Origins of Economic Growth in European Societies Since the XVIth Century: The Case of Agriculture

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The unprecedented and complex economic, social and cultural changes that began to take place in Europe after the XVIth century have frequently been described, yet there is still no agreement as to the prime mover in this transformation. The purpose of this essay will be to argue that the key and principal role in this process was played by a new high-capacity system of communication, the printing press. To suggest this is not new, and the claim has been restated most recently in Elizabeth L. Eisenstein's *The Printing Press as an Agent of Change*,[1] although it does not command wide support.[2] One reason for this may well be that no-one, including Elizabeth Eisenstein, has attempted to evaluate the impact of the new medium of communication on long-term growth in any single sector of the economy. Our purpose here will be to attempt this in the context of agricultural development, both on account of its importance in the wider process of growth and because there are sources on which to base such an analysis.

1. The search for a singular explanation

Amongst the historians who have sought to explain the origins of European economic expansion after the XVIth century, many have seen the prime cause in overseas expansion. Other have looked to changes in the mode of production and the changes within feudal society, while a vast range of other factors — climate, demography, medicine, commerce, culture and geography — have also

[1] *The Printing Press as an Agent of Change. Communications and cultural transformation in early-modern Europe* (Cambridge, 1979).

[2] Cf W.J. Bouwsma, *American Historical Review*, LXXXIV, 1979, p. 1356-1357; A.T. Grafton, *Journal of Interdisciplinary History* XI, 2, 1980, pp 265-286; R. Chartier, *Annales E.S.C.*, XXXVI, 1981, pp. 191-209.

been used to explain the complex phenomenon that one English historian describes as the "European miracle".[3]

While each and all of these played their part in Europe's subsequent expansion, none provides alone a single explanatory cause. Many of these factors are too lacking in specificity or singularity to be analysed as causes, and in any case were often present in other areas where comparable growth did not result. Comparable social and economic changes can be found in the Roman and Chinese empires, yet these never led to a process of sustained growth comparable to that achieved in Europe.[4] Others, such as David S. Landes and W.W. Rostow, have avoided this particular problem by stressing the unique character of Europe. Yet such attempts are still faced with the problem of explaining why technological development remained European and was not experienced earlier in Asia, in China and Japan. Landes argues that we should look for a cause in the peculiarly European sense of rationalism and in "what we may call the Faustian sense of mastery over man and nature".[5] And when Rostow claimed that at the start of the industrial era Europe was already inspired by a "large, fresh concept" [6] he too relied on vague and imprecise generalization.

But one can argue that it is possible to find much more specific causes that lay behind Europe's unprecedented growth not only in technological but also in economic, administrative, cultural and scientific terms after the early XVIth century. In particular, the introduction of the printing press in about 1450 provided the means to store, transmit and increase knowledge on a quite unprecedented scale.[7] The factor that had held back development from the

[3] E.L. JONES, *The European Miracle. Environments, economies, and geopolitics in the history of Europe and Asia* (Cambridge, 1981). Cf also the *Past & Present* symposium on "Agrarian class structure and economic development in Pre-Industrial Europe" (*Past & Present*, LXX, Feb 1976; LXXVIII, Feb 1978; LXXIX, May 1978; LXXX, August 1978; LXXXV, Nov 1979; XCVII, Nov. 1982).

[4] The similarities between the situation in the Roman Empire and other cultures with that in early modern Europe is stressed in the conclusion to M. ROSTOVTZEFF, *The Social and Economic History of the Roman Empire* 2nd edn, (Oxford 1957), pp. 537-541.

[5] D.S. LANDES, *The Unbound Prometheus. Technological change and industrial development in Western Europe from 1750 to the present* (Cambridge, 1980), p. 21 (1st edn 1969).

[6] W.W. ROSTOW, *How it All Began. Origins of the modern economy* (London, 1975), pp. 150-151.

[7] The printing press came from China. The full-scale importance of the printing press as a flexible and accessible high-capacity system of communication did not appear in China because of the difficult code in Chinese (ca 50,000 signs against ca 30 signs (characters) in the European languages). Early Chinese printing may for that reason be termed 'proto-printing'. The revolutionary effects caused by the transfer of printing from China to Europe may be compared with the transition from first-generation machine-code computers to second-generation computers about 1958. On the greater flexibility and accessibility of the printed word in Europe cf O. Jespersen 'The universal

earliest times when agrarian society had emerged in the neolithic era had been the lack of knowledge and the ability to communicate. The advent of the printing press in Europe made it possible to surmount this barrier which, in the case of agriculture, lay above all in the absence of practical biological knowledge.

