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**The Isolated Peasant.
Long-term Growth in Demand and Spatial Patterns of
Agricultural Supply in Southern Sweden, 1702-1857**

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Abstract

Previous research has found clear spatial patterns of agricultural supply, both in pre-industrial Europe (Grantham 1978; Grantham 1989; Kopsidis 2009) and in the less developed countries of today (Benziger 1996; Stifel & Minten 2008). The spatial structure of farming intensity is mainly attributed to the declining net-returns with the distance from the market. This paper examines the impact of distance on agricultural productivity and whether the long-term growth in demand had a diminishing impact on the spatial variation in farming intensity. The analysis is carried out by using a database on estimates of agricultural production on the micro-level together with additional information on distance from a map from the 19th century for about 2200 farm households in the province of Scania in southern Sweden during the period 1702-1857. The effect of distance on agricultural production is studied with a general least square regression (GLS) for the time periods 1702-1775, 1776-1825 and 1826-1857. The results demonstrate a distinct spatial variation in farming intensity in southern Sweden. Further, the findings also show that the spatial patterns of agricultural supply even increased over time, despite a considerable growth in demand. Overall, the results indicate that increasing demand in itself was not a sufficient pre-condition for reducing the spatial variation in farming intensity.

Key Words: spatial patterns of agricultural supply, growth in demand, von Thünen, distance, markets, town.

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1. Introduction

1.1 Research problem

The markets in pre-industrial societies functioned with a high degree of imperfection. The lack of commercialization to spread in pre-industrial societies was due, in part at least, to the long distances to the market for the peasants. In previous research of pre-industrial rural societies, clear spatial patterns of farming intensity have been found, both in pre-industrial Europe (Grantham 1978; Grantham 1989; Kopsidis 2009) and in the less-developed countries of today (Benziger 1996; Stifel & Minten 2008). The spatial structure of farming intensity is mainly attributed to the declining net-returns as the distance to the market increases, making agricultural intensification and productivity-enhancing investments at distant locations less profitable. However, most of the previous studies have examined either short-term or medium-term effects. This means that less is actually known about the long-term dynamics of change in this relationship, i.e. the impact of long-term growth in demand on the spatial patterns of agricultural supply.

During the period 1702-1857, the economic development in Sweden was substantial. The agricultural sector changed dramatically from low productivity and a high level of self-sufficiency to a sector with a high productivity and a high degree of economic specialization. The agricultural output in Sweden more than quadrupled during the period. This made it possible to support a rapidly growing population – the population increased from around 1.8 million people in 1750 to reach almost 3.5 million people in 1850. Moreover, at the beginning of the 18th century Sweden was a net-importer of agricultural products, but in the 1820s the trade deficits turned into surplus. Export of oats to England in the late 1840s and 1850s became one of Sweden's most valuable export goods (e.g. Svensson & Olsson 2009a).

The increase in agricultural supply, especially at the beginning of the 19th century, was one of the main features in the Swedish industrialization process. According to a previous view, the Swedish industrialization was mainly due to external factors, such as the increasing export of oats to England starting in the end of the 1820s. It contributed by raising large amounts of capital for the industrial sector, which had been much more difficult before (Jörberg 1980). However, this view has been challenged by more recent research, which states that the industrialization in Sweden was facilitated by the growth of agricultural supply in the first half of the 19th century. The increase of real income for a majority of the peasants thus

enabled for an expansion of the domestic market, not at least indicated by the increasing consumption of textiles already in the 1830s. Thus, a rural surplus of capital was also released to the industrial sector (Schön 1997).

One way to study the growth of the domestic market in pre-industrial Sweden is to focus on the long-term dynamics of the spatial patterns of agricultural supply. If the distinct spatial patterns of farming intensity in the pre-industrial era were due to the declining net-returns with the distance from the market, they should hypothetically be less pronounced when the demand for agricultural products increased. In other words, an increase in the demand should result in an improvement in the terms of trade for the remotely located peasants, which would stimulate productivity enhancing investments over a larger economic space. This process might be an important step towards a more developed internal market.

The aim of this paper is to analyze the impact of long-term growth in demand on the spatial pattern of agricultural supply during a phase of agricultural transformation in southern Sweden, i.e. the period 1702-1857. The intention here is to examine the hypothesis that the spatial variation in farming intensity became less pronounced over time. In the analysis, micro-data on crop production for almost 2000 peasant households from different geographical parts of Scania is used. A military map from the early 19th century is also employed to calculate the distances to nearest market place for the individual peasant households. These rural households in the sample display differences in socioeconomic, natural and geographical conditions. This information enables an analysis of the impact of the long-term growth in demand on the spatial patterns of agricultural supply in southern Sweden during the period 1702-1857.

1.2 Aim, research issues and limitations

The aim of this paper is to examine the spatial patterns of agricultural production in southern Sweden during the period 1702-1857. By “spatial patterns” I specifically refer to the impact of distance to the closest town on peasant households’ level of agricultural production, which is used as a crude measure of the market opportunity offered to the individual peasant. Firstly, the aim is to examine the impact of distance on agricultural productivity. Secondly, the purpose is to analyze how the spatial variations in farming intensity changed by taking into account the impact of long-term growth in demand.¹ This makes it possible to observe

¹ See section 3.4 for a more thorough discussion of time periods.

whether the allegedly spatial variation in farming intensity may be seen as a permanent or a dynamic feature in the pre-industrial context.

This focus allows for a more thorough study of the dynamics of change in the spatial patterns of agricultural supply in southern Sweden. New insights of the dynamics of markets in a pre-industrial context may be gained by examining the impact of long-term growth in the demand on the spatial patterns of agricultural supply during this period of rapid agricultural transformation in southern Sweden. A negative correlation between distance to the nearest town and crop production indicates a lower degree of market participation and, hence, a less developed market. Correspondingly, a decreasing impact of the distance on agricultural production over time should be interpreted as an important step towards a more developed internal market. The two main research questions may be summarized as follows:

- i) What impact did the distance have on agricultural production in southern Sweden?
- ii) How did this spatial pattern of supply change in relation to the long-term growth in demand?

To answer these two questions, a long-term study at the micro-level with a comparative approach for the period 1702-1857 is carried out. The data on crop production is derived from a longitudinal dataset, *Historical Database of Scanian Agriculture*², covering almost 2200 households from different geographical parts of Scania, a province in southern Sweden. This dataset also includes several crucial variables affecting the households' crop production. Distances to the closest town for all peasant households in this database are measured by using geographical information from a military map from the early 19th century (Swe: "Den skånska rekognosceringskartan, 1812-1820")³. The distances measured are linked to all the individual peasant households in the *Historical Database of Scanian Agriculture*. This approach makes it possible to study the effect of distance on agricultural production at the micro-level, while also controlling for other factors affecting the agricultural production.

The analysis is restricted to the time period 1702-1857. The starting year is selected to represent a starting point of the agricultural transformation in Sweden. In the early 18th century, the peasants were to a large extent self-sufficient, and only sold a rather small share of the agricultural production in exchange for basic necessities. The rather slow growth in

² See section 3.1 for a closer discussion of the data.

³ See section 3.1 for a closer discussion of the data.

demand during the beginning of the period facilitates a comparison of how the spatial variation farming intensity changed over time (Olsson 2005:104-106). Similarly, the year 1857 is chosen as an end of the present study, which is in view of the large societal and economic changes in the late 1860s and in the early 1870s. These changes led to new conditions for the agricultural sector. For example, the railway network in Sweden began to expand in size, which completely altered the means of transporting agricultural goods. The industrial revolution also intensified, but more importantly, the core of agricultural production changed from grain to animal-oriented dairies, e.g. butter and cheese. Hence, the end year signifies the beginning of a more matured agricultural sector and new possibilities of transporting agricultural products (Schön 2000:154-159, 195-201)

1.4 Outline of thesis

This paper is structured as follows. In Chapter 2, previous research is reviewed, and it will be shown why it is relevant to study the spatial patterns of agricultural supply in southern Sweden during the period 1702-1857. The theoretical points of departure of the thesis are also outlined in Chapter 2. The development of property rights during the 18th century and the first half of the 19th century are discussed at first. The causes of growth in long-term agricultural supply and long-term growth in demand are outlined after that, which provides an understanding of the different phases of commercialization in Sweden and gives a background of interpretation. Further, the relevant aspects of von Thünen's spatial model and the impact of long-term growth in demand on spatial variation in farming intensity are then discussed. The theoretical basis may be used to formulate the hypotheses for the present study.

In Chapter 3, the source material of the study is introduced, and this is followed by a presentation of the sample in the empirical investigation. Furthermore, the included sub-periods in the empirical analysis is also justified in this chapter. The last section of Chapter 3 gives a brief description of the main agricultural areas in the province of Scania, which provides an understanding of the context in which the research questions are carried out.

