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Forest History and the Great Divergence: China, Japan and the West

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ABSTRACT

This paper surveys changing interrelationships between man and the earth's forest cover over the past several centuries. The focus is on the interplay between population increase, deforestation and afforestation at both ends of Eurasia. By looking at three numerical indicators—percentage forested, per capita forest resources and the population elasticity of deforestation, Japan is compared with Lingnan, south China, and the East Asians with two European countries, England and France. Based on the East-West comparisons and on somewhat more detailed intra-Asian comparisons between China and Japan with respect to market linkages and the role of the state, the paper examines the proposition made by Ken Pomeranz that although both ends of Eurasia were ecologically constrained at the end of the early modern period, East Asia's pressure on forest resources was 'probably not much worse' than in the West.

Forest History and the Great Divergence: China, Japan and the West*

Osamu Saito

Introduction

Environmental history is an attempt to bring environmental factors into historians' exploration of the past, giving emphasis on the interrelationships between humans and nature. Forest history is a particularly interesting environmental history arena for the study of their interrelationships, since forests are not simply the target of man's exploitation but resources which man can rejuvenate by cultivating trees for either utilitarian or non-utilitarian purposes. However, such practice of afforestation did not emerge everywhere[1], and whether this did or did not emerge in the past must have affected humans' standard of living in the present immeasurably.

The standard of living is an issue that occupies a central place in a recent debate on the Great Divergence, inspired by the publication of Ken Pomeranz's book on China and the West[2]. By examining the availability of forest products, he argues that both east and west ends of Eurasia were seriously constrained before the age of fossil fuels and other mineral resources, rejecting the conventional claim that it was China that had long been under population pressure on land resources. However, he seems reluctant to go beyond the calculation of per-capita availability estimates: his Great Divergence book did not raise the question of how East Asians

* This is a revised version of the paper read at the Harvard-Hitotsubashi-Warwick Conference on 'Economic change around the Indian Ocean in the very long run' held at the University of Warwick in Venice, Palazzo Pesaro Papafava, Venice, 22-24 July 2008. Somewhat different versions were also presented at other meetings held in Leeds, Kyoto and Tokyo. The author is grateful to participants of those occasions for stimulating comments and informative suggestions.

1 See for example Richards (2003).

2 Pomeranz (2000). See also Pomeranz (2002).

as well as Europeans responded to the supposedly serious timber shortage. Nor has any critique of his thesis picked up forestry as a topic relevant to the debate on the Great Divergence.[3]

The aim of this paper is to bridge the two, i.e., forest history and the Great Divergence debate. In order to do the bridging, I shall first go over concepts and interpretations in forest history, and also measures that I believe are important in any comparative work. These are the topics of the first section. In section 2, by employing three numerical indicators—percentage forested, per capita forest resource and the population elasticity of deforestation—Japan will be compared with Lingnan, south China, and the East Asians with two European countries, England and France. Sections 3 and 4 turn, by focusing on the two East Asian countries, to the role of market forces and also of the state in relation to the emergence of afforestation in early modern and modern contexts. Finally, section 5 discusses some implications of the findings of the paper.

1. Concepts, interpretations and measures

Concepts and interpretations

There is a widely accepted view that the rise of a civilisation is accompanied by an increase in population, which after a period of balance, outstrips its material base, leading eventually to the destruction of the environment. This is a popular view. But it is worth emphasising that the view is in line with the classical Malthusian theory of population. Malthus himself did not refer to forest, but he could have easily accommodated forest in his theory of population pressure on land. Thus, when population grew forestland receded, while population stagnation (or decline) was followed by the spontaneous return of the forest; but once population increase became sustained, the continuous destruction of forests started.

In history, we have a number of accounts by contemporaries, as well as by later-day historians, that are not inconsistent with this interpretation. Take the Japanese

[3] One notable exception is Warde (2006). Although the paper is not intended to be a critique of the Pomeranz thesis, Warde does pose a question of whether early modern Europe was actually approaching an environmental bottleneck.

case, for example. In the seventeenth-century when peace returned after a prolonged period of war, with population increasing, farmland expanding and castle towns being built, the Confucian scholar Kumazawa Banzan saw a number of forests cut down and hills denuded. He went on to suggest that the country's forest cover must have followed a Malthusian-like cyclical movement corresponding to alternating periods of war and peace, and to alternating deceleration and acceleration of population growth.[4] If this would go on for millennia, its history would never be sustainable. Indeed this is exactly what Mark Elvin says about China, whose environmental history is portrayed as 'three thousand years of unsustainable growth'.[5]

Two centuries later, when a mission led by Prince Iwakura travelled Europe, the official chronicler of the journey Kume Kunitake made the following observations:

> 'Before the advance of industry in Europe, in an age when people did not know that iron could be used in place of timber, vast woodlands were cut down and forests decimated in Greece, Spain, France and Britain.
>
> 'The level plains of Prussia, too, were once covered with extensive woodlands, but *population increases have led to much of this being cleared to make way for cultivation and pastureland*, so that only a quarter of the forests remain and trees are now increasingly rare'.[6]

They learnt that in historic Europe too, there was a close association between man's procreation and deforestation.

On the other hand, however, what we are witnessing *now* in many parts of the world is a kind of forest rehabilitation in formerly degraded areas. The present-day French Pyrenees, for example, is greener than in the seventeenth century.[7] The area of woodlands in Great Britain has doubled since 1919 when the Forestry Commission was established in the government.[8] Today, while deforestation is still going on in developing countries, especially in tropical rain forest areas, *afforestation* takes hold in many developed countries. This latter phenomenon

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[4] Kumazawa Banzan, *Daigaku wakumon*, cited in Saito (1998), pp.140-141.
[5] Elvin (1993).
[6] Kume (2002), III, pp.209, 270.
[7] Fruhauf (1980). I owe Jean-Pascal Bassino for this reference.
[8] Henderson-Howat (1996).

reflects, first, the substitution of forest and other organic resources by a mineral-centred material base which characterised the English industrial revolution in the late eighteenth century and the subsequent industrialisation processes in other European countries.[9] The iron and steel industry is no longer a predator of the forest reserve, and its products are used in place of timber. This move eased the population pressure on the forest resource substantially. However, other factors were also operating in the European past. One such factor was the establishment of forestry as a science of resource management and rehabilitation. It was Germans who pioneered in this field. But even in England where deforestation had been taking place extensively, there grew interest which placed emphasis on the planting of trees. One reason was probably fears of timber shortage. But more importantly, there emerged a new 'non-utilitarian attitude to the natural world' at the upper levels of society. Landowners and the middling sort of people began to see the landscape differently, which marked the beginning of the present-day concern for forests as a component of the landscape as well as the natural environment in general.[10]

[Figure 1]

This suggests that there were two somewhat different scenarios in the history of the interplay between population and forests. One is the conventional story of continuous degradation, which is still a plausible story in, at least, some parts of the world. The other is a U-shaped pattern of deforestation and afforastation. The latter may be best illustrated in a very long-run process of interrelationships between population, farmland and forest areas in France, probably one of the best-documented countries in the world as far as forest history is concerned (figure 1). For the first six to seven centuries population and farmland moved in much the same way, while forestland's ups and downs went in the opposite direction. Population increase was followed by the clearance of forests, and hence by an increase in farmland: the cycles were Malthusian. This long period of Malthusian cycles was followed by a modern phase of afforestation. As long as the early modern and modern periods are concerned, therefore, a U-shaped pattern becomes

[9] Wrigley (1988).
[10] Grainger (1981) and Thomas (1983).

apparent. The 1990 level is a return to that of *circa* 1600.

