

New estimates of land productivity in Belgium, 1750–1850*

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Abstract

Most previous studies of Belgian land productivity in the eighteenth century have focused on the Flemish region, notably the provinces of Brabant, East and West Flanders. The evolution of crop yields in the other provinces has scarcely been considered. By constructing a new series of yield estimates for all provinces within Belgium, this article seeks to fill an important gap in rural historiography and sheds new light on the internal dynamics of Belgian agriculture during a period of fundamental economic change, 1750–1850. Our estimates show a noticeable increase in arable crop yields in the southern Low Countries in the second half of the eighteenth century. Although land productivity responded positively to rapid population growth and rising prices after 1750, it realised a less marked rate of increase. The increase in yield after 1750 can therefore not be attributed to an 'agricultural revolution': the term 'growth acceleration' seems a more appropriate description of the agricultural growth process.

In his study of the evolution of yield ratios between 800 and 1800, Slicher van Bath concluded that land productivity in the North Sea area (England, Belgium and the Netherlands) rose faster than in the remainder of the European continent.¹ Furthermore, his estimates made it clear that the increase of land productivity was most pronounced in periods of growing population pressure and rising prices (1500–1650 and after 1750). This hypothesis will be evaluated on the basis of new estimates of Belgian land productivity in the period from 1750 to 1850.

Most previous studies of Belgian land productivity in the eighteenth century have focused on the Flemish region, in particular the provinces of Brabant, East Flanders and West Flanders.²

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¹ B. H. Slicher van Bath, 'The yields of different crops, mainly cereals in relation to the seed c. 810–1820', in *Acta Historiae Neerlandica*, 2 (1967), pp. 78–97.

² For instance, J. Blomme, 'Bevolking, landbouw en rurale industrie in het Land van Waas, 18e eeuw', in *Annalen van de Koninklijke Oudheidkundige Kring van het Land van Waas*, 87 (1984), pp. 119–243; H. van der Wee and E. Van Cauwenberghe (eds), *Productivity of land and agricultural innova-*

tion in the Low Countries, 1250–1800 (Leuven, 1978); P. Vandewalle, *Quatre siècles d'agriculture dans la région de Dunkerque, 1590–1990* (Ghent, 1994); H. Van Isterdael, 'De opbrengst factoren in het Land van Aalst (17de–19de eeuw)', in J. Craeybeckx and F. Daelemans (eds), *Bijdragen tot de geschiedenis van Vlaanderen en Brabant*, I (Brussels, 1983), pp. 147–165; A. Verhulst and C. Vandenbroeke (eds), *Landbouwproductiviteit in Vlaanderen en Brabant 14de–18de eeuw* (Ghent, 1979).

The evolution of crop yields in the other provinces has scarcely been considered. Interregional yield comparisons or approximate national estimates have not yet been worked out. This lacuna must be ascribed to the discontinuity in the approaches which historians have applied to Belgian rural history. Most studies of the agricultural development of Belgium during the ancien régime have adopted a regional approach, while rural studies concerned with the nineteenth and twentieth centuries have generally been undertaken at the national level. By constructing a new series of yield estimates for all the provinces within Belgium, this paper attempts to fill an important gap in rural historiography and to shed new light on the internal dynamics of Belgian agriculture during a period of fundamental economic change, 1750–1850.

The paper is subdivided in six parts. Section one considers the main hypotheses for the development of agrarian productivity in eighteenth-century Belgium. In section two we discuss the sources which are available for the measurement of land productivity in Habsburg Belgium and their reliability. The third section describes the methods employed to calculate the gross crop yields at the regional (provincial) and national level.³ Section four reviews the results. In section five the development of arable productivity in the 1760–1850 period is interpreted in a broader context. We end with a short conclusion.

I

Within the debate on the agricultural development of Belgium between 1750 and 1850, three different hypotheses can be distinguished. The first, 'optimistic' hypothesis, emphasises that the unprecedented population increase since 1750 had a positive effect on the agricultural development of the southern Low Countries and prompted an 'agricultural revolution'.⁴ Contrary to the (neo-)malthusian model, population growth is seen as the major stimulus of agrarian innovation and specialisation. The rapid demographic expansion of the southern Netherlands boosted the prices of agrarian products, generated an extreme subdivision of peasant holdings and accelerated proto-industrial growth in the countryside. This process led to a more intensive tilling of the soil, an extension of the cultivated area, the introduction of new arable crops, the spread of improved crop-rotation systems, the development of better stock-breeding and manuring methods, and the optimisation of farming tools. The large-scale implementation of these improvements caused a revolutionary increase of total agricultural output, which was seen as the driving force of Belgium's early industrialisation.⁵ The steep increase of agrarian output appeared, for instance, in the positive balance of trade for grain. Despite the excessive rise in domestic demand, the southern Low Countries still managed to export considerable amounts of grain during the period.

³ The yield figures are expressed in metric measures. For the recalculation of these data in British units of measurement the following equivalents have to be used: 1 hectare (ha) = 2.47 acres, 1 hectoliter (hl) = 2.78 bushels and 1 kg = 2.25 pounds. In early nineteenth-century Belgium 1 hl of wheat weighted 78 kg, 1 hl of rye 71 kg, 1 hl of spelt 44 kg, 1 hl of barley 61 kg, 1 hl of oats 44 kg and 1 hl of

buckwheat 63 kg.

⁴ For instance H. Pirenne, *Geschiedenis van België van het begin tot heden* (4 vols, 5th edn, Brussels 1928), III, pp. 142–3.

⁵ J. Craeybeckx, 'De agrarische wortels van de Industriële Omwenteling', in *Belgisch Tijdschrift voor Filologie en Geschiedenis*, 41 (1963), pp. 426–38.

The most prominent advocate of the 'agricultural revolution' theory has been Herman Van der Wee. He has argued that the increased diversification of arable production in particular prompted a substantial increase in Flemish land productivity.⁶ The most important innovation in this respect was the general adoption of potatoes in the rotation scheme. Another supporter of the optimistic view has been Phil Kint. Kint observed that even in the highly productive province of East Flanders, land productivity increased rapidly during the first half of the nineteenth century.⁷ Other scholars have sought to explain the rapid growth of agricultural output in terms of the expansion of the cultivated area since 1750. Confronted with the challenge of feeding a continuously growing population, the Austrian government ordered the systematic reclamation and development of common wastelands and fallow. According to Joseph Roland, this policy initiated an agricultural revolution in the province of Namur.⁸

The second, 'pessimistic' hypothesis stresses that the adoption of new arable crops with higher yields per unit of area, like potatoes, reflected the technical incapacity of traditional cereal cultivation to increase its productivity. Because of the weak growth of cereal productivity, the expansion of potato production was necessary to ease the Malthusian tension between the increasing demand for food and limited supply of land after 1750. This argument was put forward by the Ghent historians Chris Vandenbroeke and Willy Vanderpijpen.⁹ According to their analysis of a substantial number of probate inventories, gross cereal yields in Flanders did not increase between the middle of the seventeenth century and the end of the ancien régime. It was only after 1850 that average yields grew rapidly and then due to the more generalized use of chemical fertilisers. Their study also revealed a continuous increase in the amount of seed sown per unit of area, which suggested that net productivity slackened.¹⁰ Finally, they demonstrated that the evolution of cereal yields could not keep pace with demographic growth. This cast doubt on the positive relationship between land productivity and population development. On the basis of these arguments, both scholars rejected the traditional post-1750 agricultural revolution. They went so far as to affirm Morineau's idea of an 'immobilité multiséculaire' or complete stagnation of agrarian development in Flanders between 1600 and 1850.¹¹

More recently there has been a growing consensus amongst rural historians that Belgian agriculture developed rather gradually when seen from a long term perspective. As in England,

⁶ H. van der Wee, 'The agricultural development of the Low Countries as revealed by the tithe and rent statistics', in van der Wee and van Cauwenberghe (eds), *Productivity of land*, pp. 19-22.

⁷ P. Kint, *Prometheus aangevuurd door Demeter. De economische ontwikkeling van de landbouw in Oost-Vlaanderen 1815-1850* (Amsterdam, 1989), pp. 83-95. Kint's yield estimates for East Flanders were criticized by M. Goossens, *The economic development of Belgian agriculture, 1812-1846* (Leuven, 1993), p. 86.

⁸ J. Roland, 'La révolution agricole au XVIIIe siècle, spécialement dans la province de Namur' in *Annales de la Fédération Archéologique et Historique de Belgique. XXXI^{me} Session. Congrès de Namur*

1938, 31 (1938), pp. 361-6.

⁹ C. Vandenbroeke and W. Vanderpijpen, 'The Agricultural Revolution in Flanders and in Belgium: myth or reality?', in van der Wee and van Cauwenberghe (eds), *Productivity of land*, pp. 163-170. Their view was affirmed by A. Verhulst, 'Agrarian Revolutions: myth or reality?', *Sartonia*, 2 (1989), pp. 71-95.