2. From oral/manuscript tradition to printing press and agricultural growth

In Europe practical biological knowledge remained until about 1500 limited to what could be transmitted by word of mouth and by a few written texts. The case was the same in China because the capacity of proto-printing tradition did not inhibit all innovation, as is evident in the development of the plough, but it left little room for innovation. While the skill applied to agriculture was often striking, in general terms it was only with difficulty that the knowledge acquired from antiquity was retained.[9] By and large the knowledge contained in the treatises of the Chinese agronomists Fan Shêng-Chih (1st century BC) [10] and Chia Ssu-Hsieh (VIth century AD) [11] and their Roman contemporaries, Cato, Varro, Columella and Palladius, was all that a mainly oral tradition could sustain. But such knowledge was too sporadic and inaccessible to be of practical value, and, in contrast to the systematic and accessible knowledge of the XVIIth and XVIIIth centuries, its impact on agricultural practices was imperceptible.

Within the confines of a stagnating body of scientific knowledge and experience derived from practice, agriculture responded to changing circumstances within fixed parameters: the cultivated area was expanded or contracted, livestock replaced arable farming, or vice versa. But it was not possible to increase productivity, which in turn meant that population growth could never surpass

adoption of Roman characters' in *Selected writing* (Tokyo, 1961), pp. 784, 789-790 and J. Gernet, *Le monde chinois* (Paris, 1972), p. 294.

[8] Before the advent of printing, there were probably less than 100,000 manuscript text in Europe. Cf G.G. CANNON, *Great Men of Modern Agriculture* (New York, 1963), p. 17. Perhaps 10% dealt with agriculture. Wang Yü-Hu (*Chung-Kuo Nung-Hsüeh Shu-Lu [Bibliography of Chinese Agriculture]* Shanghai, 1957) lists chronologically all known publications on agriculture, and indicates that before 1500 there were only 227.

[9] An example of disintegration of classical agronomic knowledge in M. Ambrosoli 'L'Opus agriculturae' di Palladio: volgarizzamenti e identificazione dell'ambiente naturale fra Tre e Cinquecento' *Quaderni Storici* LII, 1983, pp. 232-240. Cf also E.L. EISENSTEIN, *op. cit.* pp 10-11, 46-47.

[10] See the bilingual edition of Fan Shêng-Chih in Shih Shêng-Han *On "Fan Shêng-Chih Shu". An agriculturist book of China written by Fan Shêng-Chih in the First century B.C.* (Peking, 1974, 1st edn 1959).

[11] F. BRAY (ed.), *Essential Techniques for the Peasantry: an annotated translation of the 6th century Chinese agricultural treatise Chhi Min Yao Shu* (in preparation). On Chinese agronomy in general J. Needham, *Science and Civilisation in China* vol. 6, II, (Cambridge, 1984), pp. 47-93.

the limits of what the land could support, in Europe something a little short of one hundred million persons.[12] When this ceiling was reached, as occurred in the XIIIth century, the result was not technical innovation but rather a general decline in living standards and increased vulnerability to epidemics like the Black Death.[13]

With the advent of the printing press in Europe this situation began to change. In the first decades after 1450, printing was used mainly to produce editions of classical texts.[14] But that helped restore and diffuse the stock of ancient agricultural science.[15] For the first time the problem ceased to be the protection of already acquired knowledge and became instead its increase and development. Knowledge was no longer finite, and the limits to its diffusion had also been broken.

From 1550-1600 Europe found itself with a new body of agronomic writings. The scientific limitations of these works can easily be demonstrated, as can their lack of originality.[16] But the classical authors on which it was based were quickly superseded: authors who for over a thousand years had provided the *summum* of knowledge soon after 1750 were antiquarian curiosities.[17] This does not mean that in the short span separating 1550 and 1750 all the problems of agriculture had been resolved: agrarian chemistry was fragmentary before 1820, and plant nutrition remained a secret until the 1840s.[18] But many other problems were resolved in the course of the XVIIth and XVIIIth centuries, often through application of knowledge that had existed since antiquity but which now formed part of a more coherent and systematic framework, and which was

[12] On European population estimates before 1500 cf J.C. Russell, *Population in Europe 500-1500* (London, 1969), p. 19 and C.M. Cipolla, *Before the Industrial Revolution* (New York, 1976), p. 4.

