7.77	0.000
Early enclosures	Not-enclosed	r.c.			
	Enclosed	2.67	.33	8.08	0.000
	Re-enclosed	6.80	.70	9.65	0.000
Radical enclosures	Open-field	r.c.			
	Enclosed	18.86	.39	48.71	0.000
	Solitary, initially	-0.27	2.85	-0.09	0.925
Managed by	Peasant	r.c.			
	Manor	-4.13	1.46	-2.82	0.005
	Person of rank	-0.20	.99	-0.02	0.984
	Tenant to peasant	-.73	.86	-0.85	0.396
	Servants	5.78	1.27	4.56	0.000
Change of cultivator	First year effect	-1.88	.30	-6.18	0.000
Natural conditions	Plains	r.c.			
	Intermediate	-33.75	1.56	-21.70	0.000
	Woods	-37.63	1.71	-21.99	0.000
Trade deregulations	Rural sales 1775	5.60	.23	23.95	0.000
	Interior toll 1810	13.91	.23	60.75	0.000
	Export trade 1828	6.53	.30	21.61	0.000
Expected prices	price/wage, exp. 5 y.	4.07	.24	16.48	0.000
Constant		34.98	1.78	19.60	0.000
No. of observations		71 568			
No. of groups		2 125			
R-sq:					
Within		0.21			
Between		0.54			
Overall		0.50			
Wald chi2(18)		20832.53			
Prob > chi2		0.0000			

Note: r.c. denotes reference category

From table 4 we can see that the overall r-square is 0.50, with a higher value of explanation between farms than within the individual farms. Between farms the variables explain 54 percent of the variation in production outcomes, but within each farm they only explain 21 percent of the variation. This is to be expected, since a large share of the within variation was caused by weather, a short term factor that is outside our aim of investigation.

One important factor explaining differences according to earlier research is what type of land ownership the peasant faced on his farm. Insecure tenancies give bad incentives for long range investments in farm production. Unforeseeable raises in land rents, that could threaten to grasp the entire farm production increase, are likely to have the same effect (e.g. Herlitz 1974; Olsson 2005; Svensson 2006).

When controlling for other factors such as farm sizes and natural conditions[10], we find that tenants produced significantly less, as compared to freeholders. From the results in table 4 it is also obvious that tenants who were, by fiscal definition, *corvée* peasants (Sw: *insockne*), and thereby more controlled by the manor ("Manorial 1" in the table), performed worse than those with more loose bonds to the manorial economy (Sw: *utsockne*, "Manorial 2" in the table). In Scania most tenants that lived in the same parish as the demesnes of the manors, that is the group included in "Manorial 1", paid between 300 and 400 days per year as labour rent by the mid 19th century. Thus, in reality they had to hire extra servants for the boon work at the manor (Olsson 2002). This group experienced an increase in land rent over time. They also had insecure tenancies, particularly in the 19th century when about every second of them were evicted for demesnes' expansions in Scania. The development for tenants living outside the landowners demesnes, that is Manorial 2, were more heterogeneous in terms of security in tenancy and forms and amount of land rent, which also can explain their somewhat better economic performance. The effect of ownership differences are quite large, amounting to over ten hectolitres less in production (around 19 per cent lower production) on average being a tenant under the strict control of the manor as compared to being a freeholder.

Turning to the differences between freeholders and tenants of the crown, the land rents, in the form of taxes, were more or less fixed for both groups from 1680 to 1900 in Sweden. Both groups also had, in practice, similar and secure farm possessions during the whole period of

[10] We have also controlled for change of cultivator. The first year a cultivator handled a farm production was on average 3 per cent lower as compared to years where cultivators had been at least one year on the farm.

investigation. How can we then explain the differences in production outcomes between them?

A majority of the crown tenants bought their farms during the period of investigation, turning them into freeholds. The arguments on the causes of this major change in Swedish land possession has followed two lines. The first is that the peasants bought their farms to secure them from other potential buyers (see Rydeberg 1985; compare with Myking 2005 for similar arguments in the Norwegian case). The problem with this argument is that at least after 1789 this was definitely no threat to the tenant, due to new legislation. Still, half of the purchases into freeholds took place after 1789.