¹⁰ For rye and wheat, the quantity of seed used per hectare increased from 1.0 to 1.2 hl in about 1656-1665 to 1.5 to 2.0 hl between 1812 and 1825.

¹¹ M. Morineau, *Les faux-semblants d'un démarrage économique: agriculture et démographie en France au XVIIIe siècle* (Paris, 1971).

this view has arisen out of new research on medieval agrarian history.¹² Several scholars have demonstrated that Flemish medieval agriculture was much more varied, dynamic and flexible than had been previously accepted.¹³ Emphasis was laid on the fact that urban and commercial expansion in the thirteenth century stimulated the demand for agricultural products, which caused a rapid increase in prices. This encouraged farmers to diversify and intensify their rotation systems. Over the following centuries, systems of land cultivation were gradually improved and diffused across the Flemish countryside. Under the stimulus of renewed population growth, progressive farming techniques were also adopted in most of the Walloon provinces (Luxembourg, Namur and Liège) during the last quarter of the eighteenth century. Across this region the enlargement of total agricultural acreage due to the incorporation of potatoes, industrial and animal feed crops in the rotation system induced a considerable expansion of arable production. This raises the question of whether the term agricultural revolution should not be used to characterize the agrarian growth process which occurred in the peripheral regions of Belgium after 1750. The term 'growth acceleration' seems more appropriate as a description of the agricultural development of the Flanders region.

II

There are two problems with measuring land productivity of Belgium during the Austrian Régime. The first is the absence of direct yield data in contemporary sources. After the late Middle Ages, the large landowners (nobility and clergy) switched over from the direct exploitation of their estates to a system of leasing. As a result, the eighteenth-century accounts of ecclesiastical institutions and noble families do not contain reliable estimates of farm production and productivity. The second problem is that some series of sources cover only a small part of the actual Belgian territory (e.g. probate inventories). The two types of sources available to the historian will be described and their utility assessed.

(i) *Flemish probate inventories*¹⁴

Although it is beyond dispute that probate inventories are the richest source for the measurement of land productivity in the past, some limitations remain.¹⁵ The most crucial drawback concerns the geographical distribution of the inventories. Inventories are not available for the whole of modern Belgium, but were only produced in the former county of Flanders (the provinces

¹² For England we have drawn on B. M. S. Campbell, 'Progressiveness and backwardness in thirteenth- and early fourteenth-century English agriculture: the verdict of recent research', in J. M. Duvosquel and E. Thoen (eds), *Peasants and townsmen in medieval Europe. Studia in honorem Adriaan Verhulst* (Ghent, 1995), pp. 541–59.

¹³ E. Thoen, 'Technique agricole, cultures nouvelles et économie rurale en Flandre au bas moyen âge', in *Flaran* 12 (Auch, 1992), pp. 51–67.

¹⁴ C. Schelstraete, H. Kintaert and D. de Ruyck, *Het einde van de onveranderlijkheid. Arbeid, bezit en*

woonomstandigheden in het Land van Nevele tijdens de 17e en 18e eeuw (Nevele, 1986), pp. 15–17.

¹⁵ Some of these critical comments on the use of probate inventories for the measurement of land productivity were put forward by M. Overton, 'English probate inventories and the measurement of agricultural change', in A. van der Woude and A. Schuurman (eds), *Probate inventories. A new source for the historical study of wealth, material culture and agricultural development*, AAG Bijdagen, 23 (Wageningen, 1980), pp. 210–14.

of East and West Flanders), parts of the duchy of Brabant (Antwerp and eastern Brabant) and Hainaut (the Mouscron region). In addition, the arable crop valuations contained in the inventories are often incomplete or imprecise. Sometimes no indication is given of the area of the sown parcels or no distinction is made between the value of different crops which were sown on the same area of land.

A further problem is that of seasonality. The date of the inventory determines its usefulness for the calculation of average crop yields. The most complete and accurate inventories were drawn up in the summer months (May to September). Inventories drawn up in the autumn and spring months are less useful. We also have to bear in mind that the appraisers applied two different methods to estimate the value of land. Besides the real or anticipated sale value of the crop, they often took the costs of production as the reference base.¹⁶ These cost-of-production valuations assessed the cost of manuring, labour and sowing-seed. It is, however, unclear to what extent the appraisers included other input costs, like transport or the wages of day labourers, and deducted taxes such as tithes.

(ii) *The cadastral survey of the duchy of Luxembourg, 1766*¹⁷

The Theresian cadastral survey of the Luxembourg-Agimont region was the result of a change in central government policy after the peace treaty of Aix-La-Chapelle (1748). Influenced by mercantilist ideas, the domestic policy of the Habsburg monarchy concentrated thereafter on the consolidation of government power, the modernisation of institutions and the reorganisation of public finance. This gave rise to the creation of a more efficient administrative apparatus, the development of purposive economic intervention and a policy of fiscal reform. In order to improve policy making and stimulate national welfare, new series of economic statistics and cadastral surveys were compiled. As far as the cadastral enquiries are concerned, those for the duchy of Luxembourg (1766) and county of Limbourg (1787) merit special attention.

The purpose of the Luxembourg cadastral survey was to determine the fiscal value of immovable goods and property rights in order to introduce an equitable system of taxation. Tax reform in Luxembourg gained a high priority on the political agenda because the public debt in Luxembourg had risen rapidly since the Seven Years' War (1756-63). Furthermore, tax inequalities were more pronounced here than in the rest of the southern Netherlands because the system of taxation still relied on a contribution scale devised in 1624. This scale no longer corresponded to the economic reality of the eighteenth century.

The Luxembourg cadastral survey, which was completed over five years (1766-1771), grew into the most ambitious cadastral operation ever attempted in the southern Low Countries. It offers an insight into the structure of land holding and land use for an area of nearly 10,000 km².

¹⁶ Robert Allen worked out a method to calculate cereal crop yields from the cost-of-production valuations. His technique was criticized by both Paul Glennie and Mark Overton. See R. C. Allen, 'Inferring yields from probate inventories', *J. Economic History (JECH)*, 48 (1988), pp. 117-125; P. Glennie, 'Measuring crop yields in early modern England', in B. M. S. Campbell and M. Overton (eds), *Land, Labour and Livestock. Historical studies*

in European agricultural productivity (1991), pp. 260-63; M. Overton, 'Re-estimating crop yields from probate inventories', in *JECH*, 50 (1990), pp. 931-5.

¹⁷ The following account is based on C. de Moreau de Gerbehaye, *L'abrogation des privilèges fiscaux et ses antécédents. La lente maturation du cadastre thérésien au duché de Luxembourg (1684-1774)* (Brussels, 1994).

Measures of land productivity can be estimated from data on the annual income of taxable land. These data were registered in the so-called 'Etats d'estimation des biens fonds'. Although the calculation of annual income was primarily based on the rents and selling price of land, some of these documents (like those of the Orchimont district) contain quantitative indications of gross cereal yields per unit of area. A second series of yield data can be found in the summary reports that the local Luxembourg authorities made up by order of the 'Conseil des Finances'. These reports indicate the average rents and selling prices of arable land, pasture land, woods and waste land in the different districts of the duchy.¹⁸

III

As in most other European countries, land productivity in Belgian agriculture during the ancien régime is usually calculated in two ways. The first approach relates the output of a particular crop to the area on which it was grown. The gross yield per cropped area is expressed in units of volume or weight (hectolitres or kilograms per hectare). Yields estimated in this way are a reliable indicator of the physical productivity of the cropped parcels of land. They fail, however, to measure total land productivity, because no account is taken of the share of fallow and fodder area in the arable land and the frequency with which the land was cropped.¹⁹ In the second approach, the crop yields are computed in output per units of sown seeds. In historical literature the gross individual crop yield per seed is indicated as the yield ratio. The difference between the two measures of land productivity lies in the fact that the yield ratios are related to the sowing density. An increase in the amount of seed used in sowing, which could generate higher gross yields per cropped area, resulted in a decrease of the yield ratio. Because the gross yield per cropped area is the most common yardstick to measure land productivity in the past, we have decided to calculate Belgian arable productivity in this way. This makes our data comparable with most yield estimates for other European nations

(i) *Yield estimates on the basis of Flemish probate inventories*

Estimates of gross crop yields in the provinces of Antwerp, Brabant, East and West Flanders about 1760 relies on the analysis of probate inventories. We have selected for study the inventories of 18 villages from East Flanders and 17 from West Flanders. In order to enhance the statistical value of the estimates, we ensured that the three main Flemish soil types – sandy, sandy loam region and Polders – were represented in the sample.²⁰ For the Antwerp province

¹⁸ These reports were published by R. Dendel, 'Une enquête sur l'agriculture luxembourgeoise en 1764', *Tijdschrift van de Belgische Vereniging voor Aardrijkskundige Studies*, 27 (1938), pp. 35–46. The reports for the district of La Roche and Marche are of great importance.