The U-shaped pattern may be regarded as a corrective to the conventional story of continuous deforestation. What I would like to argue in this paper, however, is that two contrasting forces were at work in history. One is exploitation of natural forests, and the other regenerative forestry. In response to rising demand for forest products, an entrepreneur will go to a forest to cut down trees and bring them to the market (here is a question of who owns the forest; and also involved are cost-benefit calculations in which geography plays a crucial part in many cases). When the entire hill is denuded, in this exploitative mode the entrepreneur simply moves on to another hill, leading to a continuous process of deforestation. In the regenerative mode, on the other hand, felling is combined with re-planting; a rotation system is one of its oft-used methods. This allows the entrepreneur to stay with the original site, increasing the level of land utilisation and thus enabling him to maintain his market-oriented silvicultural business.

As the U-shaped scenario suggests, there are cases where the two modes appeared as stages of development. However, we need not to assume that the two appeared always in succession in history. There could be a time period in which both destabilising and stabilising forces worked side by side. Indeed this paper will show that early modern East Asia was in a forestry regime of this kind, and also that what took place in Japan after this phase was in sharp contrast with what happened in imperial China. Indeed, it is very likely that a substantial divergence emerged within pre-modern East Asia. According to the work by Conrad Totman on Tokugawa Japan, there took place a significant shift from exploitation forestry to regenerative forestry and the turning point was the late seventeenth and early eighteenth centuries.[11] Based on this work, John Richards concludes that 'despite the rise of silvicultural knowledge and practice, only Tokugawa Japan appears to have done this relatively successfully—but only with strict rationing and conservation measures'[12]. It is of particular interest, therefore, to see whether or not there existed significant differences between traditional China and Japan in terms of deforestation with respect to population growth, and if pre-modern East

[11] Totman (1989).
[12] Richards (2003), p. 622.

Asian forest situations were not much worse, to explore whether this was, as Richards suggests, the result of stringent state regulations. That is, to ask whether deforestation accelerated or decelerated in each country over the period from traditional to modern times, and what forces were at work throughout the early modern and modern periods of the two East Asian countries.

Measures

One of Ken Pomeranz's arguments is that in the eighteenth century, China and Western Europe at both ends of Eurasia were ecologically in serious trouble, implying that it was after 1800 that both went divergent.[13] One area he explored quantitatively is the relationship between population and forestland in Lingnan, China's 'second most commercialized and densely populated macro-region', and in France, a country singled out as representing Western Europe in this respect. His conclusion is that although both regions were ecologically constrained at the end of the early modern period, China's pressure on land resources was 'probably not much worse' than in France, and more specifically that 'with respect to trees and soil, the rate of decay in China was probably slower than that seen in eighteenth-century Europe'.[14] The East-West gap became apparent only when the West switched to resource-intensive production regimes.

This is a strong argument. However, I have a couple of methodological quibbles with his comparative analysis. One is that Pomeranz's analysis is a straightforwar, two-way comparison between East and West. However careful he may have been in the selection of areas studied, it is a dichotomous comparison, which cannot rule out the possibility that divergence, if any, in a pre-industrial context may have been found, not necessarily between East and West, but also within each of the pair, especially *within the East*. The second is that Pomeranz does not explicitly relate this environmental question to another theoretical issue he raised with respect to the question of the Great Divergence, i.e., market forces. While the level of commercialisation in agriculture and processing industry is extensively surveyed for both China and the West, no investigation is made with respect to the question of whether or not market forces played a part in slowing down the rate of forest

[13] Pomeranz (2000), ch. 5.
[14] Pomeranz (2000), p. 236.

degradation in East Asia.

In addition, there are a couple of technical problems as well. One is a measurement problem. In order to assess how serious the ecological problems were, two separate measures may be used: average and sensitivity measures. Pomeranz provided 'percent forested' and 'fuel supply per capita', both of which are average measures. Unfortunately, however, when he talked about the 'rate of decay', no sensitivity measure was explicitly used in order to compare Chinese rates of change with those for France, although it is evident that in order to arrive at those average figures, he did use a concept of numerically defined relationship between deforestation and population increase, which is expressed as:

$$\triangle F \div \triangle P,$$

where F stands for forestland and P for population. When $\triangle F$ takes a negative value, $\triangle F/\triangle P$ indicates lost forest per additional person. The use of this coefficient in his calculation implies that Pomeranz actually tried to measure, as a parameter, the sensitivity with which deforestation proceeded with respect to population growth.

However, as a sensitivity measure, *elasticity* is a better one. In this case, it is expressed as:

$$(\triangle F/F) \div (\triangle P/P),$$

which measures a per cent loss in forestland with respect to a per cent increase in population. Apparently the former coefficient is affected by variation in the size of forested land or population, or both, whereas this population elasticity of deforestation is not.

The second problem is concerned with the period covered. Pomeranz looked at Lingnan in the 1753-1853 period and compared the Lingnan situations with those in late eighteenth-century France. However, the comparisons should be placed in a much longer-term time frame. There are a couple of reasons for this. First, situations in a period immediately before the new era began may not be assumed to be representative of situations in the early modern period. Second, over the longer-run, the parameter may have changed. It is likely that the population elasticity would decrease with the declined level of forest cover; but it is equally

likely that deforestation would accelerate, rather than decelerate, under a certain set of circumstances. Ideally, therefore, population elasticities should be examined period by period, covering the entire period with medieval, early modern and modern times combined, thus allowing elasticity estimates to change from period to period.

2. Changes in population and forest cover, and their relationships

This can be done, thanks to the United Nations' Geneva Timber and Forest Study, for two of the European countries.[15] Estimates, however crude, of both population and forest areas in England and France are available for several benchmark years from the High Middle Ages onwards. For Japan and China no medieval data are available, but calculations can be made for both early modern and modern sub-periods.