In the first part of Chapter 4, the method of the study is presented. The choices of variables in the models are also described in greater detail in Chapter 4.

The empirical analysis is presented in Chapter 5 together with a discussion of the results.

Chapter 6 includes a summary of the entire thesis with a review of aim, theoretical basis, method and results of the study. Lastly, I conclude the results of the empirical investigation and suggest areas of future research in the same field.

2. Background

2.1 Previous research

Previous research: spatial patterns of agricultural supply

The spatial variation in farming intensity has been investigated in different contexts, both in pre-industrial Europe and in the less developed countries of today, but the studies on this topic are rather few in numbers. There are not any specific studies examining the spatial patterns of agricultural supply in the case of pre-industrial Sweden with the relevance for the present study. Studies of three different areas are of primary interest: 1) the previous research on the spatial pattern of agricultural intensity in contemporary societies and in pre-industrial Europe, 2) the previous evidence of market integration in pre-industrial Sweden, 3) the previous explanations for the increase in agricultural supply in pre-industrial Sweden.

Benziger (1996) examined the effect of distance to the main urban centers on agricultural growth in one of China's largest provinces for the period 1980-1987. The results in this study indicated that proximity to the urban centers affected agricultural growth, i.e. those rural counties in the Chinese province located close to the towns had a higher rural productivity than the more isolated ones. This meant that those peasants in the rural areas close to the towns received higher net-prices of their products than the peasants in more remote rural areas. The agricultural growth was measured at the province level, which may conceal important differences in agricultural growth between the households in this province.

This issue has also been raised in a more recent study on Madagascar by Stifel & Minten (2008), who analyzed the impact of isolation, defined as the travel time to nearest urban center, on rural productivity. Detailed data on the rural households was collected from a household survey in the year 2001, which allowed for a thorough analysis of the impact of distance on agricultural productivity. They found a negative correlation between distance to the nearest central urban area in Madagascar and rural productivity. However, the data here did not allow for any closer analysis of the impact of growth in demand on the spatial patterns of agricultural supply, as the study only used one point in time.

There are only a few empirical studies in this field on pre-industrial Europe. Grantham (1978) examined the impact of distance on the diffusion of intensive and technically advanced systems of husbandry in northern France by using prices on the regional level for meat and dairy products in 1815-1840. His study demonstrated a slow diffusion of more intensive and

technically advanced systems of husbandry in most of the regions (*cantons*) in northern France, except for the regions close to Paris. The limited net return of the sale of farm products made it unprofitable to introduce productivity-enhancing investments in the periphery, which thereby limited these improvements to the area close by Paris.

In a more recent study, Grantham (1989) showed that there were spatial differences also in the agricultural output in northern France related to the distance. The spatial variation in farming intensity may be related to concentration of urban demand to the areas close to Paris, which resulted in higher inputs of labor and capital in those areas. The paper did not study whether the process was a permanent or a dynamic feature in France's agricultural transformation.

There is also empirical evidence of a similar spatial pattern of agricultural supply in Germany during its agricultural transformation. Using data from land tax valuations on the regional level to calculate the agricultural production, Kopsidis (2009) analyzed the regional differences in agricultural intensity and local systems of cultivation in the county of Westphalia in 1830. In conclusion, the study showed that the most intensive systems of farming was found in those areas of the region where close links between the urban centers and rural areas existed. Supposedly, this made the intensive methods of cultivation more profitable in those areas.

Previous research: Sweden

There is a general lack of data on the agricultural supply side in Sweden. The process of market integration in Sweden in the 18th and the 19th centuries has been studied by a few Swedish scholars, and the analysis has been based on prices and not on production. Previous research has shown that the correlation between the prices in counties was increasing from 1770s and onwards. The stronger correlation of prices between the Swedish indicates the gradual market integration that took place (Jörberg 1972). Case studies have also addressed the links between rural areas and urban areas with regard to the agricultural supply. Hansen (1952) has demonstrated close links between the peasants in rural areas close to the towns of Simrishamn and Ystad in Scania. However, the study is only based on a few years at the end of the 18th century and the long-term patterns of agricultural supply were not studied. Fridlizijs (1981) too showed that the population of the town of Malmö in Scania purchased most of its grain from the peasants who were located within a range of 30 kilometers from the town of Malmö. However, neither the long-term changes in supply nor the impact of distance on agricultural intensity were measured in these studies.

The estimations of the agricultural growth in both pre-industrial Europe and Sweden exist, but various measurements to measure agricultural growth has been employed (see Olsson & Svensson 2009 for an overview). Until now it has also been hard to measure the contributions to agricultural growth in Sweden due to the lack of available official data on agricultural production in the 18th century and the unreliable estimates of agricultural production in the 19th century (see Gadd 1999 for a discussion). However, the use of the flexible tithes as a source for calculating the agricultural production at the micro-level has permitted more detailed and reliable estimates of agricultural production. On the basis of the flexible tithes, it has been shown that the tax levels for the peasants decreased during the 18th and 19th century, which had positive effects on agricultural supply (Olsson 2005). The flexible tithes have also been used in other studies. It has been demonstrated that the property rights had an impact on the level of agricultural production, where the freeholders had better opportunities to reinvest their agricultural surplus and had more secure property rights than the other peasant groups in Sweden (Olsson & Svensson 2009a). Evidence from another study indicates that the agricultural supply in the 18th and 19th century increased due to the rearrangement of land. The periods of rising prices and the deregulations of the grain trade in this period further stimulated the peasants to making investments in their landholdings (Olsson & Svensson 2009b).

Summary of the previous research

In conclusion, there seems to be a general agreement in the previous research that the distance has an impact on agricultural production. However, the time periods in these studies are either short-term or medium-term, and the question of how changes in the long-term demand affect the spatial patterns of agricultural supply has not been addressed. This means that there is a general lack of knowledge on whether the spatial pattern of agricultural supply in a pre-industrial context is a temporal or long-term process. These studies on the spatial variation in agricultural intensity are also almost based entirely on regional estimates, with the exception of Stifel & Minten's (2008) study of Madagascar. Thus, differences in the agricultural intensity between rural households may be concealed. Therefore, it is important to measure the impact of distance on agricultural intensity at the household level.

From the earlier studies in Sweden, it is evident that the impact of distance on agricultural intensity requires a more thorough investigation. The previous evidence of market integration in Sweden from the 1770s and onwards is based on long-term changes in the regional price levels and not production. This makes it relevant to study the response of production during a

period of rising demand, especially since the agricultural supply among different geographical groups may differ. Furthermore, various explanations for the rise in agricultural output during agricultural transformation in Sweden exist, but the impact of distance on agricultural intensity has not been examined, which further underlines the importance to study the development of spatial patterns of agricultural supply.

The present study adds to previous studies by analyzing the spatial patterns of agricultural production over time, and by recognizing that long-term growth in demand with market expansion may lead to new dynamics of the spatial variation in farming intensity. Especially with regard to the Swedish case, there is paucity of research on this matter. This paper uses a long-term approach at micro-level, which focuses on the impact of distance on agricultural supply in southern Sweden, and how it changed as the long-term demand for agricultural products increased.

2.2 Theoretical framework

2.2.1 Peasants and property rights

The gradual strengthening of individual property rights in Sweden during course of the 18th and 19th century were pivotal in the transformation of the agricultural sector. It provided the peasants with better opportunities to accumulate capital and make investments in their landholdings. However, important differences existed depending on the category of land ownership. There were three different categories of land ownership in Sweden: freehold land, crown land and noble land⁴. The freehold land belonged to free peasants, who disposed of their own surplus of production. They had to pay tax to the state for using the land. The crown land was owned by the crown, but the tenants cultivated it and paid rent for using it. The noble land belonged to the nobility but was farmed by tenants. Noble tenants were freed from paying taxes and rents to the state, but had to pay rents in kind, money and/or labor duties to a manorial landlord (Gadd 2000:76-79).

At the beginning of the 18th century the land distribution between the three peasant categories in Sweden was nearly equal. During the course of the 18th century, however, the distribution of land between these peasant groups in Sweden changed. The share of the

⁴ There were also other differences apart from legal and fiscal conditions. Since the 15th century both freeholders and crown tenants had a place in the parliament, and as one of the four estates, whereas noble tenants did not possess equal political rights as these two groups, see Gadd 2000:81-82.

freeholders increased, mainly due to dismantling of crown land but also due the sales of noble land (Gadd 2000:43-44, 204-205). The province of Scania differed from the rest of Sweden. Almost half of the land belonged to the nobility at the beginning of the 18th century, and the distribution of land even remained intact during the 19th century, in contrast to other parts of Sweden. This was due to the relatively stronger ownership that the manorial landlords enjoyed in Scania, as part of the Danish heritage in Scania (Olsson 2002:64-69).