¹⁹ M. Overton and B. M. S. Campbell, 'Productivity change in European agricultural development', in Overton and Campbell (eds), *Land, Labour and Livestock*, pp. 7–13. The various measures of land productivity are formalised in M. Overton,

Agricultural Revolution in England. The transformation of the agrarian economy 1500–1850 (1996), p. 71.

²⁰ The probate inventories for East and West Flanders used in this study are to be found in the Public Record Offices of Beveren, Bruges, Ghent and the City Archives of Aalst. The full references of these documents may be found in G. Dejongh, 'De ontwikkeling van de akkerbouwproductiviteit in de Belgische landbouw, 1750–1850', in *Bijdragen tot de Geschiedenis*, 79 (1996), p. 208.

a similar sampling method was followed. The inventories of 13 villages, situated in the Kempen, Polders and sandy soil region, formed the basis for the calculation of mean arable crop yields. The reconstruction of land productivity in Brabant posed more problems because all the available probate inventories are drawn from the eastern part of the province. It was only possible to use the inventories of four villages in the sandy loam region.²¹ Through a lack of alternative source material, the sandy and loam region could not be integrated into the sample, which makes the Brabant estimates statistically less reliable.

For each commune in the sample, we gathered the valuations of grown crops from the probate inventories for 1760-1770. Two categories of inventories were excluded: the post-harvest inventories (from October to March) and all inventories with imprecise crop valuations. A ten-year period was chosen in order to obtain a significant number of yield observations and minimize the biasing effect of extreme good or bad harvest years on the estimate of mean crop yields. Our sample consists of 530 probate inventories: 74 for the Antwerp province, 58 for Brabant, 235 for East Flanders and 163 for West Flanders.

The reconstruction of gross output per unit of area on the basis of the crop valuations in the inventories was carried out as follows. First, we converted the area of the sown parcels of land from the old system of measurement ('bunder, dagwand, roede') to the metric system (hectare). Second, the given price value for each crop was divided by the actual urban market price per unit of volume. Therefore we used the mean yearly crop prices that were registered at the nearest urban market in the same year as the inventory.²² The division of the two sets of data gave us the harvested volumes in old measure units ('viertel, halster, razier'). These figures were in turn converted to hectolitres.²³ Finally, the volume figures were related to the area of the lots and expressed as yields per hectare.

This technique of yield calculation could not be applied strictly due to the absence of market price series for several Flemish and Brabantine towns. As a result we had to use a divergent set of prices to deflate the crop values mentioned in the probate inventories. In order to get a better idea of the effect of the price series employed on our yield estimates, we calculated the statistical correlation between the absolute differences in the mean yearly rye prices of ten Flemish and Brabantine cities during the second half of the eighteenth century. The price data were taken from the grain price registers of the Central Custom Office of the Austrian Netherlands, the 'Bureau de Régie des Droits d'Entrée et de Sortie'.²⁴

In general the mean rye prices in five Brabantine cities (Antwerp, Lier, Malines, Brussels, Tirlemont) and five Flemish cities (Ghent, Sint-Niklaas, Bruges, Ypres, Courtrai) were closely

²¹ The probate inventories for Antwerp and Brabant are to be found in the General Public Records Office Brussels and the Public Records Office Antwerp. Again, see Dejongh, 'De ontwikkeling', p. 208 for full references.

²² We took the price series from J. Ruwet, E. Helin, F. Ladrerie and L. van Buyten (eds), *Marché des céréales à Ruremonde, Luxembourg, Namur and Diest aux XVIIe et XVIIIe siècles* (Louvain, 1966) and C. Verlinden (ed.), *Dokumenten voor de geschiedenis van prijzen en lonen in Vlaanderen en*

Brabant (4 vols, Bruges, 1959-1973).

²³ The conversion of the old obsolete units is based on P. Vandewalle, *Oude maten, gewichten en muntstelsels in Vlaanderen, Brabant en Limburg* (Ghent, 1984).

²⁴ The prices were published by C. Vandenbroeke, 'Het prijsonderzoek van de regering voor de steden in de Oostenrijkse Nederlanden voor graangewassen, vlas en garen (1765-1794)', in Verlinden (ed.), *Dokumenten*, IV, pp. 7-74.

correlated. The 37 pairs of coefficients between nine of the ten cities ranged narrowly from 0.70 to 0.95, with just eight correlations below this range. The price homogeneity was weak for Ypres, a city on the outermost edge of Flanders. A comparison between the rye prices in Ypres and the Brabantine cities, for instance, produced correlation coefficients of only 0.36 to 0.57. Because we always used the prices of urban markets within the same administrative region, the relative differences in crop prices had a marginal effect on our yield estimates. This was well illustrated when the main crop yields in one sample village were computed on the basis of the prices of several urban markets.²⁵ This test showed that the effect of the divergence of market prices on our estimates of Flemish and Brabantine land productivity was, at most, 10 per cent.

In order to match our yield data to Goossens' figures for the 1812–1846 period, it was necessary to make an estimate of the mean crop yields in a 'normal' harvest year.²⁶ Therefore we had to remove the outliers in our database. A comparison with the minimal and maximal yield results in different studies on eighteenth- and early nineteenth-century Belgian agriculture showed that these outliers were the result of exceptional harvest yields or valuation errors made by the appraisers. They did not correspond to normal levels of land productivity.

A two-step procedure was followed to cancel out the biasing effect of the least reliable yield data. First, the sample mean crop yields and standard deviation of the sample mean was calculated on a ten-years' basis. Second, we imposed for every crop variety an upper and lower yield limit. Assuming that the data were distributed normally around the decennial sample mean, the yield values that were higher than the sum of the sample mean and standard deviation or lower than the difference between these two were removed from our database. All yield values that laid within the intervals were judged representative and retained to measure land productivity in a normal harvest year.²⁷

Finally we aggregated the mean crop yields of the sample villages to the provincial level. Therefore, the yield data were grouped by soil type. This made it possible to compute the mean physical productivity of arable crops per soil region. The crop yields per soil region were extrapolated to the provincial level by weighting them with the relative share of each region in the total arable area per province.²⁸ Ideally the yield figures would have been weighted with the arable crop distribution in every soil region. However, given the quality of our data, such a calculation was not possible.

²⁵ See Dejongh, 'De ontwikkeling', p. 211.

²⁶ Goossens, *Economic development*, pp. 84–5.

²⁷ An alternative method of neutralizing the biasing effect of unreliable yield data is to classify the yield figures in categories of normal, good and bad harvests. We can argue, for instance, that the individual crop yields which vary between 85 and 115 per cent of the sample mean yield must be considered as normal. When the yield figures are higher than 115 or lower than 85 per cent of the sample mean, they may be considered as good and

bad harvest results. For this technique see B. H. Slicher van Bath, 'Les problèmes fondamentaux de la société pré-industrielle en Europe occidentale', *AAG Bijdragen*, 12 (1965), p. 11.

²⁸ The share of the different soil regions in total arable land between 1760–1770 was calculated by G. Dejongh, *Krachtlijnen in de ontwikkeling van het agrarische bodengebruik in België, 1750–1850* (Centre for Economic Studies, Catholic University of Leuven, Research paper 96.01, 1996), p. 47.

The described method is expressed in the following equations:

$$\begin{aligned} YC^i_{\text{Antwerp}} &= 0.55 YC^i_K + 0.41 YC^i_S + 0.04 YC^i_P \\ YC^i_{\text{East Flanders}} &= 0.62 YC^i_S + 0.29 YC^i_{SL} + 0.09 YC^i_P \\ YC^i_{\text{West Flanders}} &= 0.22 YC^i_S + 0.58 YC^i_{SL} + 0.20 YC^i_P \end{aligned}$$

where: YC^i = Gross individual crop yield per unit cropped area

K = Kempen

P = Polders

S = Sandy region

SL = Sandy loam region

(ii) *Yield estimates on the basis of the Luxembourg cadastral survey of 1766*

There are two types of documents in the cadastral archives of 1766 which inform us about land productivity in Luxembourg: the 'Etats d'estimations des biens fonds' and summary reports made up by the local authorities in the different districts of the duchy of Luxembourg. According to the 'Etats d'estimation' of the Orchimont district, mean yields of spelt and oats in the Ardennes amounted to 9.7 and 13.1 hectolitres per hectare. For the Famenne region we have used the productivity data in the survey report of Abbot Jaumain (1764). He estimated the gross yield of spelt and oats in a normal harvest year at 9.7 hl/ha.²⁹ As Goossens and Dejongh have already established that at the beginning of the nineteenth century, the mean yield of rye and oats in the Jura was 18 and 26 per cent higher than in the Ardennes,³⁰ we have assumed the same ratio in output for 1760, so that the average yield in this region is estimated at 8.0 hl/ha for rye and 9.7 hl/ha for oats.