[13] Cf. C. M. de La Roncière, *Prix et salaires à Florence au XIV^e siècle (1280-1380)* (Rome, 1982), pp. 406-421; 443-450.

[14] First printed edition of *Scriptores rei rusticae* (*Cato, Varro, Columella and Palladius*), (Venice, 1472).

[15] On diffusion of *Scriptores rei rusticae* cf. C. Beutler 'Un chapitre de la sensibilité collective: la littérature agricole en Europe continentale au XVI^e siècle', *Annales E.S.C.* XXVIII, 1973, pp. 1280-1301.

[16] See the critical edition of Konrad Heresbach *Vier Bücher über Land-wirtschaft (Rei rusticae libri quatuor)* (Meisenheim, 1970; 1st edn Cologne 1570); M. Gorrichon *Les travaux et les jours à Rome et dans l'ancienne France: les agronomes latins inspirateurs d'Olivier de Serres* (Tours, 1976), (on de Serres *Le théâtre d'agriculture* 1st edn Paris 1600).

[17] Jethro Tull defined his famous horse-hoeing agricultural system as 'Anti-Virgilian' (i.e. 'anti-classical'). *The Horse-Hoeing Husbandry* (London, 1733), pp. 40-44 (1st edn 1731); cf also G.E. Fussell, *The Classical Tradition in West European Farming* (Newton Abbot, 1972), pp. 145-149 and A.J. Bourde, *Agronomie et agronomes en France au XVIII^e siècle* (Paris, 1967), pp. 446-452.

[18] Cf G.E. Fussell, *Crop Nutrition: Science and Practice before Liebig* (Kansas, 1971).

therefore more easily utilizable. A good example is provided by the practical and theoretical developments in the use of fodder crops in the XVIIth and XVIIIth centuries which had an important impact on agricultural productivity. Beginning with Agostino Gallo and Camillo Tarello the use of clover and lucerne spread from North Italy over the whole of Europe.[19]

3. The data base

The principal evidence of the fundamental importance of printing could be provided by the number of printed treatises on agriculture that were published in Europe before 1800, when millenarian stagnation had been definitely replaced by structural and permanent growth. Unfortunately such statistics do not exist and the fragmentary character of bibliographic knowledge makes it difficult to attempt such an exercise.[20] None of the principal agrarian economies — Germany, Italy, England and France — have complete national bibliographies for works on agriculture in this period.[21] In the case of the Scandinavian/North German region, however, such bibliographies do exist. These are detailed and precise for Sweden and Finland before 1850,[22] and for Denmark, Norway and the German provinces of Schleswig and Holstein up to 1814.[23]

The Danish-North German area is a well-integrated part of the general European agricultural system. Since Norway, Sweden and Finland are untypical they are not included in the Table that follows which refers to publications only in Denmark and in the German provinces over the period 1590-1814, expressed in ten-year moving averages.

[19] E. Sereni 'Spunti della rivoluzione agronomica Europea nella scuola bresciana cinquecentesca di Agostino Gallo e di Camillo Tarello' in *Miscellanea in onore di Roberto Cessi* vol. II, (Rome, 1958), pp. 113-128. On the importance of fodder crops, esp. clover, lucerne and other legumes of C.P.H. Chorley 'The agricultural revolution in Northern Europe, 1750-1880: nitrogen, legumes, and crop productivity', *Economic History Review*, XXXIV, 1981, pp. 71-93.

[20] G.R. Boehmer *Biblioteca scriptorum historiae naturalis, oeconomiae alariumque artium ac scientiarum ad illam pertinentium* 9 vols., (Leipzig, 1785-1789), and a few other bibliographies try to be exhaustive. In reality they are not.

[21] The most important national bibliographies include M. Güntz *Handbuch der landwirtschaftlichen Litteratur* 1-3, (Leipzig, 1897-1902) (Germany); M. Lastri, *Biblioteca georgica; ossia catalogo ragionato degli scrittori di agricoltura* (Florence, 1787), (Italy); V.D. Mussert [-Pathay], *Bibliographie agronomique ou dictionnaire raisonné des ouvrages sur l'économie rurale et domestique* (Paris, 1810), (France) and W.F. Perkins, *British and Irish Writers on Agriculture* 3rd edn, (Lymington, 1939), (U.K. and Ireland). They are all selective, and mostly exclude one or more sections of the literature; for example translations from foreign languages and/or works published in journals and reviews.