The freeholders in Sweden experienced a gradual strengthening of their individual property rights. The first, and perhaps most significant, change was the introduction of a new tax system, *indelningsverket*, by the end of the 17th century. As a result of the introduction of the new tax system, the taxes were tied to the *mantal*⁵ and were paid directly to the soldier, which in practice froze the taxes. The rising agricultural productivity during the 18th and 19th centuries led to lower tax levels for the freeholders, which made it possible for the peasants to accumulate capital for investments. This had been difficult, if not impossible, before, as the taxes were set arbitrary by the Crown (Olsson 2005:174-175, 180). There were also other important institutional changes, which strengthened the freeholders' property rights. The law governing the subdivision of freehold land was eased in the year 1747, and from that time the peasants were allowed to subdivide land to the extent that it could provide for a family (Gadd 2000:71-73). The introduction of the enclosures in the early 19th century, which broke up the village and concentrated the previously scattered strips of land into a single land unit, also strengthened the freeholders' property rights, as it abolished the collective decision-making in the village council (Gadd 2000:284-285). Furthermore, the land market also developed in connection with the enclosures due to the privatization of common land. This increased the possibilities to transfer land outside of the family, and it also meant that the peasants could both acquire and sell part of their land (Svensson 2006).

The crown tenants' possession of land was in many respects similar to that of the freeholders. They were, as the freeholders, tied to the new and rigid tax system. Therefore, the crown tenants experienced, in particular when land productivity increased during latter part of the 18th century and the first half of the 19th century, declining tax levels (Olsson 2005:174-175, 181). However, there were also important differences in terms of the security of possession of land. They were tenants, albeit with strong land tenure of six-year tenancy periods. These tenures were also renewed in most cases. The land tenure could also be passed on to the children, but this was less certain. For the most part of the 18th century, however, the

⁵ Tax unit was based on estimated production capacity according to the land size, but it was not proportionally to the land size (see Svensson 2001:62-66; Olsson 2005:76-80).

crown tenants lacked long-term control of the land, and the heritage procedure was, therefore, insecure. The heritage of land tenure was thus strengthened in 1789, when a new act gave the crown tenants formal rights to their land (Gadd 2000:76). As in other parts of Sweden, the share of land belonging to crown in southern Sweden decreased consistently during the 18th and 19th centuries due to the sales of crown land to the crown tenants, who became freeholders in the process. This was a way for the state to increase its revenues following the fiscal deficits of the great Nordic war (1700-1720). The peasants, who were able to purchase their farmsteads from the crown, received full ownership of the land. This made long-term investments in their landholdings more secure. In addition, it was also possible for them to use the land as collateral for loans, which, in turn, could be used for new investments in land (Gadd 2000:201).

The noble tenants were, in contrast to the freeholders and crown tenants, part of a manorial system. Thus, there were similar heritage procedures in the manorial parishes as in the parishes with freeholders, even though such a right was not formalized legally. The tenancy could, in the most cases, be passed on to children in the household (Lundh & Olsson 2002). However, the noble tenants still had uncertain rights of possession of land and also had extensive, and often unregulated, labor duties on the demesne. The insecure property rights inhibited long-term investments and improvements in the land (Olsson & Svensson 2009a). Further, the flexible element of the land rent, labor duties, meant that the noble tenants' land rents increased as the grain prices increased almost continuously from the 1750s until the 1850s, albeit with a short cessation in the 1820s. The labor duties on the demesne for noble tenants increased and sometimes reached 300–400 days per year for the individual household as a result of the larger volumes of grain production. The expansion of the demesne production during the second half of the 18th century also involved, when needed, eviction of tenants on noble land, and this continued during the first half of the 19th century. Accordingly, the manorial estates in Scania were in this process transformed into large-scale production units (Olsson 2002:347-350; see also Olsson 2006).

2.2 Commercialization of the agricultural sector

Long-term growth in demand

The agricultural sector in Sweden experienced a long phase of economic transformation from the beginning of the 18th century to the middle of the 19th century, particularly during the first half of the 19th century. This was a period when the demand for agricultural products were

increasing at a fast rate, but also a period when the grain prices were rising and when the mercantilist trade restrictions were removed. The growth in demand, however, was rather weak in the first half of the 18th century, and the degree of self-sufficiency was high. Nonetheless, the peasants were always to some extent involved in the markets, as they needed to buy necessities that could not be produced within the household. They also had to sell agricultural products in order to pay taxes in cash (Olsson 2005:116-117). There was also a regional difference in demand for agricultural products in Sweden in the early 18th century. This facilitated at least some division of labor in the agricultural sector (Åmark 1915:53-54).

The local demand for grain increased rapidly from the 1750s and onwards. The growth of the agricultural sector, especially during the first half of the 19th century, enabled a more rapid population growth. The population doubled from almost 1.8 million people in 1750 to reach 3.5 million people in 1850, which put pressure on the agricultural sector to provide for the larger population. The agricultural transformation, together with a rapid population growth, led to large changes in the social structure. The group of landless and semi-landless people more than quadrupled between the year 1750 and the year 1850. During the same period, however, the group of landed peasants only increased by ten percent. This resulted in an increasing social differentiation (Wohlin 1909).

The enhancing social differentiation in Sweden strengthened the role of markets further, as it led to increasing demand for agricultural products. On one hand, the group of landless and semi-landless people had to buy their grain on the market. On the other hand, the group of surplus-producing peasants experienced increasing incomes, and the higher incomes among these peasants raised the demand for capital and consumption goods (Fridholm, Isacson & Magnusson 1976). Especially in the 1830s the demand for goods of higher quality increased rapidly, and the increasing consumption of textiles at that time has been specifically noted. Nonetheless, the demand for more basic commodities also started to rise in the late 1840s, when the real incomes for a larger group of peasants increased (Schön 1997).

The incentive to increase agricultural output was increasing even further during the first half of the 19th century. The first sharp rise in the grain prices occurred during the period 1800-1815 as a result of the Napoleonic wars. The grain prices, then, decreased due to the normalization of the trade after the wars ended. At this time, however, Sweden also turned into a net-exporter of grain. The second period of a strong rise in the grain prices came in the late 1840s and early 1850s. The international demand for Swedish agricultural products were increasing, and especially exports of grain (oat) to England increased, and it became one of Sweden's most valuable export goods (Schön 1997; Schön 2000:63-68).

The periods of increasing prices were important for the commercialization process, as they provided the surplus-producing peasants with new incentives to increase their production. The increasing real incomes for the peasants made further specialization possible, which involved purchasing other agricultural commodities from the market. The rising grain prices in Sweden were a result of the large economic and demographic changes, although the variation in price of grain in the short-term could be caused by other factors, such as trade and/or external harvests. The short-term variation in prices could also raise the profits for the surplus-producing peasants (Olsson & Svensson 2009a).

The deregulations of grain trade in Sweden were also a contributory factor, and they encouraged peasants to increase agricultural output further. For most part of the 18th century, the grain trade was restricted by mercantilist trade regulations. The growing demand for grain made them increasingly obsolete, and many peasants also looked for new markets. In 1775, the trade was allowed in other areas than the towns, and the peasants could sell their products to whomever they wished. The high interior toll on agricultural commodities was also abolished in 1810, and this was followed by the removal of the prohibition of exports in 1825 (Åmark 1915:64-111).

Long-term growth in agricultural supply

The long-term growth in demand was followed by long-term changes on the supply side. The growth in agricultural supply was due to both the more extensive methods of cultivation and introduction of new yield-increasing processes. For the most part of the 18th century, however, the productivity in the agricultural sector remained low, and it was based on somewhat extensive methods of cultivation and few investments in land. The increased agricultural output was mostly due to a rapid reclamation of new land, but most of the output was consumed by the increasing population (Gadd 1983). At the beginning of the 19th century the agricultural growth accelerated at a fast rate due to the faster population growth, the increasing specialization and the raising real incomes among surplus-producing peasants. By the end of the 1820s, the low growth in the agricultural sector was turned into a more sustained and productivity induced growth, as a result of the new investments in the landholdings (Schön 2000:69-73).

The contributions of technological and organizational changes to the agricultural output in the first half of the 19th century were important. The land was in itself, at least until the beginning of the 19th century, a factor that inhibited further expansion of the size of arable land, which was due to the tight connection between the arable land, the livestock husbandry

and the meadow. A further expansion of the size of arable land would therefore not only limit the possibilities of grazing and fodder for the husbandry but also reduce the number of draught animals and, accordingly, the amount of manure (Gadd 2000:111-116; Olsson 2005:106-109). At the beginning of the 19th century the fundamental obstacles to the further expansion of arable land were removed. New technical changes were introduced in the agricultural production. The cultivation of fodder crops were now integrated together with the other crops on the arable land, which reduced the previous tight connection between the arable land, the livestock husbandry and the meadow, and this enabled cultivation of new land. At the same time, the increasing use of the iron plough made it possible to cultivate the land more intensively; it meant that the number of draught animals could be reduced. The cultivation of potatoes also started to increase, and it had a higher yield than the other crops. These new technical changes led to higher marginal returns on the land (Gadd 1983).