The average land productivity at the provincial level was calculated in the same way as for the provinces of Antwerp, East and West Flanders. The mean crop yield per soil region were aggregated on the basis of the distribution of total cultivated land over the different soil regions. This gives the following result.

$$YC^i_{\text{Luxembourg}} = 0.51 YC^i_A + 0.12 YC^i_F + 0.37 YC^i_J$$

where: YC^i = Gross individual crop yield per unit cropped area

A = Ardennes

F = Famenne

J = Jura

(iii) *Yield estimates on the basis of literature and approximate extrapolations*

For the former principality of Liège, consisting of the provinces of Limburg and Liège, almost no archival sources have been found which contain quantitative information on land productivity. For the Limburg province we have only discovered data for the commune of Lommel, situated in the Kempen. The aldermen's acts of this commune mention a mean rye and buckwheat yield

²⁹ The 'Etats d'estimation' of the Orchimont district are to be found in the General Public Records Office Namur, *Tabelles cadastrales de 1766*, nos 19-86.

³⁰ M. Goossens and G. Dejongh, *Agriculture in figures. Belgian agricultural and cadastral statistics of the period 1801-1825* (Leuven, 1997), p. 134 (table 6).

of 10 hl/ha about 1760.³¹ These figures correspond strongly with the mean productivity levels in other Kempen communes during the first two decades of the nineteenth century.³² Because several studies confirm that land productivity in the Kempen stagnated under the Habsburg regime, the yield figures of Lommel may be considered to be representative for the whole region.³³ The productivity figures for the sandy loam and loam region were equated with the mean crop yields in the sandy loam region of Brabant. According to the early nineteenth-century estimates this extrapolation seems plausible. For the calculation of land productivity at the provincial level, the crop yields of the different soil regions were weighted in the same way as for the other provinces. In short:

$$YC^i \text{ Limburg} = 0.45 YC^i_K + 0.55 YC^i_{(SL+L)}$$

where: YC^i = Gross individual crop yield per unit cropped area

K = Kempen

SL + L = Sandy loam and Loam region

The gaps in our estimates were filled up on the basis of several rural studies. This point can be clarified with some examples. Goossens' estimates show that the mean potato yields in the provinces of Namur and Luxembourg about 1812 were identical (105 hl/ha).³⁴ Considering that one hectare of potato land in Luxembourg produced 100 kilograms of potatoes c. 1760, the same level of physical productivity may be assumed for the province of Namur.³⁵ Furthermore, we have noticed that the gross yields of barley and oats in Hainault during the French Period were similar (27–28 hl/ha). We have assumed that this yield convergence also applied in the Austrian period. A similar method of calculation was used for the reconstruction of the wheat and oats yields in the province of Limburg.

The results of our calculations and those of Goossens are presented in tables 1 (cereal crops) and 3 (industrial crops and potatoes).³⁶ The yields that were computed on the basis of literature and extrapolations are quoted in *italics*. The '-' sign means either that a certain crop variety was not cultivated in the province or no reliable yield estimates could be made. The national crop yield data for 1812 and 1846 differ from Goossens' published figures because they have been recalculated on the basis of the productivity data of only those provinces for which mean gross yields for 1760 were estimated.

³¹ Public Records Office Hasselt, Old Communal Archives, Lommel, no. 10.

³² Goossens and Dejongh, *Agriculture in figures*, p. 133 (table 3).

³³ The stagnation of land productivity in the thinly-populated and slightly urbanised Kempen region during the second half of the 18th century is pointed out by R. Knaepen, *Mol-Baelen-Desschel 1559–1795* (Mol, 1982), p. 283 and E. Vanhaute, *Heiboeren. Bevolking, arbeid en inkomen in de 19de*

eeuwse Kempen (Brussels, 1992), pp. 98–9.

³⁴ Goossens, *Economic development*, p. 89.

³⁵ The potato yield in Luxembourg is derived from F. Pirotte, *La terre de Durbuy aux XVIIe et XVIIIe siècles* (Louvain, 1974), pp. 161–3.

³⁶ Our calculations only relate to 1760. The yield data for the two other benchmark years (1812, 1846) are taken from Goossens, *Economic development*, pp. 85–91.

TABLE 1. Gross cereal crop yields in Belgian agriculture, 1760-1846 (hl/ha)

<i>Province</i>	<i>year</i>	<i>rye</i> (hl/ha)		<i>wheat</i> (hl/ha)		<i>maslin</i> (hl/ha)		<i>buckwheat</i> (hl/ha)		<i>barley</i> (hl/ha)		<i>oats</i> (hl/ha)	
Antwerp	1760	12.5	100	13.7	100	-	-	-	-	20.2	100	22.3	100
	1812	16.7	134	15.5	113	16.5	-	22.7	-	25.0	124	29.7	133
	1846	18.3	146	17.8	130	19.0	-	23.1	-	29.9	148	36.2	162
Brabant	1760	12.7	100	11.8	100	11.8	100	13.0	100	20.3	100	19.6	100
	1812	13.2	104	12.2	103	12.4	105	14.1	108	21.6	106	22.0	112
	1846	16.7	131	16.4	139	17.1	146	18.7	144	28.3	139	33.3	170
Limburg	1760	11.5	100	11.0	100	-	-	11.8	100	11.0	100	14.0	100
	1812	14.4	125	12.7	115	-	-	15.5	131	13.1	119	17.6	126
	1846	15.4	134	17.2	156	18.7	-	16.7	142	24.7	225	27.6	197
East Flanders	1760	16.2	100	14.7	100	15.9	100	16.0	100	22.5	100	25.8	100
	1812	19.9	123	18.8	128	17.8	112	19.8	124	23.0	102	26.0	101
	1846	21.6	133	20.0	137	21.1	133	21.2	133	32.9	146	36.8	143
West Flanders	1760	13.3	100	13.4	100	13.5	100	12.3	100	23.4	100	25.2	100
	1812	16.6	124	15.4	115	17.7	131	15.9	129	29.5	126	32.7	130
	1846	21.2	159	20.1	150	20.0	148	23.6	191	41.1	175	37.1	148
Hainault	1760	18.9	100	14.9	100	-	-	13.0	100	20.0	100	21.1	100
	1812	24.0	127	18.0	121	20.0	-	16.0	123	27.1	136	28.0	133
	1846	20.3	107	19.7	132	18.9	-	19.0	146	36.3	182	38.8	184
Liège	1760	-	-	-	-	-	-	-	-	-	-	-	-
	1812	16.7	-	13.5	-	14.8	-	-	-	18.1	-	25.7	-
	1846	17.9	-	17.4	-	19.0	-	18.8	-	19.9	-	26.1	-
Luxembourg	1760	10.3	100	7.0	100	-	-	-	-	9.0	100	10.6	100
	1812	12.5	121	7.8	111	8.6	-	5.5	-	10.0	111	13.4	126
	1846	19.3	187	14.8	211	15.4	-	13.3	-	17.2	191	24.6	232
Namur	1760	11.5	100	12.0	100	-	-	-	-	-	-	20.0	100
	1812	14.0	122	12.6	105	-	-	-	-	17.5	-	26.9	135
	1846	16.9	147	15.9	133	18.8	-	20.4	-	23.5	-	25.7	129
BELGIUM	1760	13.3	100	12.3	100	13.7	100	13.2	100	18.1	100	19.8	100
	1812	16.4	123	14.1	115	16.0	116	16.3	123	21.3	118	24.5	124
	1846	18.7	140	17.7	144	19.4	141	19.8	151	30.1	166	32.5	164

Note: Indices 1760 = 100.

Source: 1760, derived from probate inventories as described in text; 1812 and 1846, recalculated from Goossens, *Economic Development*, as described in text.

IV

This part of the paper is subdivided into three sections. The first describes the development of cereal crop yields between 1750–1850 and draws a comparison between our estimates and some long-term series on Flemish cereal yields. A second section concerns the evolution of industrial crop and potato yields during the eighteenth and nineteenth centuries. In the third section, growth in arable productivity is linked to the movement of population and agrarian prices.

(i) *Cereal crop yields*

Table 1 shows how the mean cereal crop yields in Belgian agriculture increased between 16 and 24 per cent during the second half of the eighteenth century. With the exception of rye, the productivity of bread cereals (wheat and maslin) saw a less pronounced increase (16 to 17 per cent) than those for buckwheat, barley and oats (18 to 24 per cent). This tendency continued through the first half of the nineteenth century.³⁷ By 1846 the average yields of maslin and wheat had increased by 21 and 26 per cent respectively compared with the beginning of the century. The yields of oats and barley went up by no less than 33 and 41 per cent!