[22] P.M. Hebbe, *Den svenska lantbrukslitteraturen* 2 vols. (Stockholm-Uppsala, 1939-1945).

[23] O. Karup Pedersen, (ed.) *Dansk Landbrugsbibliografi* (pre-1814) (Copenhagen, 1958), p. 460.

Agricultural works began to appear in this region a bit later than in the Central and Southern parts of Europe. The first Danish treatise was relatively early — in 1528 — but it was not until after 1590 that publications became frequent, which is why our graph starts at that point.

The graph shows that publications on agriculture increased dramatically over the 225 years considered. After an early gradual ascent, doubling the number of publications in the first 50 years, the growth became quicker and more regular during the XVIIIth century; the period required for doubling the number of publications is reduced to less than 20 years.

The graph indicates a general increase in scientific knowledge after 1590. Indeed, this might also be described as a bombardment, since editions were on average about 300 copies. On the basis of the total number of publications (6250) this amounts to about 2 million copies of agricultural treatises circulating within the restricted area of Denmark and Schleswig-Holstein alone between 1590 and 1814. For Europe as a whole, the relative population figures would suggest some 200,000,000 texts.[24] Since such treatises numbered about 10,000 in 1470,[25] this suggests an increase of the order of a factor of 20,000. Agricultural literature became a mass commodity in the period between the XVIth and the XVIIIth centuries and, since this was also the period in which agricultural growth became structural and permanent, there would appear to be sound reason for correlating the two. By way of counter hypothesis one should also mention that there was no comparable expansion in agricultural literature in China. It was in the same period that Chinese agriculture began to lose ground to Europe after being ahead for more than two thousand years.[26]

4. Printing and the development of modern societies

It is for bibliographical reasons not possible to compare the output of agricultural literature with developments in other fields of applied knowledge.[27] There is, however, a striking parallel with the development of one of the principal exact sciences, astronomy, since 1601. Also the number of scientific

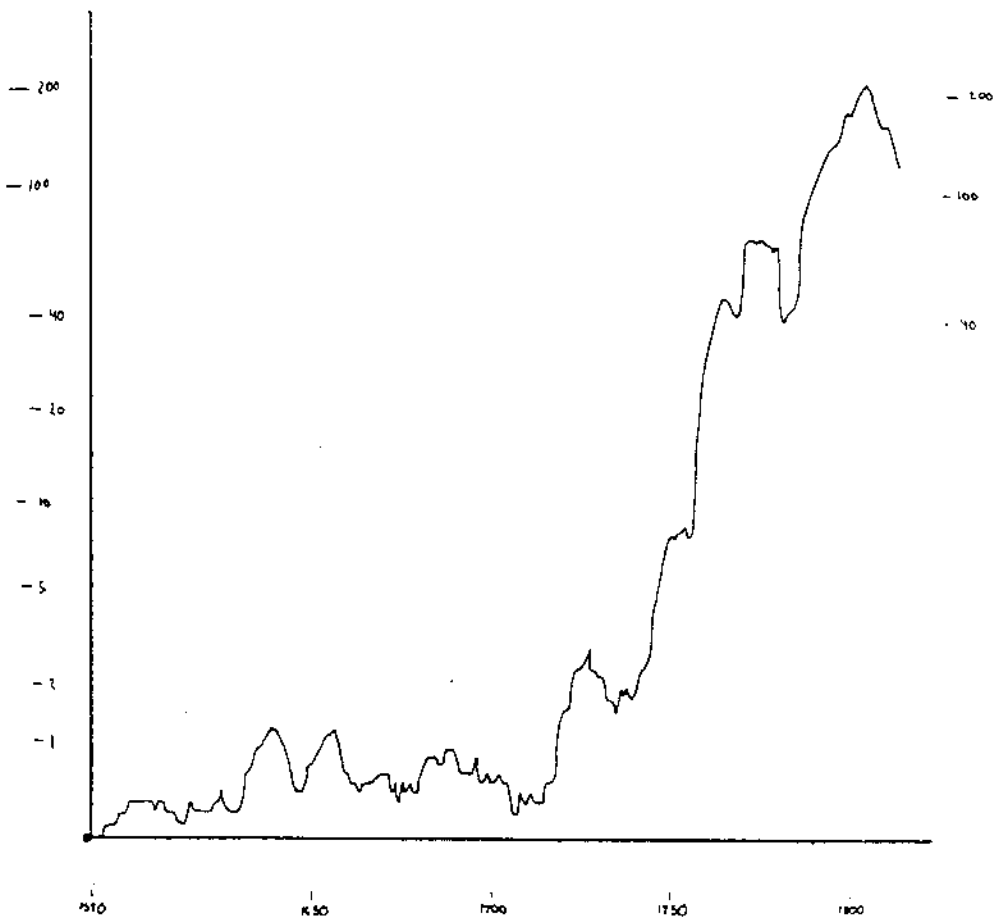
[24] Cf T. KJAERGAARD, *Den offentlige kritik af den danske enevaelde* (Copenhagen University Ph. D. Thesis) vol. 1, 1973, pp. 58-150 (on editions in Denmark); M. AMBROSOLI 'Lettori e chiosatori delle edizioni a stampa di Pier de 'Crescenzi tra 1474 e 1561' *Rivista storica italiana*, XCVI, 1984, pp 367-368 (on the diffusion of de 'Crescenzi's bestseller *XII libri ruralium commodorum*). An average of 300 is a low estimation.