The second argument is that owning a freehold farm gave better opportunities than crown tenancy for mortgages and for division and partition of the farm (Gadd 2000:201). This argument can also explain the differences in economic output. Those peasants who were aware of their farms' economic potential, and were willing to use this potential for economic transactions, were to a great extent the same peasants who purchased their farms into freeholds. In order to test for the economic benefits of dividing farms we made a simple calculation of average production output during the 19th century for divided and non-divided farms in our sample. This calculation reveals that output per area was almost 40 percent higher for farms that were divided than for those who stayed solid. The effects were strongest in the plain land, 60 percent, but weaker in the wood lands, were production was around 20 percent higher on divided farms.

Another factor, widely discussed not only in Sweden but also in the rest of Europe, is the potential impact of enclosures on production and productivity (e.g. Allen 1992; Clark 1998; Fridlizius 1979; Heckscher 1949; McCloskey 1975; Overton 1996; Svensson 2006). In Sweden, two main types of enclosures took place during the agricultural transformation. The early enclosures starting in 1757 and continuing until 1827 did not imply a break with the open-field system but merely to rearrange holdings for the purpose of reducing the number of strips. These enclosures, as well as the ones conducted according to later enclosure acts, depended upon an application from one of the landowners in the village. Only if an application was put forward the village would be enclosed. On the other hand, if one landowner applied for enclosure the rest of the village had to participate regardless if they desired an enclosure or not (see Svensson 2006). For us, this means that not all villages were

enclosed during the period studied and among those who were enclosed the timing of enclosure differed substantially.

The early enclosures in Scania had a significant positive effect on production as can be seen in table 4. Having a second rearrangement according to these enclosure acts made production increase even further. One potential explanation for the positive effect is that each peasant had less strips to manage and therefore spent less time moving to different locations. Another, perhaps more important factor is that in conjunction with the enclosures investments in drainage often took place which improved the soil.

However, an even larger effect on production came with the more radical enclosures starting in 1803. These enclosures implied a break with the open-field system introducing individual management of land on unified holdings. An enclosed farm, controlled for farm size, natural conditions and ownership, produced on average over 18 hectolitres more than a comparable farm within the open-field system. There are a number of potential factors explaining this result.[11] First, after the enclosures the farmer could adapt crops to specific soil conditions and individually decide the time for seed and harvest. In Scania, for example, a more elaborated crop rotation including fodder crops was not adapted until after the break of the village organisation. Second, as the radical enclosures implied that the village was dissolved and farmers moved out to the more remote parts of the village land it included the conversion of previously non-cultivated land to arable land. Third, creating unified holdings made it easier to divide them between the children or to sell parts of the land to non-kin. As we have seen above, division or partition of farms increased the output per area unit.[12]

A contemporary notion was that the peasants were conservative towards change and that progress above all was due to enlightened landlords and persons of rank spreading their ideas to the peasants, the latter accepting them either voluntarily or by force. This notion has been frequently discussed among Swedish and other researchers (for a thorough discussion, see

[11] For further estimates and explanations, see Svensson 2008.
[12] Solitary farms that had not been part of the open-field system, mainly because of their remote and isolated geographical position, showed no significant difference from farms within the open-field system despite the former having their land in one unit. This could indicate two things: First, it was the timing of the enclosure that mattered. Breaking the village system in a period of increasing commercialisation had an effect on production while being outside this system all the way made no distinct differences. Secondly, these solitary farms might have had some special characteristics affecting their production, as their remoteness, which is not controlled for in the regression.

Svensson 2006). Since we do not study production on the manors we cannot address the full extent of this discussion. However, as we have seen, the closer connected to the manors the peasants were, the worse were their economic performances. From the tithe rolls and tax material we can also follow who actually managed the farms and, thus, separate peasants from persons of other social groups.