An interregional comparison of productivity levels points to a strong continuity during the 1760–1850 period. Around 1760, as in the first half of the nineteenth century, the provinces of East Flanders and Hainault had the highest yields per hectare. The provinces of Antwerp, Brabant and East Flanders occupied a middle position with a mean rye and wheat yield of 12–13 hl/ha. In the southern regions (Luxembourg and Namur) and the northeast periphery of modern Belgium (Limburg), cereal production failed to reach a productivity threshold of 12 hl/ha for rye and wheat, and 20 hl/ha for oats and barley.

The cereal productivity data are a good parameter of the progressiveness and backwardness of arable farming systems about 1760. In the provinces with the lowest cereal yields (especially Luxembourg and Namur), the agricultural economy was relatively underdeveloped.³⁸ Two and three-year crop-rotation systems predominated. Furthermore, the wasteland or outfield area ('terres sarts'), which produced one cereal crop every 10 to 30 years, still covered a large part of total agricultural area. Technological progress was seriously hampered by the poor soil quality, the low population pressure, the deficient transport network and institutional constraints, such as the persistence of communal property rights and feudal obligations. The agriculture in the provinces with high average crop yields per sown area (in particular East and West Flanders) was characterized by intensive cultivation and efficient crop-rotation systems. The progressiveness of Flemish arable farming under the Habsburg regime was mainly the result of natural environmental advantages, the high population pressure, the predominance of small farming units, the dense urban network and the good market access.

When examining the relative increases in cereal productivity between 1760 and 1810, we notice that the evolution of cereal yields was strongly diversified by region. Of the provinces with the highest productivity levels, Hainault was the most dynamic. In East Flanders, on the other hand, the oat and barley yields had reached a temporary ceiling by around 1760, while the yields of

³⁷ *Ibid.*, pp. 85–8.

³⁸ C. Billen, 'Des campagnes sous le joug des traditions', in H. Hasquin (ed.), *La Wallonie. Les pays et les hommes* (2 vols, Brussels, 1975), pp. 295–311.

bread cereals still increased. In the first half of the nineteenth century, an inverse movement took place. Within the middle category of provinces, the yield development in Antwerp and West Flanders stands out when compared with the situation in Brabant. During the period under consideration, West Flanders registered a remarkable increase in cereal yields per sown area (25 per cent for rye, 31 per cent for maslin, 26 per cent for barley and 30 per cent for oats). In contrast with East Flanders, West Flemish agriculture succeeded in maintaining the increases in oat and barley yields into the middle of the nineteenth century. The productivity trend in Antwerp followed that in West Flanders, except that the mean rye yield showed a stronger increase (34 per cent). Diametrically opposed to this was the development in the province of Brabant. This region recorded the weakest productivity growth nationally (only 3 to 12 per cent). Finally, in the provinces with the lowest productivity levels (Limburg, Luxembourg and Namur) we observe a striking homogeneity in the evolution of the mean yields per hectare.

(ii) *Long-term development of cereal crop yields*

The comparison of our estimates with long-term yield series concentrates on the county of Flanders, because it is the only region for which such series are available. The main aim of this long-term comparison is to answer the question of whether the development of arable productivity in eighteenth-century Flanders had a revolutionary, gradual or stagnant character. Although several scholars have put forward different views on this topic, the debate remains inconclusive.

Flemish agriculture had already realised high crop yields by the late Middle Ages. The mean rye yield in the chancellery of Audenaerde (sandy loam region) during the period 1450-1560 was approximately 13-16 hl/ha. This was at most 20 per cent lower than, and in the best harvest years similar to, the mean rye yields of the East Flemish sandy loam region around 1760 (16.5 hl/ha).³⁹ A second example concerns the Polders around Bruges. In this region, the rye and wheat yields in the second half of the fourteenth century already fluctuated between 11-14 hl/ha and 11-13 hl/ha.⁴⁰ Compared with the average productivity level in the West Flemish Polders around 1760 (14 hl/ha), this was already remarkably high.

When interpreting the estimates of Flemish yields in the Middle Ages and early modern period, we must take account of the crop-rotation system. Tits-Dieuaide, for example, calculated that the rye and wheat yields in Brabant during the second half of the fifteenth century amounted to 18 to 20 hl/ha.⁴¹ According to our estimates, the mean gross yield of both crops about 1760 was 12 to 13 hl/ha, or 50-55 per cent lower than 300 years before! Because fallow land still played an important role in fifteenth-century Brabant agriculture, the real gross yields per unit of *arable* area was, however, much lower than Tits-Dieuaide's figures suggest.⁴²

Vandenbroeke's estimates for the chancellery of Alost, in the East Flemish sandy loam region,

³⁹ E. Thoen, *Landbouweconomie en bevolking in Vlaanderen gedurende de late Middeleeuwen en het begin van de Moderne Tijden*, II (2 vols, Ghent, 1988), p. 813.

⁴⁰ J. Mertens, *De laat-middeleeuwse landbouweconomie in enkele gemeenten van het Brugse platteland* (Brussels, 1970), pp. 78-9 and pp. 155-162.

⁴¹ M.-J. Tits-Dieuaide, *La formation des prix céréalières en Brabant et en Flandre au XVe siècle* (Brussels, 1975), pp. 93-6.

⁴² The same accounts for A. Derville, 'Le rendement du blé dans la région lilloise (1285-1541)', in *Bulletin de la Commission Historique du Département du Nord*, 40 (1975-6), p. 35.

also confirmed that Flemish agriculture traditionally recorded high yields. His data on gross rye yields for the period between 1620 and 1790 are shown in table 2.⁴³ According to Vandenbroeke, the development of arable productivity in East Flemish agriculture after 1760 was far from revolutionary. He deduced this from the fact that the mean cereal yields in earlier periods equalled those of the late eighteenth century (e.g. in 1656–65) and even exceeded them (1716–45). Moreover, he emphasized that the amount of sowing seed used after 1750 showed an upward trend. The tendency towards a more dense sowing after 1750 pointed to a technical incapacity of cereal cultivation to increase the mean productivity per hectare.

TABLE 2. Mean gross rye yields in the Land of Alost (East Flanders), 1626–1825

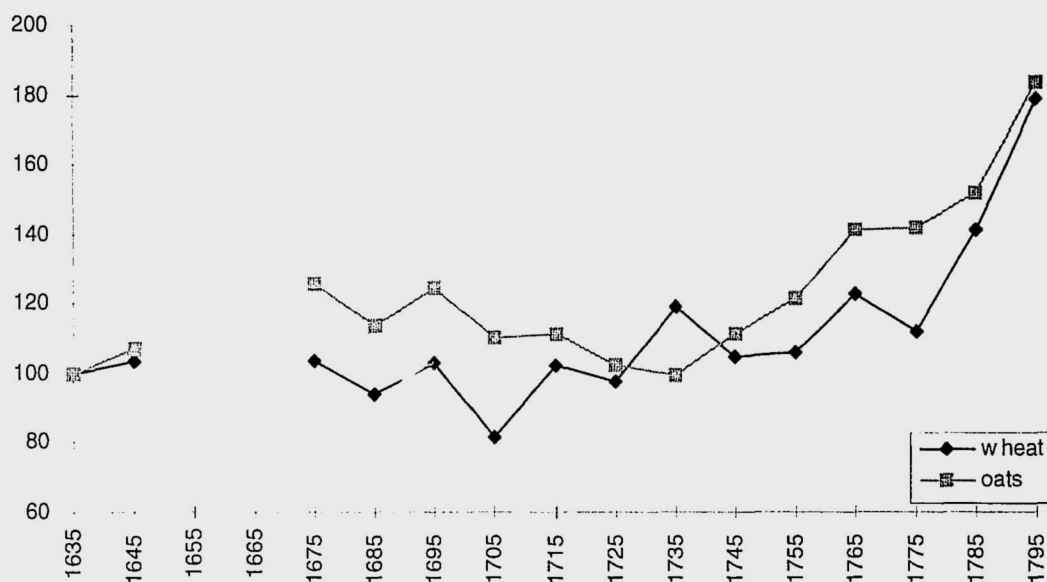
<i>period</i>	<i>rye yield (hl/ha)</i>	<i>index</i>	<i>period</i>	<i>rye yield (hl/ha)</i>	<i>index</i>
1626–1635	14.37	100	1716–1725	19.59	136
1641–1650	14.23	99	1726–1735	19.93	139
1646–1655	16.03	112	1736–1745	19.73	137
1656–1665	17.29	120	1746–1755	18.76	131
1666–1675	15.25	106	1756–1765	18.42	128
1676–1685	16.22	113	1766–1775	18.87	131
1686–1695	13.70	95	1776–1785	21.50	150
1696–1705	15.94	111	1786–1795	17.19	120
1706–1715	14.99	104	1805–1815	18.10	126
			1812–1825	20.51	143

Note: 1626–1635 = 100.