New institutional arrangements were also important to increase agricultural production. The first enclosure act, *Storskifte Enclosure Act*, was issued in the year 1757. The purpose of the first enclosure was to reduce the number of strips of land, but the village was still arranged in an open-field system with scattered strips of land in different fields. The initial enclosure was thus conducive for making improvements in the land, e.g. draining and ditching (Gadd 2000:274-275). The more radical enclosures occurred during the first half of the 19th century. As a result of the later enclosures, the landholdings were rearranged into one single land unit. The enclosed land gave the peasants individual decision-making of the entire landholding – as opposed to previously with the collective decision-making in the village council. The decisions, as far as the cultivation are concerned, were now adjusted to the peasants' needs, which led to a more rational cultivation of the land, e.g. sowing, harvesting and introduction of new crops (Svensson 2001; Olsson 2005).

2.2.3 Space, farming intensity and spatial expansion

The mechanisms by which space are giving rise to increasing agricultural intensity were at first described by von Thünen in the 19th century. Von Thünen's spatial model was based on the following assumptions: 1) there was one central market place for all agricultural products, 2) all transports costs were constant from any given point, 3) a homogeneous agricultural region in terms of climate and natural conditions existed, 4) labor and capital was completely mobile. The basis of the model also rested on the assumption that the peasants wanted to maximize their economic rent, i.e. the difference between revenue and cost per acre. By

holding all other effects on agricultural intensity constant, von Thünen was able to show that the agricultural intensity was lower with increasing distance from the market (von Thünen 1826:7-8).

Given the assumptions of the spatial model, a clear relationship between farming intensity and distance to market was hypothesized and central to the spatial variation in farming intensity was the declining gross revenues further away from the market. This was related to the fact that the final demand only came from one single market and the fact that the transport costs were constant in all directions. The net revenue decreased as the distance to the single market increased, which was due to the higher transport costs (von Thünen 1826:12-17). As the net return declined with distance from the market, higher inputs of capital and labor were more economically viable in the areas close by the town (von Thünen 1826:23-37, 144-147).

The higher inputs of labor and capital close by the town also meant that different crops with different yields were cultivated. According to von Thünen, the crops with higher yields required larger inputs of capital and labor, which meant that the crops with a higher economic value per acre became more feasible to cultivate closer to the market. Furthermore, the crops, often those with higher yields (e.g. fresh vegetables), also required proximity to the market, since they become less valuable, even valueless, if time was devoted to transporting them to the town. In contrast, the crops with the lower yields were grown further away from the market due to the lesser competition for land in those areas. These crops required lower inputs of labor and capital and was, therefore, cultivated in the remotely areas. As a result, the use of farmland became organized in a fashion with the market in the center (von Thünen 1826:37-40, 96-105).

In essence, the spatial model of von Thünen demonstrated that the type of land use was sorted into a concentric series, and that the farming intensity was more profitable near the market, due to the higher net-prices. The model was based on the assumption that there existed a competitive equilibrium with a single market in the center. In reality, however, there existed several alternative local markets in pre-industrial Europe, and the lower intensity further away were rather due to the poorer connection with the markets and the lesser participation there in. The extensive cultivation in the remote areas was also caused by a high degree of self-sufficiency, which has, for example, been shown to be prevalent in the 19th century for France by Grantham (1989) and for Germany by Kopsidis (2009). The spatial theory of von Thünen was also built on the assumption of a homogenous agricultural environment, but in practice, there are several other factors that have an influence on the concrete arrangement of variation in farming intensity and land use, such as the relative

development level of transport infrastructure and the natural conditions. These factors have a centrifugal or centripetal effect on the farming intensity cultivated depending on whether they increase or decrease the revenues per acre of land. The natural conditions also influences which crops that are cultivated, and may in some cases favor crops with higher yields in areas further away from the market (for discussion see Peet 1969; Peet 1970).

A long-term growth in demand decreases the impact of the distance on farming intensity. A rising demand leads to a general increase in the food prices. The increasing food prices make an intensification of the agricultural cultivation more profitable, both in the agricultural areas close to the marketplace (town) and in the remote areas. However, the agricultural productivity decreases at a faster rate in the rural areas close to the town, as they have higher share of inputs of capital and labor. Conversely, the increasing food prices leads to raising net prices for the peasants at distant locations, which thereby makes productivity-enhancing investments more economically viable over a larger space. The more intensive and technically more advanced system of crop cultivation also becomes more profitable at the distant locations due to the improving net-revenues. Furthermore, the inter-regional trade also increases in size due to the expansion of arable land, which facilitates a division of labor between the remote regions and the nearby regions (Peet 1969; Peet 1970).

2.3 Hypotheses

The previous discussion has focused on the development of property rights in Sweden, the long-term changes in demand and agricultural supply. The impact of distance on agricultural supply and the effect of long-term growth in demand on the spatial patterns of agricultural supply have also been discussed. If certain simplifying assumptions are made, many of which will be relaxed later, it is possible to analyze the impact of long-term growth in demand on the spatial patterns of agricultural supply in southern Sweden during the period 1702-1857. On the basis of the previous discussion, a model regarding the development of the spatial patterns of farming intensity can be made for southern Sweden during the period 1702-1857. It is reasonable to expect that the further away from the towns, the lower production will be. However, the impact of distance on agricultural production is to a large extent dependent on the changes in the land rents for the peasants. The noble tenants, who experienced increases in the labor duties and faced evictions, did not react in the same way to increasing prices as the freeholders and the crown tenants, whose land rents declined during the 18th century and the

19th century. For this reason, it is reasonable to assume that the crown tenants and the freeholders were more sensitive than the noble tenants. From the previous discussion, however, it seems likely that the impact of distance on agricultural supply should become weaker over time due to the long-term growth in demand, which improves the net-returns for the remotely located peasants. The variation in farming intensity should, therefore, be more pronounced at the beginning of the period, i.e. when there was a higher degree of self-sufficiency. The spatial patterns of agricultural supply should also be less distinctive in the second half of the 18th century, when the demand for grain increased in connection with the social differentiation. Similarly, I expect the spatial variation in agricultural intensity to be less pronounced when the exports of grain occurred during the first half of the 19th century.

3. Data and area

3.1 Source material

The data on the agricultural production for the rural households is collected from the *Historical Database of Scanian Agriculture*⁶. The *Historical Database of Scanian Agriculture* also contains information on the size of each landholding (*mantal*), the type of ownership (i.e., manorial, crown or freehold), the timing of institutional changes (enclosures) and the natural conditions. The calculation of agricultural production in this dataset is based on the tithe payments, where every tenth of the harvest was paid to the local clergy. The tithes in this region were also paid to the Crown and to the church. The government regulations in the 1680s fixed the annual amount of tithes paid to the crown and the church, and they remained so until the 1860s, while the tithes paid to the local clergy were flexible. The *Historical Database of Scanian Agriculture* contains information on the annual crop production for the period 1702-1857 and covers 34 parishes in Scania, but not any single household is accounted for during the entire period, since all tithe accounts were not maintained, and there was also a conversion of flexible tithes into fixed tithes. However, each farm is followed at least during a coherent time period of 25 years. Taken as a whole, the database covers almost 80 000 tithe payments for the entire period.

As mentioned earlier, the priest monitored and processed each tithe payment in the parish. Since the priest himself was also a farmer and lived in the same parish as the peasants who paid the tithes, the problem of cheating with the taxes should hypothetically be minimal. The fact that the tithes were also collected at the household level makes it possible to identify the number of taxpayers and the main principles of collecting the tithes. The production estimates are of high reliability, and this is underlined by the general agreement of the production estimates with the contemporary reports of harvest failures in the 18th and 19th century, the high correlations between the household's total of production in the same year and the negative correlation with grain prices.

To calculate the households' distance to the closest town, the old military map from the early 19th century (Swe: "Den skånska rekognosceringskartan, 1812-1820") is used. This map was constructed for military purposes during the period 1812-1820, and the aim was to ease

⁶ The description of the *Historical Database of Scanian Agriculture* (HDSA) is based on Bohman (2009); Svensson & Olsson (2009a); Svensson & Olsson (2009b).

the movement of military troops in the case of a war. In the year 1812, when the construction of the map was initiated, clear instructions were given as to how the map should be drawn. The previous geographical maps lacked specific details on the features of the landscape, and they only contained judicial information and the topographic conditions in Scania were somewhat general on the maps. The new military map contained more detailed information on the topographic conditions and the different administrative units in Scania, e.g. parishes (Lewan 2004).