As far as south China is concerned, figures and percentages assembled by Robert Marks and Ken Pomeranz about Lingnan provide us with estimates for three benchmark years, 1700, 1853 and 1937.[16] It is obvious that south China cannot represent the whole empire, but the size of this macro-region, 39 million hectares, is large enough to make a comparison with Japan and other countries significant. Its climate and flora share the same characteristics with Japan, although Lingnan is a little more subtropical. Moreover, Lingnan was one of the macro-regions where eighteenth-century population growth was strongest, which will make the pre-modern Lingnan-Japan comparison particularly revealing with respect to the impact of population increase on the region's forest cover. According to Marks and Pomeranz, the forested area was 18,300,000 hectares in 1700, which declined to 2,900,000 hectares in 1937. During the same period, population is estimated to have increased from 11,500,000 to 47,600,000 (see table 1, lower panel).

[Table 1]

For Japan after the mid-nineteenth century, there are two series of data. One is

[15] UN Economic Commission for Europe (1996).
[16] Marks (1998) and Pomeranz (2000).

government land statistics and the other geographers' estimates by using a 2 km mesh on the Geographical Survey Institute's successive 1 to 50 thousand scale maps. The government statistics is yearly but subject to frequent changes in definition and category. The geographers' are compiled by Yukio Himiyama and his associates, available only for benchmark years of 1850, 1900, 1950 and 1985. Their results, especially those for prewar years, give us substantially larger forest-area estimates than the government's forestry statistics. But Himiyama's methods are systematic and mutually consistent, so changes that actually took place in land use are likely to be better reflected in the Himiyama series than in government statistics which are said to have been affected by frequent changes in definition and category. Also, the Himiyama estimates start with the end of the Tokugawa period. Since the government statistics began in the Meiji period, this is of considerable merit. For the period after 1850, therefore, the Himiyama estimates will be used. They give 24,818,000 hectares for the forested area today, which is only slightly smaller than that of 25,497,000 hectares estimated for 1850 (see table 1, upper panel).

For earlier periods, no such estimates are available. However, a cursory look at the Tokugawa historiography reveals that there were two areas in which important moves took place. One is in the supply of timber. There is evidence that the period of 1570-1670 saw a vast number of trees depleted since the demand for construction timber was strong in that period of population growth and town building. After the late seventeenth century came an age in which plantation forestry was established. Increasingly trees, especially conifers, were planted in cut-over places, felled forty to fifty years later, then sold at the market. This county-wide emergence of regenerative forestry implies that the proportion forested declined during the seventeenth century but returned to the initial level by the end of the Tokugawa period.[17]

The other story is concerned with agriculture. The period of timber depletion was coincided with that of land reclamation. Most of arable fields created during this period were found in marshy flood plains, implying that reclamation itself was not

[17] Totman (1989) and Saito (1998).

associated with the clearing of forests.[18] However, recent case studies have shown that peasants did clear the wood on the village common in order to create grassland for collecting a vast amount of grasses. The grasses were put into compost, mixed with cattle excrement and used as fertiliser. This type of home-made fertiliser, widespread in western provinces, played a significant role in yield growth but caused the denudation of village-owned hills. No return of the wood occurred in those grasslands since peasants kept using the commons for that purpose.[19] Himiyama and others give an estimate of 4.4 million hectares for 'rough land' in 1850, showing that the area consisted of village commons used for grass cutting as well as fuel gathering, fields used for sifting cultivation, completely denuded forest areas and other types of 'rough land'.[20] It is difficult to determine exactly what proportion of the 4.4 million hectares had been converted from the 'forest' category to the grassland type of village commons since the early seventeenth century, but an assumption may be made that as much as one-third of this total 'rough land' area in 1850 had been wooded in 1600.

All this gives us an estimate of 27 million hectares for Japan's forest area at the beginning of the seventeenth century. Given the nature of the evidence we have, this estimate is probably on the high side. For the corresponding figure of population I choose 17 million, which is substantially larger than Akira Hayami's widely accepted estimate of 12 million.[21] According to my estimates, therefore, the degree of deforestation during the period up to 1850 is probably *over*stated and that of population increase somewhat *under*stated. In other words, it should be noted, the population elasticity of deforestation calculated from these figures is likely to have an *upward* bias.

Let us now have a look at the average measures of deforestation for the four countries. Tables 2 and 3 set out the proportion of forests to the total land area and the forestland per capita. Both tables broadly confirm that both England and France exhibit a U-shaped curve. For East Asia, since the time period covered is

[18] Saito (1998).
[19] Isoda (1996). See also Chiba (1991) and Mizumoto (2005).
[20] Nishikawa et al. (1995), pp.4, 78-79.
[21] Reported in Miyamoto (2004), p.38.

short, it is difficult to identify a long-run trend; seemingly Lingnan's is continuous deforestation, while Japan exhibits long-run stability.

[Table 2; Table 3]

In addition, there are some more findings that merit attention. First, forest cover in the British Isles of the High Middle Ages was already much thinner than on the European continent. The proportion of wooded land in England at the time of the Domesday Survey was 15 per cent, which declined to 10 per cent in the mid-fourteenth century and further to 8 per cent in 1688, while the French percentage for 1000 was 47 percent and even in 1700 it stood at 15 per cent. This impression is confirmed by a recent account by Paul Warde that at the end of the sixteenth century, the proportion was one third on continental European countries of France, German-speaking areas, Bohemia and Poland, with the Danish proportion being one quarter, whereas the figure was 12 per cent for Ireland, 6-7 per cent for England, and 4 per cent for Scotland.[22] It is difficult to know to what extent these differences were a historical consequence of the Saxon invasion, and to what extent explained by the British Isles' climatic or geological conditions. Whichever the explanation, it is evident that there were already substantial differences in the initial conditions within medieval Europe.

Second, Lingnan's early modern level of 1.6 hectare forestland per capita comes between the medieval English and French levels, and its mid-nineteenth century value of 0.3 hectares in the middle the early modern English and French levels. In terms of the proportion forested, moreover, Lingnan in the mid-nineteenth century was clearly higher than the French level at the beginning of the eighteenth century. These findings, while not entirely consistent with Richards' account of China's forest cover steadily disappearing during the late imperial period[23], seem to support Pomeranz's claim that in the eighteenth century China's ecological situations were 'probably not much worse' than in France.

Third, however, somewhat different contrasts emerge if we turn to changes over

[22] Warde (2006), p.34.
[23] Richards (2003), ch. 4.

time. In the long history of deforestation, the largest reduction in forest cover of both England and France occurred before the end of the seventeenth century, not in the eighteenth century, nor in the subsequent century of industrialisation. Indeed, it is not coincidence that John Nef argued that there occurred the 'timber famine' in the sixteenth and early seventeenth centuries. The pan-European shortage of timber and firewood drove prices of those forest products relative to those of other commodities, which eventually led to the substitution of coal for wood in the subsequent centuries.[24] In contrast, the tempo of Lingnan's deforestation became faster during the late nineteenth and early twentieth centuries than in the earlier period. Ways in which deforestation proceeded during the early modern period were thus different.