Our results show that farms managed directly by a manorial estate performed significantly worse than farms managed by peasants. For farms managed by other persons of rank than the estate owner there is no significant difference from peasant management. Although the number of observations for this kind of farms is low, less than 2 per cent of the sample, we can at least state that there is no indication that persons of rank and other gentry performed significantly better than the peasants. Sometimes the owning peasants for some reason could not manage the farm themselves, but had to lease it to another peasant or someone else in the village. This could be the case if the farm manager was struck by disease or during periods of widowhood or under aged heirs. These leaseholders did not differ significantly in their production capacity from farms ran by the owners themselves. However, farms managed by servants solely, without the manager present, performed significantly better. Although they were quite few, we can assume that the later category was the most commercialized types of farmsteads within the peasant community.

Finally let us look at the commercial opportunities: deregulations of markets and grain prices. One important factor explaining increase in production is an increasing demand for grain. Demand during the eighteenth century came from interior trade with deficit areas of Sweden as well as through the population growth and social differentiation which followed the initial rise in production (see Olsson and Svensson 2008a for a more detailed discussion). With the withdrawal of the prohibition against rural trading 1775, the abolition of the interior toll in 1810 and the abolition of export regulation 1828 new channels for the Scanian grain were opened. All these three deregulations show significant positive effects on grain production, specially the lifting of the interior toll, an action which also had an immediate effect on consumers' grain prices.

Price incentives are measured with rye prices index divided by rural day labourers' wages index.[13] We assume that peasants' economic behaviour was not dependent only upon price changes from one year to another, so we use a Nerlove model to calculate expected prices.[14] Our model is:

$$Pe_t = \frac{5P_{t-1} + 4P_{t-2} + 3P_{t-3} + 2P_{t-4} + 1P_{t-5}}{15}$$

Here Pe_t is the expected price for an actual year, built on the preceding five years' prices, weighted higher the closer in time they get.

Our results indicate that peasants did react to price incentives; with higher real prices on grain, production increased. The figure can be interpreted as if the expected real prices of grain doubled, an average peasant increased grain outputs with 4 hectolitres, which means almost 8 percent higher production. So, commercialisation, in the form of trade liberalisation and high real prices on grain, made peasants invest in their production leading to higher output.

Conclusion

To summarise our findings, Scania, the granary of Sweden, displayed a large increase in agricultural production from the eighteenth century to the middle of the nineteenth century. In effect, production more than quadrupled with the largest growth taking place after 1780. In this latter period production outperformed population growth substantially. The growth consisted above all of increasing crop production, both in the staple crops, rye and barley, and in oats, wheat, beans, peas, buckwheat and in the emerging production of potatoes. The crop share of the total value of production increased over time, partly due to an expanded crop production and partly due to animal production decreasing over time.

Differences in production were of course due to farm size and natural conditions. Large farms produced more than small farms and farms in the plains produced more than farms situated in more forested areas of the region. However, it is when we control for these factors that we

[13] The day labourers' wage series have been constructed from the *Malmöhus län* series 1781–1864, for 1733–1780 interpolated with the *Kalmar län* series (Jörberg 1972) and for 1697–1732 interpolated with the wages of unskilled labourers in Stockholm series (Söderberg 2007)
[14] Askari and Cunnings 1977, Schäfer 1997, pp. 110–111.

reveal the most interesting differences in production achievements. First, property rights mattered; freeholders produced more per area unit than tenants on Crown and noble land. Secure property rights among self-owners together with rising prices and fixed taxes promoted investments in crop production. For those peasants that were tenants under the nobility, rising rents and the threat of eviction prevented such immense investments.

Furthermore, growth in the agricultural production was not a linear phenomenon; there were phases of growth and stagnation. Growth came about after periods of reallocations of land and subsequent investments. A pronounced growth phase started with the intensification within the old village system. This was, however, not a viable solution over the long term. With the introduction of the radical enclosures, containing among other things the break-up of the village system and the introduction of new crop rotations, growth increased even faster. At the same time, liberalisation of trade contributed to growth, and the peasants reacted to price incentives by increasing grain production.

In all, Swedish agriculture made a dynamic impact on the overall economic development during the latter part of the eighteenth century and the first half of the nineteenth century. Production increased so imports of grain turned to exports, commercialisation spread among large layers of the population and so did income. Deepened property rights were established and successive investments in human capital followed (Nilsson et. al. 1999). Together this provided the prerequisites and framework for the subsequent industrialisation process.

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