In the present study, the data from *Historical Database of Scanian Agriculture* is combined with the geographical information on distance from the old military map. By combining the two datasets, it was possible to obtain longitudinal data and, therefore, also to trace, and to compare, the impact of distance on agricultural supply. There are some problems to merge the data from these two sources, as the map was drawn during the period 1812-1820. The enclosures at the beginning of the 19th century altered the geographical location of the rural households. However, this problem is rather small, as the farms just moved a small distance within the same village. Another problem occurs if the households disappeared during the course of the 18th century. Therefore, information on distance are lacking for some households in *Historical Database of Scanian Agriculture*.

3.2 Sample

The sample of the present study consists of 34 parishes in southern Sweden for the period 1702-1857. It covers almost 2200 farm units from different geographical parts of Scania. The information from all 34 parishes and 2200 farms units represent diverse natural conditions and socioeconomic conditions, which makes the sample quite heterogeneous. The sample's degree of representativeness for the whole period may be discussed from several different positions and is summarized in Table 1 below. According to Campbell's (1928) ethnological and geographical classifications on the agricultural areas in Scania, the sample can be classified as follows: 17 % of the farms in the sample were located in the plain district (favorable soil conditions), 46 % of the farms were situated in the intermediate district (less favorable soil conditions than in the plain district), and 37 % of the farms were located in the forrest district (unfavorable soil conditions). The sample also contains different type of land categories, as shown in the Table 1. With respect to the physical distance to the closest town, there are also large differences within the sample. The shortest physical distance to the closest town was

five kilometers, whereas the longest physical distance reached 44 kilometers. The mean value of the distance was 25 kilometers.

Table 1: Descriptive statistics of sample, 1702-1857

<i>Variable name</i>		<i>Percentage/Mean</i>
Farm Size	<i>Mantal</i>	0.31
Natural conditions	1) Plain	17
	2) Intermediate	46
	3) Forrest	37
Type of land	1) Freehold land	37
	2) Crown land	21
	3) Manorial 1 (ins)	25
	4) Manorial 2 (uts)	17
Initial enclosures	1) Not enclosed	70
	2) Initial enclosure	26
	3) Re-enclosed	4
Radical enclosures	1) Solitary	5
	2) Not enclosed	77
	3) Enclosed	18
Distance		25 (km)

Source: *Historical Database of Scanian Agriculture*

The goal of the study is to trace the spatial patterns of agricultural supply in southern Sweden, and the design of the present sample makes it possible to fulfilling the aim. The sample displays rather large differences when it comes to the distribution of property rights, natural conditions and geographical locations, but the sample has a high degree of representativeness. It has been selected to enable a thorough analysis of the determinants of agricultural production. The longitudinal data in the sample also facilitates a comparison of the changes in the spatial patterns of agricultural supply across both time and space.

3.3 Choice of time periods

The intention here is to discuss the principles for the dividing the main period into sub-periods. For the purpose of measuring the impact of long-run growth in demand on the spatial variation in farming intensity, and to facilitate a comparison over time, the covered time period here, 1702-1857, is divided into three sub-periods. The three chosen sub-periods will allow for an interpretation of how the long-term growth in demand affected the spatial patterns of agricultural supply in Sweden. The development is rather simplified, but the three periods are chosen to represent fairly stable periods with regard to the pattern of demand. The first period, when the level of self-sufficiency was high and the small-scale regional trade dominated, ends in the year 1775 with the first deregulation of the grain trade. With also the following deregulation of grain trade in 1810, the growth of the domestic market began to expand. Therefore, the second period account for a period of growth in domestic demand. The third and last period starts in the year 1826, since the prohibition of exports was removed in the previous year. Sweden was by then a net-producer of grain, and the exports of grain were also increasing rapidly due to a rising international demand for Swedish grain.

3.4 Description of area

The area covered by the sample stretches across the county of Scania in southern Sweden. The natural conditions of the landscape in Scania varied to a large extent. According to the earlier ethnological and geographical classification of Scania (Campbell 1928; Bohman 2009), the landscape of the 18th century can be divided into three types of agricultural areas: the plain district, the forest district and the intermediate land. The plain district was found along the south coast and the west coast but also extended inwards in parts of central Scania. The landscape was flat in the plain district, and the fertility of the soil was also favorable. This meant that the peasants in the plain district produced a considerable surplus of grain, but the deficit of building material due to the lack of forrest in the plain district encouraged trade with other parts of Scania, mostly with the forrest district. The forrest district covered foremost the northern and central parts of Scania. It was also located in some parts of inland Scania. The natural conditions in the forest district varied depending on the location in the district, but the conditions of soil conditions were generally poor due to both the hilly topographic conditions and the forrest features of the landscape. As a consequence of the natural conditions in the

forrest district, the output of production was mixed, and it included timber, tar, grain and animal production. Finally, the intermediate district in Scania covered both ends of the coasts in Scania but was also situated in the inner parts of Scania. In the intermediate district, the natural conditions also varied to a large extent. The landscape was both hilly and flat and, hence, the area of arable land was smaller than in the plain district. The natural conditions in the intermediate district had an impact on the production output, and it was rather diversified. The meadows were the main source of income but animal breeding was also important and so was production of grain.

4. Method

4.1 Statistical model

The aim of this paper is to study how the impact of distance on agricultural production changed during the period 1702-1857. The analysis is, therefore, carried out by examining which factors that have an impact on the household's level of crop production.

The variable to be explained is change in annual grain production of each individual farm. The dependent variable is continuous and denotes whether an increase in terms of the level of grain production for each farm compared to the previous year has taken place. As instrument for the econometric analysis the general least square regression (GLS) is chosen. The panel regression models are estimated to account for the panel structure of the data set. This econometric analysis also makes it possible to measure how the independent variables explain the changes in crop production across both time and space. The econometric analysis of the crop production is performed separately for the three sub-periods, as discussed previously, in order to measure and compare the impact of distance on agricultural production with regard to the long-term changes in demand.

The independent variables in this paper are supposed to explain the variation in crop production over time and space. Consequently, other factors, apart from the distance, must also be measured in the model in order to analyze the determinants of crop production for each farm, and how these determinants changed during the three sub-periods. Both time invariant and time varying variables are included in the models. The independent variables for the natural conditions, socioeconomic conditions, distance and *mantal* (farm size) vary between agricultural areas/parishes but are fixed over time. The variables for the initial enclosures and the radical enclosures changes over time but are constant between the cases. The crop production of each farm is, therefore, viewed as a function of *mantal*, distance, type of district, initial enclosures and radical enclosures. The regression estimates also contain a time variable and a squared time variable to measure unobserved changes over time (not reported in the regression estimates). The models estimated in three sub-periods are very similar to each other; the only differences are the exclusion of the dummy variable re-enclosed and the radical enclosures in the first sub-period, since these changes had not occurred at that time. The number of observations in the models are 19 930, 37 349 and 13 179, with the highest number for the sub-period 1776-1825 and the lowest number for the sub-period 1826-1857.

The theoretical considerations and the construction of the variables in the model are discussed in greater detail in section 4.2.

4.2 Explanatory variables

The underlying question of this paper is what factors that have an impact on agricultural output, so the dependent variable in the regressions estimates is the level of crop production of each farm, measured in hectoliters. The crop production consists of both grain and potatoes. The independent variables are presented in below, where a more detail description of the independent variables are given together with discussion of the expectations of the independent variables.

Farm size

The variable of farm size is indicates by *mantal*. The *mantal* was an administrative measure of the farms' expected production capacity and was used for the purpose of collecting taxes. The size of the area was thus taken into account in the estimations of *mantal*. However, the *mantal* remained much the same, despite increasing land productivity, so this variable is a less accurate measure of the size of farms, although previous studies have demonstrated a close connection between the size of arable land and *mantal* at the beginning of the 19th century (see Svensson 2001:62-66; Olsson 2005:76-80). The expectations on the regression estimates are that the size of *mantal* should have a positive impact on production, and it should also increase over time as land productivity increased.

Natural conditions

The variable natural conditions are supposed to control for the effect of soil quality on agricultural production, i.e. whether more favorable conditions raises agricultural output. The measure of soil quality is derived from Campbell's (1928) ethnological and geographical classifications of the main agricultural areas in Scania, which includes the following categories: plain district, intermediate district and forrest district. The peasants in the plain district are expected to be better off than the peasants in the other two districts, as the soil conditions were the most favorable there. The peasants in the intermediate district, in turn, are assumed to have a higher agricultural output than peasants in the forrest district due to the slightly better soil conditions. These variables are captured by categorical dummy variables.