Source: C. Vandenbroeke, 'Graanopbrengsten en oogstschommelingen in Zuid-Vlaanderen (17e–begin 19e eeuw)', in A. Verhulst and C. Vandenbroeke (eds), *Landbouwproductiviteit in Vlaanderen en Brabant 14de–18de eeuw* (Ghent, 1979), pp. 385–7.

Although Flemish agriculture had already recorded high crop yields since the late Middle Ages, there was still room for a real increase in cereal productivity after 1760. Vandenbroeke's hypothesis, that since the beginning of the seventeenth century crop yields in Flanders showed an 'extremely stable character', is open to criticism on several grounds. First, the author limited his analysis to the evolution of bread cereal yields in the region around Alost during the seventeenth and eighteenth centuries. He considered his estimates as being representative for the entire Flemish countryside, which we might question. Second, he paid too little attention to the important changes in land productivity that took place during the first half of the eighteenth century. Third, when a comparison is made between Vandenbroeke's data for the seventeenth century and the late medieval levels of land productivity in the same region, we notice that the idea of an intersecular stability of cereal yields conflicts with historical reality. Available estimates for Ninove, near Alost, make clear that the mean gross yield of one hectare

⁴³ C. Vandenbroeke, 'Graanopbrengsten en oogstschommelingen in Zuid-Vlaanderen (17e–begin 19e eeuw)', in Verhulst and Vandenbroeke (eds), *Landbouwproductiviteit*, pp. 385–7.



Note: 10-year means; 1625–1635 = 100

Source: P. Vandewalle, *Quatre siècles d'agriculture dans la région de Dunkerque, 1590–1990. Une étude statistique* (Ghent, 1994), pp. 458–467

FIGURE 1. Index of mean gross yields of wheat and oats in the region of Dunkerque, 1635–1795

of rye in the beginning of the fifteenth century amounted to 11 or 12 hectolitres.⁴⁴ This is significantly lower than Vandembroeke's calculations of the average productivity level in the first decades of the seventeenth century (14 to 16 hl/ha).

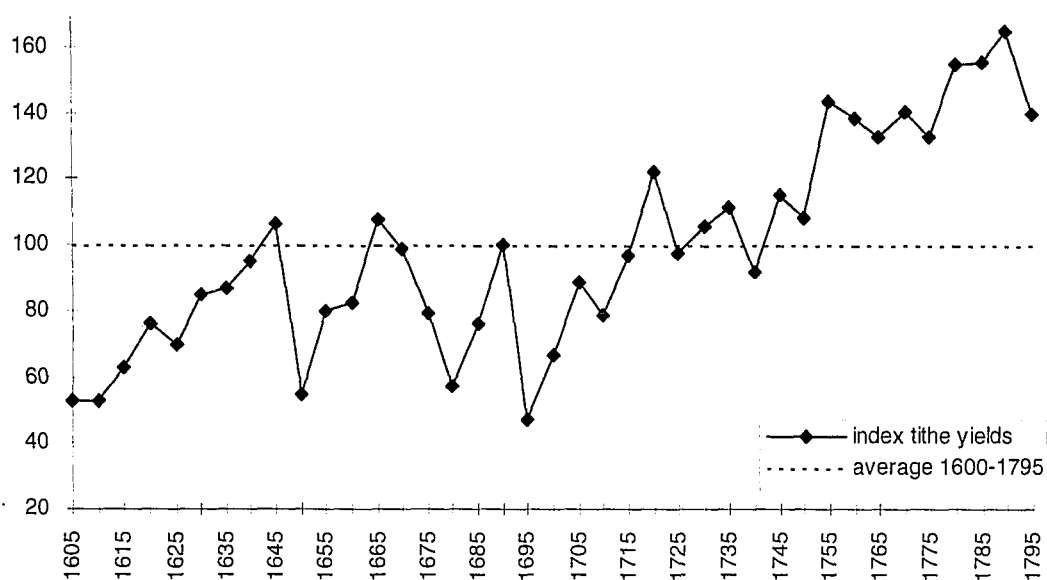
Furthermore, the long-term evolution of crop yields in other Flemish regions deviated from that of the Alost model constructed by Vandembroeke. In the Land of Waas (sandy region), for instance, mean cereal yields continued to increase significantly after 1750. During the second half of the eighteenth century, rye yields amounted to approximately 18 hl/ha. This comes down to a growth of 20 to 40 per cent compared with the periods between 1700–1717 (c. 15 hl/ha) and 1720–1739 (c. 13 hl/ha).⁴⁵ Even in the polders of West Flanders there was an increase in yields during the Habsburg regime. Vandewalle's estimates for French Flanders display a strong productivity growth in the period 1755–1795. Whereas the rye and oat yields about 1756–1765 were approximately 14 hl/ha and 30 hl/ha, they had already increased to 20 hl/ha and 38 hl/ha respectively at the eve of the nineteenth century (see figure 1).

Data drawn from tithe returns also makes it certain that the gross yields of arable crops in Flanders did not stagnate after 1750. Before describing these, we need to offer a few cautionary comments concerning the utility of tithe data for an analysis of arable productivity. For several

⁴⁴ E. Van Cauwenberghe and H. Van der Wee, 'Productivity, evolution of rents and farm sizes in the Southern Netherlands agriculture from the fourteenth to the seventeenth century', in van der Wee

and Cauwenberghe (eds), *Productivity of land*, p. 131.

⁴⁵ J. Blomme, 'Bevolking, landbouw en rurale industrie', pp. 181–4.



Note: 5-year means; 1600-1795 = 100.

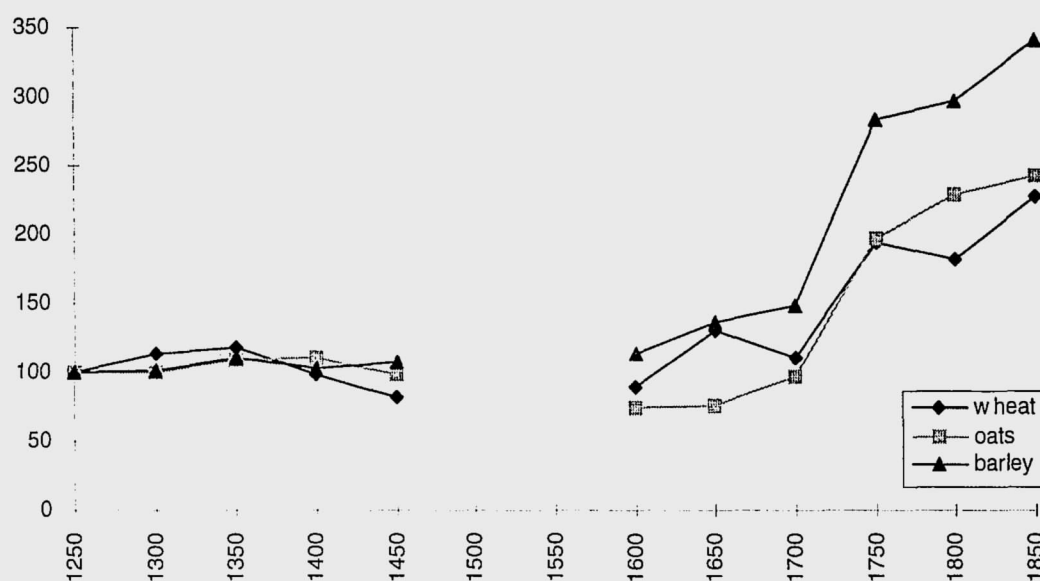
Source: E. Thoen, 'Landbouwproductie en bevolking in enkele gemeenten ten zuiden van Gent gedurende het Ancien Régime (14e-18e eeuw)', in A. Verhulst and C. Vandenbroeke (eds), *Landbouwproductiviteit in Vlaanderen en Brabant, 14de-18de eeuw* (Ghent, 1979), pp. 177-195.

FIGURE 2. Index of tithe yields of the Chapter of Saint Bavo in Ghent, 1605-1795

reasons the tithe documents of the southern Low Countries cannot be used to calculate harvest yields in the past. First, the ratio of tithes to the gross output on the titheable area did not equal 10 per cent, but fluctuated between 10 and 20 per cent. Furthermore, the actual area of a tithe domain and the ratio of crops subject to tithes in the total exploited acreage can rarely be ascertained from the accounts of the ecclesiastical tithe owners. There may have been changes in the assessment base and the titheable area which are unknown to us. Moreover, the people liable to pay tithes had to carry out a number of additional obligations for the institutions receiving the tithes. It is impossible to express these obligations in terms of money. In some cases, tithes were farmed out together with other taxes or separate parcels of land. Finally, we must bear in mind that crop damage due to unfavourable weather conditions or war was seldom proportionally deducted from the agreed rental.