Fourth, Japan's initial level of forest cover was high, over 70 per cent, and exhibits little change in the subsequent four-century period. The proportion forested in 1985 still stood at 67 per cent. Its per capita forestland, on the other hand, displays a steady decline as population increased. Taken together, it suggests that the relationships between population change and deforestation were somewhat different from those operating in the other countries.

This final point leads us to examine our third measure, population elasticity of deforestation, which measures the sensitivity of decline in the forest area with respect to population increase. The elasticity of -0.1, for example, implies that a 10 per cent increase in population was followed by a mere 1 per cent decline in the forest area; on the other hand, a much higher elasticity of -1.0 means that a 10 per cent increase in population resulted in a 10 per cent loss of forest cover. Unlike the previous two tables, the calculation is made for the intervals between all the benchmark years indicated in appendix tables. From table 4 and figure 2, three observations can be made.

[24] Nef (1932), I, pp.156-164. There can be no doubt that fears of wood shortage were expressed across the regions of early modern Europe. However, that fact should not be taken to imply that Europe was approaching an ecological exhaustion already at the end of, say, the sixteenth century (for a survey of the 'reality of the woodland' in seventeenth- and eighteenth-century European states, see Warde 2006). What the evidence presented in this paper indicates is simply that the pace with which forests were felled exceeded the rate of population increase far greater in the early modern than in the modern period.

[Table 4; Figure 2]

First, the pattern of change over the second millennium is surprisingly similar for both England and France. True, there are some noticeable differences between the two graphs, such as more serious forest degradation taking place early in modern England than in France in the same period, eighteenth-century deceleration in deforestation being more marked in England than in France, and France's drive for re-forestation more intensive than in England in the nineteenth and twentieth centuries. However, it is also true that these differences look minor if compared with the broad pattern of change: that there occurred an acceleration of degradation in the early modern period, but deforestation became less serious in the eighteenth century. This was probably the end product of various forces such as state regulation, imports from Norway and Baltic countries, and the increased application of scientific forestry. The latter move began in the eighteenth century, which eventually led to an increase in forest yields and the advance of afforestation from the nineteenth century onwards.[25]

Second, table 2 and figure 2 confirm that deforestation in eighteenth-century China was not much worse than in Western Europe in the same period. In elasticity terms, too, the Chinese level comes in between the English and French levels in the eighteenth century. As Pomeranz argued, the 'great divergence' took place after this stage. However, it should be noted that as for Europe, the eighteenth-century levels were not a good indicator of what was happening in the early modern period. In the eighteenth century, Europe was in transit from the stage of deforestation to that of afforestation. For Lingnan, south China, unfortunately, it is not possible to extend the calculation of elasticities back into periods before 1700. However, Marks's study on Lingnan shows that there were close links between population growth, the expansion of food base and the clearance of forests, suggesting that if two of the three are known, conjecture may be made about the third. According to his estimates, both population growth and arable expansion between 1700 and 1853 were fastest in the entire period since the

[25] See Warde (2006).

end of the fourteenth century. The rates of increase in the period up to the mid-seventeenth century were modest, while during the Ming-Qing transition the arable area increased only marginally and population even decreased.[26] It is very likely, therefore, that the elasticities had remained modest from the Song to the early Qing, and hence, that there had been neither an acceleration nor a deceleration in deforestation during the period up to 1700.

Third, just as percentages forested did, the Japanese elasticities too seem to fit with the pattern of long-run stability. However, this does not mean that the original flora was kept intact, nor does it suggest that trees and shrubs native to the particular forest site were well protected. The stability in the level of forest cover was never a product of any conservationist policies or cultural beliefs. Forest tree species did change substantially as plantation forests advanced. Broadly speaking, the change was from broad-leaves to conifers. Today, there are more plantations of *sugi* (Cryptomeria japonica) and *hinoki* (Japanese cypress) than in the beginning of the Tokugawa period.[27]

The paucity of numerical data for Tokugawa Japan does not allow us to break down by sub-period, but the consensus is that there were two periods of deforestation throughout the four-century period since 1600. The first was in the seventeenth century. Literary sources strongly suggest that from *circa* 1570 to 1670, there was a timber shortage and the destruction of forests took place all over the country, with numerous reports of erosion and flooding and of village-versus-village, district-versus-district disputes flared up by such environmental hazards. Yet it should be remembered that even the very low elasticity of -0.09, estimated for the entire Tokugawa period, was somewhat overstated. This implies either that the degree of seventeenth-century forest degradation was comparatively less serious, or that the tempo of re-forestation in the subsequent period was substantially fast, or both.[28] The second period of deforestation was in the late nineteenth century when industrial demands for firewood increased. But the degree of acceleration in this period was considerably modest compared with early modern European and

[26] Marks (1998), pp.158, 280.
[27] Nishikawa et al. (1995), ch.1.
[28] Totman (1989) and Saito (1998).

with modern Chinese deforestation. Moreover, from about 1900 Japan entered a stage in which the rate of felling trees exceeded that of planting trees. Apparently modern Japan took a path different from the Chinese path.

3. Market linkage: the common denominator in early modern East Asia

The tripartite comparison of Japan, China and the West has made it clear that there were more contrasts than similarities. Contrasts among the countries were found not only in modern but also in traditional times; contrasts emerged within East Asia as well as between East and West. So the question is: what are the factors affecting these differential courses? More precisely, what factors made Japan's historical pattern so different from China's and from Western Europe's pattern?

One obvious factor is agriculture, for in earlier stages of development, as we saw in the French case (figure 1 above), population increase, forest clearance and the expansion of farmland were closely linked. Undoubtedly, this also played a considerable role in Lingnan in the seventeenth and eighteenth centuries. The strong growth of population was accompanied by internal migration flows, which meant, in most cases, clearing forests on hillsides and in mountains. In Japan too, the seventeenth century saw an increase in population and in land reclamation. On the face of it, this suggests, as Totman did,[29] that this direct link between population and the clearance of woodland was at work in early Tokugawa Japan. However, as we have already seen, the seventeenth-century expansion of farmland was made possible chiefly by converting low-lying, marshy areas in river deltas into paddy fields.[30] The only negative factor that was operating in relation to agricultural growth in this period was, as we have also seen, the clearance of woodlands near villages in the western provinces.[31] On balance, however, the loss of forests caused by the push of settlement frontiers into mountains must have been relatively insignificant in the case of seventeenth-century Japan.

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[29] See charts in Totman (1989), pp.176-177.
[30] Saito (1988), pp.179-187.
[31] See references in footnote 18 above.