Type of land

The landed groups are categorized into four categories and are indicated by categorical dummy variables. The freeholders are the first category of landed groups, and they are expected to be better off than the other landed groups due to their stronger property rights. The tenants on crown land are the second category, and their socioeconomic position was similar in many respects with the freeholders. They are, therefore, only expected to be slightly worse off than the group of freeholders. The last two categories of landed groups consist of noble tenants. The distinction between these two categories is that the first group of noble tenants (“Manorial 1”) had weaker connections to the manorial estate, whereas the second group of noble tenants (“Manorial 2”) was controlled harder by the manor and had more extensive labor duties on the estate. The last category of noble tenants is for that reason assumed to be the worse off among the landed groups (see Olsson 2002; Olsson 2006).

Initial enclosures

The variables initial enclosure indicates whether a farm has been enclosed or not. Similarly, if the initial enclosure was repeated, this is indicated by the variable re-enclosed. Both of these variables are categorical dummy variables. These variables should be compared to the households that have not been enclosed. The fewer number of strips of land following the initial enclosures is expected to raise agricultural output, so the re-enclosure of land should also improve the economic performance of farms.

Radical enclosures

The enclosure of a farm is also expected to affect agricultural output positively due to the strengthened property rights and the new crops. This variable is indicated by the variable enclosure and is a categorical dummy variable. There are also solitary households included in the analysis. Most of the solitary farms were found in the remote areas, especially in the forrest district, and they were not enclosed, since the land was already arranged in one single unit already. However, the impact of being solitary is not clear, at least not in comparison to the farms in the open-field system, which is the reference category here.

Distance

Turning to the measure of access to the market, the variable physical distance to the nearest town was chosen. Nonetheless, this measure is far from perfect. Given the plethora of options presented to peasants it is not obvious to what towns the products were sold to or that all

products were sold in one town. It is, however, reasonable to assume that producers wanted to minimize transport costs and, therefore, had most of their business relations with the nearest town. Furthermore, distance is not a perfect reflection of actual transport costs, as the transport costs was also influenced by the modes of transport, the quality of infrastructure and the topographic conditions. Taken on a very general level the variable physical distance should reflect the access to the market, especially when supplemented with a rough indicator of the road-holding qualities. As an indicator of the road-holding qualities, the average travel time per kilometer for the small roads and the main roads is chosen, and are based on contemporary estimations made by the Postal services in the 18th century. The small roads have been multiplied by 1.33, since it took two hours to transport goods 10 kilometers on small roads but only one and half hour to transport goods on the main roads (Enghoff 1938:97). The distance is expected to be negatively related to rural productivity growth. The distance is also squared to measure whether the impact is slower further away from the town.

5. Empirical analysis

5.1 Statistical results

Regression estimates 1702-1775

The findings regarding the determinants of agricultural output are presented below. As may be seen in Table 2, the overall R-square value is 0.62, which means that the independent variables explain 62 % of the changes in the dependent variable. Thus, the value of explanation in the regression is much higher between the farms than within them, i.e. 0.01 as compared to 0.72, which indicates that most of the differences in grain production is found between the farms rather than changes over time. The main explanation for this is probably the variation in weather that had a large impact on the short-term fluctuations in agricultural output.

Table 2: GLS-regression on crop production in southern Sweden, 1702-1775.

Category	Variable	Coeff	Std.Err.	P> z
Mantal	Mantal in size	69.85	2.14	0.000
Land ownership	Freehold	r.c.	-	-
	Crown	0.29	0.72	0.684
	Manorial 1	-6.50	1.24	0.000
	Manorial 2	-4.20	1.31	0.001
Initial enclosures	Not-enclosed	r.c.	-	-
	Enclosed	-1.78	0.52	0.001
Natural conditions	Plain	r.c.	-	-
	Intermediate	-35.82	1.48	0.000
	Forrest	-34.93	1.53	0.000
Distance	Distance	-0.52	0.13	0.000
	Distance2 (squared)	0.01	0.01	0.000
Number of observations: 19 330				
Number of groups: 960				
R-Square	within:	0.01	Wald chi2(5):	2739.31
	between:	0.72	Prob > chi2:	0.000
	overall:	0.62		

Note: r.c. denotes reference category

The results for independent variables are shown in Table 2 above. Starting with the distance variables, they are both statistically significant. The negative sign of the distance variable is in line with the expectations. This shows that during this period the demand was weak, and this concentrated demand geographically, which led to spatial differences in agricultural output. Moreover, there is a statistically significant but weak effect for the squared distance, which indicates that the impact of distance on agricultural production increased at a slower rate as the distances from the town reached long distances.

Turning to the control variables, the overall effect of the size of farm, measured as *mantal*, was a significant raise in grain production. The mean size of a farm was around an average of 0.31 *mantal*, and the interpretation of the coefficient is that agricultural output increases with almost 70 hectoliters of grain when the farm size became three times larger in size.

The effect found for type of district is, as could be expected, also statistically significant. The results in Table 2 show that the peasants located in the intermediate and forrest district produced almost 35 hectoliters less of grain than the peasants in the plain district. This is most likely related to the better quality of the soil in plain district, which enabled for a considerable surplus production of grain, as opposed to the less favorable soil conditions in the intermediate district and forrest district.

The results displayed in Table 2 also show that the initial enclosures had a negative impact on crop production compared to unenclosed households. This variable is, however, not easy to explain. It may be that draining and ditching of new land in connection with the initial enclosures led to fewer draught animals, which resulted in less manure being produced. Before the introduction of new crops and the iron plough, this led to decreasing agricultural output (Gadd 1983).

When it comes to differences between the different land categories, there are two estimates that are statistically significant. However, there is no statistical difference between the crown tenants and freeholders, as seen in Table 2. This highlights the similar socioeconomic conditions for both of these groups during this period. Thus, the results demonstrate the worse economic performances of noble tenants compared to the freeholders, where manorial 1 denotes those noble tenants who lived outside the parish and manorial 2 signifies those peasants who lived inside the parish and had a closer connection to the manorial estate (Olsson 2005).

Regression estimates 1776-1825

The statistical results for the period 1776-1825 are reported in Table 3 below. The overall R-square value of the regression is 0.50, which means that 50 percent of the variation in grain production is explained by the included variables in the regression estimate. As could also be expected, the regression still explains more of the variation between the farms than over time, but the value of explanation within farms is higher than in the previous regression estimates, which is probably due to the inclusion of the radical enclosures in the estimates.

Table 3: GLS-regression on crop production in southern Sweden, 1776-1825.

Category	Variable	Coeff	Std.Err.	P> z
Mantal	Mantal in size	124.87	3.62	0.000
Land ownership	Freehold	r.c.	-	-
	Crown	-1.89	0.72	0.026
	Manorial 1	1.16	0.82	0.426
	Manorial 2	-7.17	1.69	0.000
Initial enclosures	Not-enclosed	r.c.	-	-
	Enclosed	1.31	0.52	0.001
	Re-enclosed	0.45	0.83	0.581
Radical enclosures	Open-field	r.c.	-	-
	Enclosure	12.30	0.50	0.000
	Solitary	-1.60	3.07	0.601
Natural conditions	Plain	r.c.	-	-
	Intermediate	-36.77	1.72	0.000
	Forrest	-41.58	1.98	0.000
Distance	Distance	-1.39	0.20	0.000
	Distance2 (squared)	0.01	0.01	0.000
Number of observations: 37 330				
Number of groups: 1505				
R-Square	within:	0.25	Wald chi2(5):	14280.68
	between:	0.59	Prob > chi2:	0.000
	overall:	0.50		

Note: r.c. denotes reference category

Table 3 above display the results of regression estimates for the period 1776-1826. The effect of distance on crop production is still statistically significant, and the negative sign of the distance variable is also as expected, even though the impact of distance on agricultural production increased in importance compared to the previous period (1702-1775). This indicates that, when demand for agricultural products increased, the spatial variation in agricultural intensity became more distinctive. However, there is still a statistically significant but weak effect for the variable squared distance. This shows that the impact of distance on agricultural production increased at a slower rate as the distance increased, i.e. a threshold effect.

There was an overall positive effect of the size of farm on grain production, as could be expected. Since the mean size of a farm was around an average of 0.31 *mantal* during the entire period, the interpretation of the coefficient is that agricultural output increased with around 124 hectoliters of grain when the size of the farm increased by three times.

The type of district is still statistically significant. The peasants situated in the intermediate district produced almost 37 hectoliters of grain less than the peasants in the plain district. Moreover, the peasants located in the forrest district produced a reduced amount of about 41 hectoliters of crop production less than the peasants in the plain district. This is in line with what could be expected. The higher quality of the soil conditions in the plain district led to higher agricultural output for the peasants there. The peasants in the intermediate district had slighter better soil conditions than the peasants in the forest district, as shown by the difference in agricultural output.