Provided that the tithe series cover several centuries and all data are converted into fixed volume units or into monetary terms, the series enable us to reconstruct long-term trends in arable production. With regard to the county of Flanders, the tithe data show a remarkable output increase since the second half of the eighteenth century. This appears, for instance, from the tithe yields of the Chapter of Saint Bavo in Ghent (figure 2).⁴⁶ According to this data, arable production in the sandy and sandy loam regions of East Flanders rose 50 per cent between 1750

⁴⁶ E. Thoen, 'Landbouwproductie en bevolking in enkele gemeenten ten zuiden van Gent gedurende het Ancien Régime (14e-18e eeuw)', in Verhulst and Vandenbroeke (eds), *Landbouwproductiviteit*, pp. 177-195.



Note: 1250 = 100.

Source: B. M. S. Campbell and M. Overton, 'A new perspective on medieval and early modern agriculture: six centuries of Norfolk farming, 1250-1850', *Past and Present* 141 (1993), pp. 70-1.

FIGURE 3. Index of mean gross yields of wheat, oats and barley in Norfolk, 1250-1850

and 1790.⁴⁷ If we accept that the fallow land in both areas was almost completely exhausted and total cultivated acreage increased only by 7 to 8 per cent between 1760 and 1830, the upward trend of tithe returns must have been mainly due to the combined effect of a more efficient output structure and increased land productivity.⁴⁸

In short, the ceiling which the Flemish cereal yields had reached in the course of the seventeenth century was gradually exceeded during the first half of the eighteenth century. The yield rise continued after 1750 and accelerated from the beginning of the nineteenth century onwards. The hypothesis of a long-term stability in agricultural productivity during the ancien régime – referred to in the literature as 'immobilisme pluriséculaire' – needs to be rejected for the county of Flanders.

Several other progressive rural areas in Western Europe experienced a development of land productivity analogous to that in Flanders. The most striking example in this connection was the East Anglian county of Norfolk, another area with fertile loam soils. As in Flanders, the agriculture of this region had already developed in a progressive way during the Middle Ages. By the last quarter of the thirteenth century, for instance, the fallow was gradually eliminated and more intensive and diversified systems of crop rotation were adopted. Campbell and

⁴⁷ The upward trend of tithe returns since 1750 has also been noticed for other regions in the Austrian Netherlands, e.g. south east Brabant. See F. Daelemans, 'De tienden van het Sint-Geertrudekapittel

van Nijvel (15e-18e eeuw)', in Verhulst and Vandenberghe (eds), *Landbouwproductiviteit*, pp. 221-3.

⁴⁸ Dejongh, *Krachtlijnen in de ontwikkeling*, p. 47.

Overton have constructed an impressive long-term series of gross cereal yield data for Norfolk. Their estimates, which cover a period of six centuries, are reproduced in figure 3.⁴⁹

The Norfolk estimates show, on the one hand, that there was a positive correlation between the general population trend and the evolution of cereal yields. Cereal yields increased in periods of demographic growth and went down when population pressure decreased. On the other hand, gross cereal yields appeared to be extremely high during the Middle Ages, as was the case in Flanders (up to 17 hl/ha for wheat in the period between 1275 and 1350!). Until the end of the 17th century, the mean grain yields fluctuated around the medieval levels. From the beginning of the eighteenth century, a new phase of accelerated growth became apparent and the medieval productivity levels were dramatically exceeded.

A second example is the Ile-de-France, the region around Paris. In 1540–1600, the mean wheat yield in this region amounted to 18 hl/ha. This level remained nearly constant until the middle of the eighteenth century. Because of the increased specialization and commercialization of farming due to rapid demographic expansion, crop yields shot up after 1750. By the end of the ancien régime, they reached an historic record of 24 to 25 hl/ha.⁵⁰

(iii) *Potato and industrial crop yields*

The expansion of potato cultivation in the Austrian Netherlands provided a strong stimulus for growth in agricultural productivity. In yield per unit area, the productivity of potatoes was eight to nine times higher than that of wheat. As may be seen from table 3, the mean gross yield of potatoes was 110 hl/ha, compared with 13 hl/ha for rye and 12 hl/ha for wheat.⁵¹ Given that the calorific value of potatoes was 25 per cent of that of rye and wheat, one hectare of potatoes could feed twice as many people as one hectare of bread grains. In this way, the potato cultivation guaranteed a noticeable expansion of the primary food supply. Furthermore, potatoes were rich in vitamin C, so that they contributed to a qualitative improvement in the daily menu of the rural population.⁵²

Although most of our yield data for potatoes are based upon approximate estimates, we can draw a number of conclusions. We note, for example, that the average national potato yield during the period 1760–1812 increased by only 20 per cent. This is a modest growth compared with the development which occurred during the first half of the 19th century (51 per cent). Moreover, the pattern of regional productivity of potato cultivation around 1750 showed little similarity to that of the cereal crops. In the provinces of Luxembourg and Namur, which traditionally recorded the lowest cereal yields, the yield of potatoes fluctuated around the same level as that of the more progressive agricultural regions, such as Brabant and Hainault.

⁴⁹ B. M. S. Campbell and M. Overton, 'A new perspective on medieval and early modern agriculture: six centuries of Norfolk farming, 1250–1850', *Past and Present*, 141 (1993), pp. 70–1.

⁵⁰ J. M. Moriceau, 'Au rendez-vous de la "Révolution Agricole" dans la France du XVIIIe siècle', in *Annales. Histoire. Sciences Sociales*, 49 (1994), pp. 33–5. J. M. Chevet, 'Production et productivité: un modèle de développement économique des campagnes de la région parisienne aux XVIIIe et XIXe

siècles', *Histoire et Mesure*, 9 (1994), pp. 105–8, also noticed a considerable yield rise in the Paris region during the eighteenth century.

⁵¹ C. Vandenbroeke, *Agriculture et alimentation* (Ghent and Leuven, 1975), pp. 272–3.

⁵² More information on the importance of potato cultivation can be found in C. Vandenbroeke, 'La culture de la pomme de terre en Belgique (XVIIe–XIXe siècles)', in *Flaran* 12 (Auch, 1992), pp. 126–8.

TABLE 3. Gross industrial crop and potato yields in Belgian agriculture, 1760-1846 (hl/ha and kg/ha).

<i>province</i>	<i>year</i>	<i>flax (kg/ha)</i>		<i>coleseed (hl/ha)</i>		<i>potatoes (hl/ha)</i>	
Antwerp	1760	—	—	—	—	120.0	100
	1812	400	—	16.2	—	153.7	128
	1846	504	—	20.3	—	230.4	192
Brabant	1760	308	100	—	—	100.0	100
	1812	400	130	18.7	—	122.6	123
	1846	496	161	17.4	—	197.1	197
Limburg	1760	—	—	—	—	100.0	100
	1812	431	—	7.5	—	139.3	139
	1846	404	—	14.8	—	184.3	184
East Flanders	1760	321	100	—	—	141.2	100
	1812	450	140	18.0	—	158.8	112
	1846	641	200	21.1	—	202.4	143
West Flanders	1760	323	100	15.1	100	121.9	100
	1812	400	124	16.4	108	154.0	126
	1846	584	181	22.9	152	218.9	180
Hainault	1760	320	100	—	—	100.0	100
	1812	431	135	23.6	—	120.0	120
	1846	564	176	19.2	—	184.1	184
Liège	1760	—	—	—	—	—	—
	1812	350	—	19.4	—	119.7	—
	1846	444	—	15.5	—	233.2	—
Luxembourg	1760	—	—	—	—	98.0	100
	1812	250	—	3.2	—	105.0	107
	1846	306	—	9.6	—	184.1	188
Namur	1760	—	—	—	—	100.0	100
	1812	250	—	10.0	—	105.0	105
	1846	467	—	12.8	—	159.0	159
BELGIUM	1760	318	100	15.1	100	110.5	100
	1812	420	132	16.4	108	132.3	120
	1846	571	180	22.9	152	195.0	177

Note: indices 1760 = 100.

Source: see text.

The evolution of potato yields between 1760 and 1812 also deviated sharply from that of cereal crop yields. In the majority of regions, potato yields per hectare increased less than the productivity of the most important cereals. This was especially true for the present day regions of Wallonia and the province of East Flanders.

As for the yield of industrial crops also presented in table 3, the productivity of flax cultivation in the provinces of East Flanders, West Flanders and Hainault in the mid-eighteenth century was characterized by a strong homogeneity. In these three regions the mean flax yield around 1760 amounted to approximately 320 hl/ha. In terms of yield rise, the fastest growth is seen in East Flanders and Hainault (35 to 40 per cent). With an increase of only 24 per cent over 60 years, West Flanders was clearly lagging behind developments elsewhere.