Another factor is demand for forest resources, timber and fuel, which could act as a factor stimulating domestic regenerative forestry. It is evident that in modern Western Europe both state initiative and market forces are operating in that process.[32] In pre-modern China and Japan, it was primarily market forces that were at work in making provisions for the domestic needs for timber and fuel. On occasion the market acted as an agent of exploitative felling, leading to massive deforestation. It was more likely to happen in areas where topography was not favourable for the spontaneous regrowth of the forest, such as granite hills in Mediterranean Greece and in Japan's Inland Sea coast, especially when large-scale construction works such as the building of new palaces, castles and towns were carried out. However, under some circumstances the market could also act as a *stimulus* to the emergence of regenerative forestry.

Tokugawa Japan

Take the Tokugawa case first. There is much evidence that as population expanded and towns grew, old-growth stands were extensively logged in the seventeenth century. Forests after forests were cleared to supply the materials for building castle towns. As Kumazawa Banzan lamented, 'eight out of ten mountains of the realm have been denuded'[33], although what he actually meant must have been that 'eight out of ten *accessible* mountains have been denuded'. One consequence of this building boom was ecological degradation; judging from edicts and ordinances issued by the Tokugawa government in the late seventeenth century, serious erosions and floods must have taken place in various parts of the country. At the same time, it should be noted, many mountain districts responded to the shortage of timber created by this boom, first by felling natural forests, then eventually by introducing a regenerative forestry as an economically viable business pursuit.

By the 1710s, a number of provinces became known as market-oriented suppliers of timber to metropolises such as Kyoto, Osaka, Nagoya and Edo. With this move, two different types of forestry districts emerged[34]. One was a type of forestry dependent largely on spontaneous rejuvenation of the forest. This was possible

[32] Morin (1996) and Henderson-Howat (1996).
[33] Cited in Totman (1989), p.70.
[34] Nishikawa (1959-61), Nishikawa (1961) and Kato (1995).

only where forest areas were substantially large and government regulations such as banned access and rationing were tight and effective. Kiso, Hida, Akita, Tsuruga and Tosa are its notable examples, most of which were large and powerful daimyo territories located in rather remote provinces in the north-east or the south-west. The other type was privately managed plantation forestry, in which more emphasis was given to *re*planting and rotation. This entrepreneurial type of market-oriented timber production was mostly found in privately-owned forests surrounding the metropolises. The district of Ome, for example, was in Edo's hinterland while Yoshino and Tanba targeted the Osaka and Kyoto markets. According to an analysis of early Meiji silvicultural reports sent from prefectures[35], intensive afforestation management at the beginning of Meiji rule was found in regions between the Tanba-Yoshino line to the line connecting the Kuzuryu to the Tenryu River, and also in an area from Oku-Tama to Chichibu. The former area served collectively as a supply zone to the metropolitan markets of Kyoto, Osaka and Nagoya, while the latter was a hinterland of the Edo market. And the former was far larger in size than the latter. All these are practices found on private land. In the rest, therefore, daimyo-controlled forestry was predominant, although even within that category commercially-oriented areas dependent on spontaneous regeneration should be distinguished from those where no systematic replanting was carried out.

Yoshino led the way to regenerative forestry in the private sector. Records show that afforestation in this area started on mountain sites formerly used for slush-and-burn farming in the mid-seventeenth century, and it gained momentum from the turn of the century onwards[36]. There is evidence that in this type of the market-oriented timber trade no particular intervention was made by the local daimyo government, and that commission rates asked by metropolitan merchants were not excessive. According to a case study of Tanba, a transit tax collected at a river landing by the local government was 5 per cent on each raft[37]. In the case of Yoshino, the tax imposed by the Wakayama government was 10 per cent while the commission rates were much lower—3 per cent in Wakayama and 1 per cent in

[35] Fujita (1995), map 2.2.12, p.81; reproduced in Totman (1989), p. xxii.
[36] Izumi (1992). See also Fujita (1995), ch.3.
[37] Nishikawa (1961), p.458.

Osaka[38]. During the latter half of the Tokugawa period, therefore, forestry output in the entrepreneurial sector near the metropolitan markets must have grown much faster than in the daimyo sector of remote provinces.[39]

[Table 5]

Of the metropolitan markets, Osaka occupied a central place in the Tokugawa period as it was on the top of the country's distribution networks. There is a trade statistics for 1714, which enables us to examine the composition of Osaka imports shipped from various provinces of the country.[40] Since the 1714 statistics covered all the merchandise produced in rural provinces as commodities for Osaka (thus excluding tax rice sent by daimyo authorities themselves), table 5 indirectly indicates the relative importance of the timber trade to other trades in the early eighteenth century. Not surprisingly rice and other agricultural products constituted the largest group, i.e., 39 per cent; next to the agricultural produce came two groups of commodities, i.e., clothing and forest goods of timber, firewood and charcoal, constituting 11 and 13 per cent respectively of the total value of imports. Of the latter group, timber outweighed firewood and charcoal (9 and 4 per cent respectively). On the face of it, the levels of these percentages do not seem to have been particularly high, but it should be realised that much of rural non-agricultural pursuits such as weaving and logging was done by village farm populations as by-employments. By the early eighteenth century, therefore, the 1714 trade statistics suggests that timber, firewood and charcoal as well as textile fabrics had already been established as important commodities marketed in the metropolis. According to the 1736 statistics of a similar, though less comprehensive kind,[41] timber came not only from districts surrounding Osaka, but from remote north-eastern and south-western provinces as well. This suggests that at this stage the share of timber shipped from daimyo-controlled forestry districts was still large, while judging from early Meiji statistics, timber imports from privately-run conifer plantations around Osaka and Kyoto, such as those in Tanba, Yoshino and

[38] Izumi (1992), pp.440, 446.
[39] For other districts, see Mihashi (1960), Murai and Takahashi (1960), Tokoro (1970), and Totman (1985).
[40] Oishi (1975), Appendix 2 to ch.3.
[41] Osaka-shi Sanjikai, vol.1 (1913), pp.769-779.