The results in Table 3 also show that the initial enclosures during the middle of the 18th century had a positive impact on crop production, but there is not a statistically significant effect of the re-enclosure of land. Even more important for raising agricultural output were the radical enclosures at the beginning of the 19th century. The radical enclosures of farms increased agricultural output by almost 12 hectoliter of crop production. Thus, the effect of being solitary is not statistically significant, which implies that the conditions were fairly similar for the solitary peasants to that of peasants in the open-field system.

The regression estimates in Table 3 also indicates that the crown tenants performed worse than freeholders. The crown tenants produced almost 2 hectoliters less of grain than freeholders. However, there is a lack of statistical significance for the noble tenants who lived outside parish and paid most of their rents in kind or money, which is not in line with the expectations. Even so, the noble tenants who lived in the same parish as the manorial landlord had a considerable worse economic performance than the freeholders. They produced almost

7 hectoliters less of crop production. It is, however, hard to give any more thorough explanations for this difference, given the data at hand.

Regression estimates 1826-1857

The estimates for the period 1826-1857 are reported in Table 4. As shown, the overall R-square value of the regression is 0.47, but the R-square is higher between the farms than within. The between R-square value is 0.49, whereas the within R-square value is only 0.19, which is probably, as mentioned before, caused by the exclusion of weather in the regression estimates.

Table 4: GLS-regression on crop production in southern Sweden, 1826-1857.

Category	Variable	Coeff	Std.Err.	P> z
Mantal	Mantal in size	163.87	3.62	0.000
Land ownership	Freehold	r.c.	-	-
	Crown	-5.57	1.85	0.003
	Manorial 1	-14.53	3.45	0.000
	Manorial 2	-19.91	3.37	0.000
Initial enclosures	Not-enclosed	r.c.	-	-
	Enclosed	7.39	2.75	0.007
	Re-enclosed	-3.70	0.83	0.513
Radical enclosures	Open-field	r.c.	-	-
	Enclosure	12.30	0.50	0.910
	Solitary	-1.60	3.07	0.924
Natural conditions	Plain	r.c.	-	-
	Intermediate	-41.60	3.88	0.000
	Forrest	-61.71	3.79	0.000
Distance	Distance	-2.13	0.66	0.000
	Distance2 (squared)	0.03	0.01	0.000
Number of observations: 13 179				
Number of groups: 1247				
R-Square	within:	0.19	Wald chi2(5):	4195.60
	between:	0.49	Prob > chi2:	0.000
	overall:	0.47		

Note: r.c. denotes reference category

As shown in Table 4 above, the effect of distance is statistically significant, and the impact of is negative on agricultural production. This indicates that the spatial variation in agricultural intensity became more pronounced during this period. The estimate of the squared variable distance indicates a small, positive effect, and this effect is also statistically significant. This means that the impact of distance on agricultural production diminished at a slower rate with long distances.

The size of farm had a positive impact on grain production during the period 1826-1857. The interpretation of the coefficient is that agricultural output increased with around 163 hectoliters of grain, if the size of the farm were enlarged by three times in size.

The type of district is also statistically significant. The peasants in the intermediate district had an agricultural output of grain that was almost 42 hectoliters lower than that of the peasants in the plain district. Moreover, the peasants situated in the forrest district produced about 41 hectoliters of crop production less than the peasants in the plain district, while the peasants situated in the forrest district produced almost 62 hectoliters less than peasants in the plain district. This underlines the importance of natural conditions when the commercialization of agriculture accelerated.

The results in Table 4 also show that the initial enclosures starting in the middle of the 18th century had a positive impact on crop production, which increased the agricultural output by 7 hectoliters, but the re-enclosure is not statistically significant. Moreover, the radical enclosures at the beginning of the 19th century were important for raising agricultural output, but they are not statistically significant for this period. Considering that the enclosure of a farm increased agricultural output by almost 12 hectoliter of crop production in the previous period, the probable explanation for the lack of statistical significance is that few of the farms in the sample were enclosed during this period. Being solitary is not statistically significant either, which still implies that the conditions were fairly similar for the solitary peasants to that of peasants in the open-field system.

The empirical analysis in Table 3 also indicates that there were still large socioeconomic differences between the peasants. The crown tenants produced almost 6 hectoliters less of grain than freeholders. The noble tenants (“Manorial 1) who lived outside the parish had close to 15 hectoliters less crop production less than the freeholders, while the noble tenants who lived in the same parish as the manorial landlord had a considerable worse economic performance. Their crop production was almost 19 hectoliters less than the freeholders’ amount of crop production.

5.2 Discussion of results

The overall effect of distance was a significant decrease in grain production. The spatial patterns of agricultural supply in southern Sweden was already established at the beginning of the 18th century, and from that time onwards the spatial variation in farming intensity became more pronounced. The somewhat weaker impact of distance on agricultural production in the first period indicates that growth in demand led to less pronounced spatial patterns of agricultural supply. As the analysis of demonstrated, the period of increasing commercialisation did not reduce the spatial variation. Rather, the impact of distance on agricultural production increased during the second period and also during the third period. The long-term growth in demand was not enough to weaken the strong connection between distance and agricultural intensity during latter part of the agricultural transformation in southern Sweden. This should be interpreted as the lack of integration of the remotely peasants in the markets of pre-industrial Sweden.

6. Closing discussion

6.1 Summary

The first purpose of this study has been to examine the impact of the space on agricultural production, measured as the distance to the closest town, during the period 1702-1857. The second aim of this paper has been to study the impact of long-run growth in demand on spatial variation in farming intensity. An examination of the impact of long-run growth in demand on spatial patterns of agricultural supply during a phase of agricultural transformation provides new insights into the dynamics of markets in a pre-industrial context. A diminishing impact of distance on agricultural productivity has here been interpreted as an important step towards a more developed internal market.

In the theoretical background, the spatial model von Thünen was discussed. According to this model, the main reasons for the spatial patterns were due to differences in capital and labor inputs as well as the cultivation of crops with different yields, which was caused by the higher net-prices for the peasants located nearby the towns. However, a raise in the demand should result in an improvement in the terms of trade for the remotely located peasants, which would thereby stimulate productivity-enhancing investments over a larger economic space. This would have a diminishing impact on the spatial patterns of agricultural supply. It was here hypothesized that the variation in farming intensity in the case of southern Sweden should be more pronounced at the beginning of the period, i.e. when there was a higher degree of self-sufficiency, but should also be less distinctive in the second half of the 18th century when the demand for grain increased. Similarly, the increasing international demand for grain during the first half of the 19th century ought also to have a diminishing impact on the spatial variation in farming intensity.

The empirical analysis of this paper is done by means of an econometric method. As a choice of instrument the general least square regression was selected in this paper. This method made it possible to control for both time and space in the regression estimates. The dependent variable was the amount of crop production of each farm household, measured in hectoliters. The estimations were made for the three specified sub-periods: 1702-1775, 1776-1825 and 1826-1857. These three sub-periods were chosen to represent fairly stable periods with regard to the pattern of demand. For three sub-periods the independent variables are *mantal*, natural conditions, type of landownership, initial enclosures, radical enclosures and

distance. The models estimated in three sub-periods are very similar to each other, although the dummy variable re-enclosed and the radical enclosures are excluded in the first sub-period, as these changes had not occurred at that time.

The spatial patterns of agricultural supply showed a rather unexpected development. The results demonstrated that the spatial variation in farming intensity became more pronounced over time in southern Sweden, despite a considerable growth in the demand, which would support the view that there was spatial concentration in demand, especially during the periods 1776-1825 and 1826-1857. The main finding is that long-term growth in the demand was not in itself a sufficient pre-condition for reducing the spatial variation in farming intensity.

6.2 Concluding remarks

This paper has studied the impact of long-term growth in demand on the spatial patterns of agricultural supply in southern Sweden during the period 1702-1857. In previous research of pre-industrial rural societies, clear spatial patterns of agricultural supply have been found, both in pre-industrial Europe (Grantham 1978; Grantham 1989; Kopsidis 2009) and in the less-developed countries of today (Benziger 1996; Stifel & Minten 2008). The main contribution of the present study is the long-term perspective and the emphasis of the impact of long-term growth in demand on spatial variation in farming intensity. New evidence is presented here, supporting a more negative view of the growth of a domestic market in southern Sweden compared to the previous research on market integration in Sweden (Jörberg 1972).

The results presented here demonstrate that the spatial pattern of agricultural supply in southern Sweden was well established already at the beginning of the 18th century, when there was a high degree of self-sufficiency and limited trade. Despite a considerable growth in the demand during the late 18th century and early 19th century, which was due to the increasing social differentiation, the spatial patterns of agricultural supply did not become less pronounced, but rather the opposite. In fact, the spatial variation in farming intensity increased during the period 1776-1825 compared to the period 1702-1775. As also shown in the empirical analysis, the impact of distance on agricultural productivity became even more distinctive during the period 1826-1857, regardless of the rising international demand for grain, which potentially could induce productivity-enhancing investments in the more remote areas. The interpretation of the results is that the commercialization increased further in those

areas where it already had began. The main explanation for this pattern is probably the declining net-prices as the distance to the market increased, which concentrated demand and, hence, productivity-enhancing investments in a limited space nearby the towns.