V

In order to broaden our understanding of the development of land productivity, we have compared our yield estimates with estimates of population growth and cereal price series. The comparison between the yield data in tables 1 and 3 with the population figures presented in table 4 makes it clear that the demographic boom and increased demand for food after 1750 had a stimulating effect on Belgian land productivity. Arable productivity responded to population increase in a 'Boserupian' rather than a 'Malthusian' way. This was confirmed by the fact that during the second half of the eighteenth century the southern Low Countries evolved from a grain-importing to a grain-exporting country.

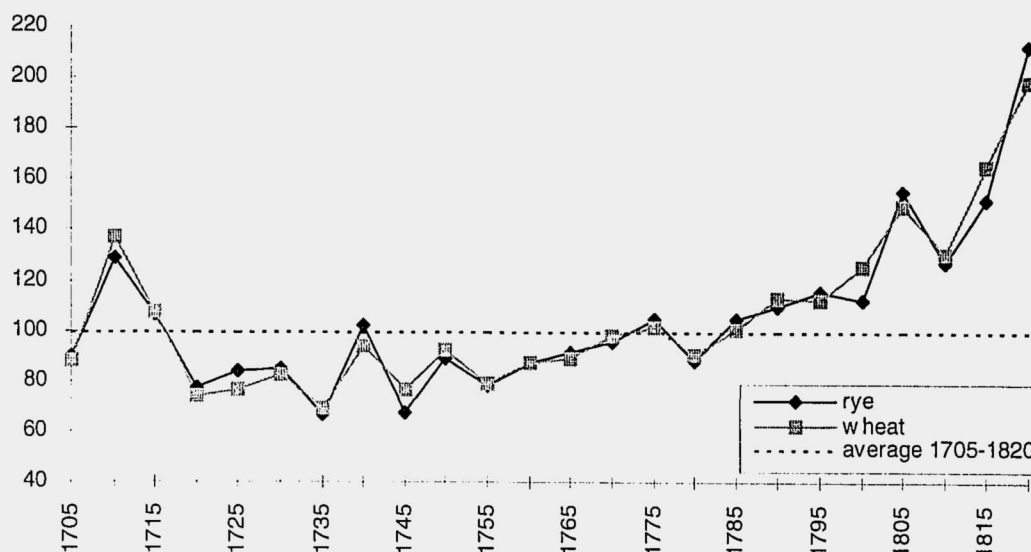
TABLE 4. Demographic development of Belgium, 1700-1800

Province	Absolute numbers			Index		
	1700	1750	1806	1700	1750	1806
Antwerp	225,000	212,500	284,600	106	100	134
Brabant	255,000	287,700	432,000	89	100	150
Limburg	96,000	103,000	129,000	93	100	125
East Flanders	345,000	450,000	573,500	77	100	127
West Flanders	305,000	380,000	491,100	80	100	129
Hainault	295,000	380,000	472,400	78	100	124
Liège	213,000	265,000	293,000	80	100	111
Luxembourg	76,000	85,000	123,600	89	100	145
Namur	85,000	116,000	143,700	73	100	124
BELGIUM	1,895,000	2,279,200	2,942,900	83	100	129

Source: P. M. M. Klep, 'Population estimates of Belgium by province (1375-1831)', in *Historiens et populations. Liber amicorum Etienne Hélin* (Louvain-la-Neuve, 1991), pp. 496, 505.

The increase in cereal crop productivity, however, was lower than the average national population growth. Compared with a demographic growth of 29 per cent between 1750 and 1806, cereal crops recorded a yield increase of 16 to 24 per cent. If we take the yield of rye, the increase in crop yields kept up with the average demographic growth in only four of the nine provinces (Antwerp, Limburg, Hainault and Namur).

A second way to evaluate the trend in Belgian land productivity lies in the comparison between the development of cereal yields and the fluctuations in cereal prices. As the market prices of cereal crops were the most important incentive for the farmers to maximize the



Note: average 1705-1820 = 100.

Source: C. Verlinden (ed.), *Dokumenten voor de geschiedenis van prijzen en lonen in Vlaanderen en Brabant* (4 vols, Bruges, 1959-1973) and J. Ruwet, E. Helin, F. Ladrier and L. van Buyten (eds), *Marché des céréales à Ruremonde, Luxembourg, Namur and Diest aux XVIIe et XVIIIe siècles* (Louvain, 1966)

FIGURE 4. Index of mean urban rye and wheat prices in the southern Low Countries, 1705-1820

productivity of the arable land, we can investigate whether there was a significant correlation between both variables. Within the framework of this research, we present, in figure 4, the trend in market prices for the two major bread cereals (rye and wheat) for 1705-1820. This was calculated from the market prices series for eleven cities in six different provinces: Antwerp (province of Antwerp), Brussels, Diest and Louvain (Brabant), Eeklo, Ghent and Audenaerde (East Flanders), Bruges and Courtrai (West Flanders), Luxembourg (Luxembourg) and Namur (Namur).⁵³ The evolution of nominal rye and wheat prices was expressed in five-year indices, whereby the average of all years was equated to 100.

Figure 4 demonstrates how nominal rye and wheat prices saw an almost uninterrupted growth between 1735 and 1820. Only in the years 1775-1780 and 1805-1810 did the prices dip below the average of the previous period. Where the population of this period increased by almost 30 per cent, the prices of rye and wheat jumped by 139 and 115 per cent respectively. In short, although there was a positive correlation between the movement of population, prices and land productivity, the latter realized a less marked increase. If an agricultural revolution is defined in terms of a sudden and rapid productivity growth, the increase of gross crop yields since 1750 can not be typified as revolutionary. It seems preferable to talk about a period of 'growth acceleration'.

What agricultural or technical factors made possible the increase in average crop yields after 1750? It may be assumed that more intensive soil cultivation and improved methods of fertilisation were largely responsible for a real increase in land productivity. The better fertilisation

⁵³ The price data were derived from Ruwet *et al* (eds), *Marché des céréales* and Verlinden (ed.), *Dokumenten*.

must be attributed to the adoption of more progressive crop rotations, the generalization of stall feeding and increasing use of urban manure. The relative importance of these factors was regionally differentiated. In the provinces of Brabant, East and West Flanders, the accounts and lease registers of a number of towns reveal that the value of the urban manure concession rose rapidly after 1750. This points to a sharp increase of the demand for urban manure at the countryside. Because urban manure was qualitatively superior to traditional farm manure, it certainly contributed to a new upswing of land productivity.⁵⁴ In the southern provinces, the yield rise was mainly the result of the gradual elimination of the fallow area. The abolition of the feudal prohibitions on breaking the fallow permitted an increasing share of former fallow land to be cultivated with animal feed crops, such as clover and turnips. This led to both a qualitative improvement and a substantial expansion of manure production.

The impact of the increased seed sown, on the other hand, has not yet been fully explored. Vandenbroeke defended the idea that the increase in productivity was partly due to a denser sowing of cereal crops.⁵⁵ Goossens has calculated that at the beginning of the nineteenth century, the quantity of seed sown had a significant influence only on the average yield level for rye. For other crops, it did not appear to be a very effective means of increasing land productivity.

VI

Our estimates show a noticeable increase in arable crop yields in the southern Low Countries in the second half of the eighteenth century. This casts serious doubts on the hypothesis of an intersecular stability in arable productivity throughout the ancien régime. Although land productivity responded positively to the rapid population growth and rising prices after 1750, it realised a less marked rate of increase. The increase in yield since 1750 cannot, therefore, be attributed to an agricultural revolution. The term 'growth acceleration' seems more appropriate for the description of the agricultural growth process which occurred in the period 1700–1850. So far as Flanders is concerned, a long-term comparison reveals that the breakthrough in land productivity came in the first decades of the eighteenth century. The yield rise continued after 1750 and accelerated from the beginning of the nineteenth century.

We might end with two observations which serve as both cautions but also suggestions for future work in this field. First, we have to bear in mind that land productivity is only a partial measure of total agricultural productivity. Livestock, labour and total factor productivity must also be considered to elaborate a consistent explanatory model of agricultural development. Second, the terms which are used to evaluate agricultural growth in the past must be defined more clearly. The question arises, for instance, of the criteria on which agrarian progress may be called revolutionary. Are population figures and price data a sufficient reference base? By establishing a more standardized conceptual framework, it will be possible, in the future, to work out profound comparisons of agricultural productivity over time and space.

⁵⁴ Goossens, *Economic development*, pp. 287–292.

⁵⁵ C. Vandenbroeke, 'Graanopbrengsten en oogstschommelingen', pp. 387–9 and Goossens, *Economic development*, p. 270.