Kumano, as well as firewood and charcoal imports from similar districts, increased substantially faster than from the daimyo-owned forestry areas in the subsequent periods[42]. Indeed, according to the Tanba study, there was a four-fold increase in the supply of timber: the annual total of rafts floated down the river is estimated to have been from 600 to 800 in the 1670s; two centuries later the number increased to a level of 3,000.[43]

The advance of plantation forestry became possible as importing foreign timber was not an option in Tokugawa Japan where the economy was virtually closed to international trade. There is evidence that this new type of forestry was regarded by contemporaries as commercially viable. A look at farm and silvicultural manuals and encyclopaedias, published in increasing numbers from the turn of the seventeenth century, reveals that the writers encouraged commercially minded rural entrepreneurs to cultivate *sugi* (cryptomeria) and *hinoki* (cypress) as demands for construction timber remained strong. They argued that prices of good timber in metropolitan markets would rise more than proportionally to the size of timber, and that such buoyant market prices would justify the increased input of labour and capital in a plantation business whose gestation period tended to be as long as 20 years or even more. The manual writers thus provided entrepreneurs with techniques and general know-hows in forest management. Similar market linkages were, though to a much lesser extent, found for the cultivation of firewood as towns' demand for charcoal and firewood increased in the latter half of the Tokugawa period.[44]

A few more remarks may be made in relation to the emergence of market-oriented forestry. First, an impression derived from the Yoshino and Tanba case studies is that merchants in the forestry district were involved in plantation management as well as logging and transport. Given the long gestation period in forestry, the cost of financial provisioning must have been substantial for them. At this stage, it is difficult to know exactly to what extent their activities were self-financed, and how they were financed when borrowing became necessary. In this respect, however, it

[42] Kato (1995), pp.11-16.
[43] Fujita (1973), pp.145, 151-152.
[44] Saito (1998), pp.146-149.

is interesting to note that a general tendency of interest rate levels in urban money markets was on the decline—in the case of loans to daimyo—from 12-13 per cent in the first half of the eighteenth to about 8 per cent in the mid-nineteenth century. Tokugawa Japan's success in regenerative forestry may, therefore, be placed in the evolution of capital markets[45].

Second, the case of Yoshino suggests that regenerative forestry raised the level of land utilisation as well as that of labour intensity. When afforestation started there as a commercially viable industry, a cultivation system of 20-years' cycle was introduced to enable foresters to harvest as early as possible. In the subsequent period, however, the cycle was lengthened to produce better-quality, hence better-priced timber, with a more labour-intensive technique which combined dense planting with more frequent thinning-out. A result of this shift was a substantial increase in land productivity[46]. Like intensive agriculture that progressed over the same time period, forestry became labour-intensive as well as land-intensive. The advance was thus *Boserupian*, and it was this advance in productivity that gave a competitive advantage to the entrepreneurial sector, in which the average size of cultivation area was undoubtedly smaller than the daimyo-controlled provinces.

[Figure 3]

Third, moreover, the macro-economic significance of this productivity advance may be estimated by looking at relative price movements of forest products. Unfortunately, no price data exist for earlier periods when timber shortage was still substantial: the data become available only from 1785 for firewood and charcoal and from 1838 for timber, so that it is not possible for us to substantiate the wood shortage thesis for early Tokugawa Japan in such a manner as European early modernists did with price data. Even with such short time series, however,, it is worth examining how prices of forest products were compared with the general price index and that of raw silk, the best performer of all commodities in the Tokugawa period. Figure 3 shows that changes in the silk price index relative to

[45] Saito and Settsu (2006).
[46] Izumi (1992), pp.420-422.

the general price index were generally on the decrease (except in the final period of 1854-65). It implies that raw silk became cheaper in comparison with other commodities, suggesting that its production base in the countryside expanded and its productivity increased more than demand for silk increased[47]. We do not know exactly how the demand for silk changed, but judging from the stability of population and gradualness in economic growth in the period before the opening of the Treaty ports in 1859, the supply side was the determinant of this relative price series. Also noteworthy is that, as far as the period between 1785 and 1854 is concerned, the relative price curves for raw silk and forest products moved more or less together, suggesting that if earlier data had been available, the graphs for timber, firewood and charcoal must have behaved in much the same way as for raw silk. In other words, there took place productivity growth in forestry too and it was probably large enough to keep the supply to the metropolitan markets sufficiently elastic.

Imperial China

Much has been said about historic China being a case of continuous forest degradation. Empirically, however, evidence is not quite robust yet. In this respect, Li Bozhong's work on Jiangnan is invaluable. Having examined various effects of the development of the Lower Yangzi economy, he maintains that its growth was both stimulant to and constrained by the timber trade with local economies of Fujian, Hebei, Hunan, Sichuan, Guizhou and Yunnan. Overall, he argues, the latter effect outweighed the former as reflected in rising prices of timber in Jiangnan[48].

However, there is some evidence that afforestation was being practised. For example, Li shows that some of the regions mentioned above had already practised regenerative forestry from early times, while Robert Marks notes by quoting

[47] For the background of this proto-industrial success, see Miyamoto (2004) and Shimbo and Saito (2004). During the 1854-65 period, the trend was reversed. In 1859, the country was forced to enter world trade, which meant that Japan's silk industry faced an unprecedented increase in demand for raw silk from overseas markets. It changed the supply-demand balance completely, which explains why the graph shows a sudden rise in the final period.

[48] Li (1986). I owe Thomas Rawski and Yuki Umeno for this important reference.

Gottlieb Fenzel, a German forestry expert, that while much of northern Guangdong had became 'vast stretches of flat, barren hills' by the early twentieth century, 'the Yao tribesmen who Fenzel observed had taken to replanting trees after they moved on; but the Chinese did not do so then and probably had not in earlier times either'.[49] It seems true that ethnic minorities such as the Miao as well as the Yao played a prominent role in the timber trade from early periods in south China,[50] and recent studies of documents concerning the Miao of Guizhou and their cultivation of Cunninghamia, a coniferous tree used as construction timber, suggest that their timber trade was a sustainable business. The forestry district of Qingshui-jiang, south-eastern Guizhou, in the eighteenth century started to cultivate Cunninghamia for urban markets in the Lower Yangzi and also established links with the public-sector procurement of the building material for the palace in Beijing.[51] For these commercial links, both local Miao-speaking merchants and city-based Han Chinese dealers played an equal part, making the timber trade sustainable and keeping replanting commercially viable.

All this may give an impression that market-oriented afforestation was practised only by minority people but never by Han Chinese. Indeed, among several types of forestry in traditional China examined by Menzies, logging operations in deep mountains organised by Chinese merchants was probably the most straightforward, as well as the most exploitative, form of market activity.[52] Han settlers in the Yangzi highlands (called *pengmin* or shack people) are also said to have led to environmental degradation as they usually cleared woods on hill slopes to convert them to fields for maize, causing soil erosion downstream.[53] On the other hand, however, there is evidence that the ways in which the woodland was managed in the Miao-speaking area of Guizhou were not different from those found for forestry districts in Huizhou. According to the study by Mio Kishimoto of both Guizhou and Huizhou contract documents,[54] it seems certain that over the entire late imperial period China's forestry was in private hands. In the private

[49] Li (1986), pp.88, 92, and Marks (1998), pp.319-320.
[50] Menzies (1994), p.99.
[51] Daniels (2003), Aihara (2003), Kishimoto (2003) and Aihara (2007).
[52] Menzies (1994), ch.8.
[53] Richards (2003), pp.126-131.
[54] Kishimoto (2003).

sector, as in Tokugawa Japan, it was local merchants who managed forests as well as the distribution of timber. Hill owners, rarely involved in the cultivation of trees, received a share of proceeds from the sale of trees at the end of the cultivation cycle. One difference with Tokugawa Japan is that the Chinese relation between the hill owner and the merchant was somewhat more businesslike. The contract was for one cultivation cycle. In most cases, it was another merchant who signed in for the next cycle, but at the same time, there is no indication that such high turnover caused any instability in the trade. The planter's share was one third in most cases. Although the share of a half was not rare, the tendency seems to have been for the planter's share to decrease, rather than to increase. Again, this is probably not a reflection of planters' worsening bargaining position, but of a tendency for the planters to earn extra incomes by cultivating crops such as millet and sesame.[55] Thus, as Nicholas Menzies says, Cunninghamia cultivation was probably the 'longest lived, most resilient example of forest management'.