In theory the long-term growth in demand should lead to a lesser spatial variation in farming intensity. However, there is little support for this argument in this study. The results show that the spatial patterns of agricultural supply increased over time, regardless of the fact that there was long-term growth in the demand in southern Sweden during the period 1702-1857. The exact mechanisms are difficult to pinpoint given the data at hand. A possible explanation for the persistence of the spatial variation in farming intensity during the course of the 18th century and the early 19th century may be an insufficient transport infrastructure. High transport costs may lower, or even erase, the profits of selling products in the towns, which means that the peasants who are located in the remote areas react slower to new market possibilities, especially in comparison to the centrally located peasants who are situated nearby the towns (Visser 1980). It seems likely that insufficient infrastructure in southern Sweden was a probable explanation for the persistence, and even the increase, in the spatial variation of agricultural intensity.

In conclusion, the results show that the spatial patterns of farming intensity were a long-lasting feature of the pre-industrial society of southern Sweden. The spatial patterns of agricultural supply was already established at the beginning of the 18th century, and from that time onwards the spatial variation in farming intensity became more pronounced. It is evident that certain preconditions must be fulfilled for the spatial variation in farming intensity to diminish. The transport costs must be at levels that do not lower, or even erase, the profits of transporting agricultural products to the market. There must also be a considerable growth in demand at the same time, which induces productivity-enhancing investments over a larger economic space. The more pronounced spatial patterns of agricultural supply in southern Sweden imply that these pre-conditions were not in the place. The impact of distance on agricultural production did probably not start to decrease until later - during the second half of the 19th century – when the railway network expanded and further agricultural growth occurred due to the new technical changes, e.g. fertilizers and agricultural machinery. This most likely meant that agricultural production was profitable in a way that made it less dependent on the distance to markets and the demand coming from there.

This preliminary study has provided new insights into the spatial patterns of agricultural supply in southern Sweden during the period 1702-1857. The analysis has demonstrated that a clear spatial variation in farming intensity existed, and that these spatial patterns became more

pronounced over time, despite a considerable long-term growth in demand. There are several ways in which this issue could be studied further and more thoroughly. Firstly, the impact of transport costs on agricultural productivity could be further delved into by taking into account the modes of transports, the quality of infrastructure and the natural conditions. The approach here should be dynamic and try to measure the changes in transport costs over time. Secondly, future research could also study the spatial diffusion of productivity-enhancing investments, e.g. new crops and new technology, which would further increase the understanding of the mechanisms causing spatial variation in farming intensity. Finally, the links between the urban-rural areas could also be further explored by investigating the trade-networks and credit relations, and the spatial dimension of these relationships.

References:

Sources:

Historical Database of Scanian Agriculture, Department of Economic History, Lund University

”Den Skånska Rekognosceringskartan”, 1812-1820, Lantmäteriet.

Literature:

Benziger, V. (1996). “Urban Access and Rural Productivity Growth in Post-Mao China”, *Economic Development and Cultural Change*, 44(3):539-570.

Bohman, M. (2009). *Bygder eller bara bönder. Tradition och rationalitet i den skånska jordbruksomvandling*, Unpublished Ph.Lic dissertation, Lund University, Department of Economic History.

Campbell, Å. (1928). *Skånska bygder under förra hälften av 1700-talet- Etnografisk studie över den skånska allmogens äldre odlingar, hägnader och byggnader*, Uppsala: Lundequistska.

Enghoff, K. (1938). *De allmänna vägarna i Malmöhus län. Historisk översikt av vägväsendets utveckling från äldsta tider intill år 1937*, Lund: Håkan Ohlssons Boktryckeri.

Fridholm, M, Isacson, M & Magnusson, L. (1976). *Industrialismens rötter. Om förutsättningarna för den industriella revolutionen i Sverige*, Stockholm: Prisma.

Fridlitzius, G. (1981). *Handel och sjöfart. Malmö stads historia, del 3*, Malmö: Allhems förlag.

Gadd, C-J (1983). *Järn och Potatis. Jordbruk, Teknik och Social Omvandling i Skaraborgs Län*, Göteborg: Ekonomisk-historiska Institutionen.

Gadd, C-J. (1999). ”Präster och landshövdingar rapporterar”. I Jorner U. (red.) *Svensk jordbruksstatistik 200 år*, Stockholm: Statistiska Centralbyrån.

Gadd, C- J. (2000). *Den agrara revolutionen 1700-1870*, Stockholm: Natur och Kultur.

Grantham, G. W. (1978).”The Diffusion of the New Husbandry in Northern France, 1815-1840”, *Journal of Economic History*, 38(2):311-337.

Grantham, G. W. (1989).”Agricultural Supply During the Industrial Revolution: French Evidence and European Implications”. *Journal of Economic History*, 49(1):43-72.

Hanssen, B (1952). *Österlen. Allmoge, köpstafolk och kultursammanhang vid slutet av 1700-talet i sydöstra Skåne*, Ystad: Nordiska Museet.

Jörberg, L. (1972). *A History of Prices in Sweden 1732-1914*, Lund: Gleerups förlag.

- Jörberg, L. (1980). *Den ekonomiska utvecklingen i de nordiska länderna 1850-1914*, Lunds Universitet: Ekonomisk-Historiska institutionen.
- Kopsidis, M. (2009) "Markets and Farming Intensity in Pre-industrial Westphalia Peasant Agriculture circa 1830: Boserup Meets Thuenen" in *Markets and Agricultural Change in Europe*, V. Pinilla (eds), Turnhoet: Brepols.
- Lewan, N. (2004). "Beskrivningar till den skånska rekognosceringskartan". *Ale tidskrift*, 2:1-10.
- Lundh, C & Olsson, M. (2002). "The institution of retirement on Scanian estates in the nineteenth century", *Continuity and Change*, 17:373-403.
- Olsson, M. (2002). *Storgodsdrift. Godsekonomi och arbetsorganisation i Skåne från dansk tid till mitten av 1800-talet*, Stockholm: Almqvist & Wicksell.
- Olsson, M. (2005). *Skatta dig lycklig. Jordränta och jordbruk i Skåne 1660-1900*, Hedemora: Gidlunds förlag.
- Olsson, M. (2006). "Manorial Economy and Corvée Labour in southern Sweden 1650–1850, *Economic History Review*", LIX(3): 481–497.
- Olsson, M. & Svensson, P. (2009a). "Peasant economy. Markets and agricultural production in southern Sweden 1711-1860", in V. Pinilla (eds.) *Markets and agricultural change in Europe (13th to 20th centuries)*, Turnhout: Brepols.
- Olsson, M & Svensson, P. (2009b). "Explaining agricultural growth". Submitted to *European Review of Economic History*.
- Peet, R. (1969). "The Spatial Expansion of Commercial Agriculture in Nineteenth Century: A Von Thünen Interpretation", *Economic Geography*, 45(4):283-301.
- Peet, R. (1970). "Von Thünen Theory and the Dynamics of Agricultural Expansion", *Explorations in Economic History*, 8(2):181-201.
- Schön, L. (1997). "Internal and external factors in Swedish industrialization", *Scandinavian Economic History Review*, 45:209-223.
- Schön, L. (2000). *En modern svensk ekonomisk historia. Tillväxt och omvandling under två sekel*, Stockholm: SNS Förlag.
- Svensson, P. (2001). *Agrara entreprenörer. Böndernas roll i omvandlingen av jordbruket i Skåne ca 1800-1870*, Stockholm: Almqvist & Wicksell.
- Svensson, P. (2006). "Peasant and Entrepreneurship in the Nineteenth Century Agricultural Transformation in Sweden", *Social Science History*, 30(3):387-429.
- Stifel, D. & Minten, B. (2008). "Isolation and Agricultural Productivity", *Agricultural Economics*, 39(1):1-15.

Visser, S. (1980). "Technological Change and the Spatial Structure of Agriculture", *Economic Geography*, 56(4):311-319.

von Thünen, J. H. (1826), *Isolated state: an English translation of Der Isolierte Staat* in Hall, P. (eds), Oxford, New York: Pergamon Press.

Wohlin, N. (1909). *Den jordbruksidkande befolkningen i Sverige 1751-1900. Emigrantutredningen. Bilaga IX*, Stockholm: Kungliga boktryckeriet.

Åmark, K (1915). *Spannmålshandel och spannmålspolitik i Sverige 1719-1830*, Stockholm.