[25] See note 8 & 14 above.

[26] WANG Yü-Hu *op. cit.* mentions only 208 Chinese agricultural treatises in the period between 1500 and 1800. See also J. Needham *op. cit.* pp 85-43, 553-616.

[27] The lack of exhaustive retrospective bibliographies is evident in all sectors of applied science, not only agriculture cf B. GILLES (ed.), *Histoire des techniques* (Paris, 1978), p. 676.

ANNUAL PRODUCTION OF AGRICULTURAL TREATISES IN DENMARK AND SCHLESWIG-HOLSTEIN BETWEEN 1590 AND 1814: TEN-YEAR MOVING AVERAGES



Annual production of agricultural books, pamphlets and articles in Denmark and Schleswig-Holstein between 1590 and 1814: ten-year moving averages.

Note on the Table:

Each unit represents a published work of whatever form for which there is a publication date and which was published in Denmark or Schleswig-Holstein between 1590 and 1814. No destinction has been made between original works and translations, and re-editions have also been included.

journals founded since 1665 follow similar growth patterns, with a doubling of output every 20 years in the XVIII th century.[28].

I would claim that the curve given above for the agricultural literature represents an ideal-type presentation of the development of knowledge and communications in post-Renaissance Europe, a development reproduced simultaneously in all sectors of knowledge. I suggest that this expansion of knowledge together with improved means of communicating this knowledge constitutes the fundamental factor in sustained growth in Europe since the XVIth century, not only of agriculture, but of the economy and of the society as a whole. The counter-hypothesis is once again China where no similar exponential development of knowledge and diffusion of knowledge took place. Lying behind this development was the new high-capacity communication-system, the printing press.

The advent of printing in Europe was much more than one innovation amongst many, as has often been claimed.[29] It was, as Victor Hugo observed, 'the greatest event in history, the mother of all subsequent revolutions'.[30] On this basis, modern science, technology and society was to develop. Printing provides the key for understanding when, where and why these changes began. How the process of modernization, once initiated, came about and took distinct forms in each European country is a question of micro-historical research.

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The advantages of the argument above can briefly be summarised as follows:

1. It provides an explanation of why sustained growth initiated in Europe and nowhere else and began precisely in the XVIth and XVIIth centuries.

2. It is a specific explanation which does not rely on recurrent phenomena such as social tension, demographic changes, economic fluctuations, overseas expansion or religious tendencies.

3. It avoids any form of geographical, climatic or ecological determination.

[28] J.C. Houzeau & A. Lancaster *Bibliographie générale de l'astronomie jusqu'en 1880* vol. II, (London, 1964), pp. LXXI-LXXIII (1st edn 1880-89) and D. de Solla Price, *Science Since Babylon* 2nd edn, (New Haven, 1975), p. 166.

[29] C.M. Cipolla, *op. cit.* pp. 167-168. Cf also E.L. Eisenstein, *op. cit.* pp. 20-21

[30] *Notre-Dame de Paris*, (Pléiade, Paris, 1975), p. 182 (1st edn 1831).