Outside this commercial sector of forestry, there was another regime: woodland owned and carefully maintained by the corporate community. Although not for commercial purposes, as the Huizhou case shows,[56] the woodland was kept maintained and harvested regularly by the lineage group to earn income for maintaining the ancestral halls and for other purposes. Villages and temples also maintained woods in a similar manner. Forest management of this kind, therefore, must have contributed to slow down the long-run rate of depletion.[57] As far as south China in the period before the mid-nineteenth century is concerned, therefore, the ways in which market demand was translated into the practice of regenerative forestry were probably also similar to those found in Tokugawa Japan. In this sense, as Mark Elvin says, 'the cultivation of trees could be a form of premodern high-tech'.[58] In other words, in imperial China too, both destabilising and stabilising forces were at work side by side, although all the evidence so far examined seems to suggest that the performance of market-oriented plantation forestry was somewhat better in Tokugawa Japan than in Qing China..

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[55] Aihara (2003), pp.135-136, and Kishimoto (2003), p.172.
[56] Kishimoto (2003), pp.187-188.
[57] Menzies (1994), pp.76-77.
[58] Elvin (2004), p.78

Thus, long-run trends are determined by the outcome of whether or not the rate of depletion was lower than the rate of renewal. Once the former exceeded the latter, the pressure to harvest immature trees would start 'a downward spiral'. Such a cash-in imperative was a product of market forces. However, Elvin does note that a phase of environmental degradation in the commercial plantation sector 'did not become clearly established until the eighteenth and the nineteenth centuries'. According to him, one critical factor in plantation managers' cost-benefit calculations was the theft of wood, which 'became a widely prevalent scourge, which inhibited production by small producers with inadequate means to defend themselves; and market pressures probably tended to compel not only a concentration on cultivating quick-growing species but also sales of relatively immature trees as soon as a profit could be taken'.[59] Such crimes presumably increased in various parts of the empire towards the end of the Qing and beyond. In the case of village and clan forests also, Menzies notes that their disappearance did not accelerate before the 1911 revolution.[60] Thus, the real cause of the 'downward spiral' that is believed to have taken place in the late Qing and in the Republican period would probably be found in the area of 'law and order' rather than in the market sphere.

4. The role of the state: divergence in modern East Asia

'Law and order' is one of the issues closely associated with the 'role of the state' question. As long as what economists call 'externalities' exists to environmental issues, we cannot leave the issues entirely to the market. And since much of forestland was owned by the state and the procurement of forest resources made for the state, some kinds of regulations and institution building carry prime importance. Just as the Tokugawa shogunate and local daimyo did, the state could control forest resources with banned entry or access, thus allowing the area to regenerate eventually, or by issuing edicts to regulate usage of forest products. The latter is interpreted by John Richards as constituting 'a system of public rationing that seems to have has some impact'. In villages, peasants developed their own

[59] Elvin (1998), and Elvin (2004), pp.81-85.
[60] Menzies (1994), p.87.

rules to regulate access to firewood, green fertiliser and fodder, which also 'constituted a system of rationing'.[61] However, what the Tokugawa state did was not just strict rationing. Indeed, a careful reading of Totman's *The Green Archipelago* reveals that institution building in the state sector was the key in accounting for, if not the real cause of, the rise of regenerative forestry in response to the growth of market demand, hence for Tokugawa Japan's record in forest management in general, for which the state played a part.[62]

Throughout history, however, the state has not always been a reliable agent of control, maintenance and management with respect to forests. In fact, in his discussion of temple and monastic forest conservation, Menzies contends that imperial policies of successive Chinese dynasties were inconsistent. National interests often took precedence over concern for forests. Prohibitions could be followed by state-initiated incentives to colonisation and land clearance, while in the area of commercially oriented plantation forestry state intervention, be restrictive or market-friendly, seems to have been minimal.[63] On the other hand, the Tokugawa shogunate's policies were less inconsistent. But in the case of Japan, probably more important than the attitudes of this central government was what took place at regional levels. In the Tokugawa decentralised system, the local daimyo government was increasingly interested in forest management—as a public body in charge of the prevention of erosions and flooding and as a fiscal body in want of new sources of revenue. What emerged in many parts of the country during the eighteenth century was an agreement between the daimyo government and local farmer-entrepreneurs or village officials. One form called *nenki-yama* was simply a fixed term lease contract between the two parties. Another form, which as institution building proved to be more important, was to share the harvest on the daimyo-owned forestland. It was called 'shared-yield forest' (*buwake-yama* in Tokugawa terminology), another kind of lease arrangement under which it was the lessee who planted trees and sell the tree products at the market.[64] The contract was for one tree generation, but was in most cases

[61] Richards (2003), p.185.
[62] Totman (1989), especially ch.7.
[63] Menzies (1994), pp.91-92.
[64] Totman (1989), pp.163-165. For detailed accounts of local practices, see Shioya

renewable. It seems that the planter's share of the harvest gradually increased as the eighteenth century progressed, from a level below a half to the fifty-fifty mark, and from that fifty-fifty mark to a level above a half[65]. It is interesting to note here that the general level of planters' share was higher in Tokugawa Japan than in imperial south China, and that it was on the increase rather than the decrease. Apparently, this Tokugawa system provided an incentive to the local entrepreneur to expand the cultivation of trees the market wanted by making a deal with the local government with respect to the state-owned forestland. The emerging system proved to be effective, giving the local government revenues and the local people a stable source of profits, by keeping forest areas replanted. In other words, this can be regarded as a *decentralised* way in which the state exercised its influence in maintaining the nation's forest cover.

Another pronounced difference between China and Japan seem to have emerged after the demise of the old regime. Given the magnitude of population elasticity for Lingnan from 1853 to 1937, and given the possibility that troubles in the 'law and order' area increased over time, it seems likely that the entire system of resource control and management started to crumble during the late Qing-Republican period.[66] In contrast, Japan's new Meiji government took a much firmer stance on forest management. Part of the reason for that stance is found in what the Iwakura mission of the 1870s learnt from the West. After noting how seriously forests were under attack in the European past, the chronicler Kume added that:

> 'It was in light of this [state of forest degradation] that forestry systems were subsequently promoted so that nowadays, while liberal politics are increasingly practised in Europe, in forestry laws alone the freedoms of former times are actually being curtailed.[67]

And, after the Prussian visit, he noted:

> As a result, laws have recently been introduced to protect the forests, and the government has been making intensive efforts to plant large quantities of

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(1959), parts 3-4.

[65] Shioya (1959), p.101. Despite this tendency, the most common of all observed cases was a fifty-fifty share, closer to that found for the rice tax level in farming.

[66] As I am no specialist in Chinese history I simply await future research by experts in this field.

[67] Kume (2002), III, p.209.

saplings during the felling season.[68]

They learnt that the government should take the initiative in forest management. Subsequently, government officials and experts looked to continental Europe, especially Germany for the science of forestry, through which they absorbed its protectionist philosophy. All this meant centralisation in policy-making and the growth of forests under the control of the central government, which was a clear departure from Tokugawa governance tradition.

In practice, however, what occupied a central place in government policy-making was to promote commercially viable plantation forestry. It simply endorsed the tendency towards coniferous plantations that had been taking place from late Tokugawa times. Moreover, as the Meiji era progressed, the government's forestry bureau began to rely more on hands-off than on hands-on measures. Although the Meiji Forest Law gave a secondary importance to traditional institutional frameworks, especially century-old 'shared-yield forest contracts', the late-Meiji government re-discovered it as an effective means of promoting afforestation in the state sector and also in forest areas owned by local authorities and private landlords. And this functioned well, just as the system had worked for local daimyo-owned forestland in the late Tokugawa period.[69]

All this, however, should not be taken to imply that the role of the central government became all-important in modern Japanese forest management. First of all, there was a shift within the state sector: the gravity of regenerative forestry shifted from forests owned by the state to those managed by prefectural governments and also to those owned by village authorities. Second, in the private sector too, afforestation advanced with reversed, rising trends in relative prices of both timber and charcoal up to 1922, the year that marked the end of a wartime boom[70]. Intensive methods of afforestation originated in Yoshino defused over remote regions of the country, which now gained—thanks to the coming of railways—better transport access to metropolitan markets. It is true that it was

[68] Kume (2002), III, pp.270-271.

[69] Nishio (1988), pp. 108-109, 138-140. A brief account by a contemporary of the Meiji system and its relations with Tokugawa practice is found in Matsunami (1919), pp.263-277.

[70] For the movements of relative prices for 1879-1939, see Kumazaki (1967), p.57.

areas of publicly-owned forests where such intensive methods were initially adopted, and that the level of progress in the private sector of the interwar period was stagnant as relative prices of timber fell. However, their advance made in the period before the 1920s should not be underestimated[71].

Third, the expansion of charcoal producing districts should also be noted. Unlike firewood, charcoal in Japan before the Second World War was a commodity of comparatively high income elasticity. For the period before the First World War especially, it stood at 0.5 as against 0.1 for firewood (the elasticity of 0.5 is comparable to that of construction timber for the same period)[72]. As income levels rose and urbanisation proceeded, therefore, the demand for charcoal increased, which in turn sent a signal to some districts that more gains would be made by specialising in burning charcoal and, hence, in cultivating particular kinds of wood suitable for charcoal making. Moreover, some of traditional industries such as sericulture, demands for its industrial use increased in initial phases of development[73]. Thus, in the production of charcoal too, the linkage between market demand and regenerative forestry went hand in hand, and it is worth reiterating that it had already started in the hinterlands of cities from the late Tokugawa period.

5. Concluding remarks

Ken Pomeranz argued, based on a comparison between China and France, that early modern East Asia's forest degradation was 'not much worse' than in eighteenth-century western Europe, and the foregoing observation made in terms the population elasticity of deforestation with Japan and England added has revealed that the elasticity values for Tokugawa Japan and Qing China were certainly not much worse than those for England and France in roughly the same period. This may be taken to imply that Pomeranz was right.

However, there are a couple of caveats to be made. First, the observation in this

[71] Fujita (1995), chs.4-5.
[72] Kumazaki (1967), p.25.
[73] Taniguchi (1998).

paper with respect to the population elasticity of deforestation should not be taken to mean that, as Pomeranz seems to have implied, both East Asia and Europe were ecologically seriously constrained in the eighteenth century. As we have seen, forest depletion in England and France was far more precipitous in earlier centuries, and Western Europe in the eighteenth century was in the middle of the process from deforestation to afforestation. Second, as far as the East Asian countries are concerned, it is evident that stabilising as well as destabilising forces were operating during the early modern period, and that market linkages are likely to have exerted under certain circumstances *positive* influences on forest management and the advance of regenerative forestry. Divergence took place in the nineteenth century and widened thereafter in this area of forest history. In the West, deforestation was associated with pre-modern economic growth. And the substitution of minerals and fossil energy for forest resources, on the one hand, and the rise of a new environmental thinking, on the other, led the way to reforesting Europe in the modern period. In contrast, China's pre-modern systems of regenerative forestry collapsed, which resulted in uncontrolled deforestation in the post-imperial period. It is probably not because her resource substitution was delayed, but because something more fundamental collapsed at the end of the imperial era, which in turn affected the economic and social aspects of people's living seriously. On the other hand, only Japan saw afforestation taking hold and its systems established in an early modern setting. But it was not because, as John Richards tried to argue, the state took strict restrictive measures to promote a regenerative mode of forestry, but because market linkages worked for regenerative forestry to be commercially viable. Institutions that emerged during the early modern period were a product of processes in which both governments and local entrepreneurs played a part. It was those early modern institutions, as well as intensive methods of afforestation, that kept the country's forest cover from degradation throughout the modern period.

Finally, a few more points may be made for environmental history. Whenever global comparisons are attempted with respect to forests, geographical factors such as geology and climate should be taken into consideration. To be sure, one important reason why Japan is still so green is that a combination of temperature, humidity, and landforms allows—unless deforestation is not followed by severe

erosion—woodland to rejuvenate itself without much human intervention, in contrast with north and north-western Europe whose average temperature is much lower and whose surface cover was stripped off by late Pleistocene glaciers. This must certainly have acted as a favourable factor for daimyo-managed forestry which relied entirely on natural regeneration in the Tokugawa period. At the same time, however, such factors are unable to explain the differences that took place between Japan and south China from the nineteenth century onwards. Both regions share much the same flora, climate. Wet rice is the principal component of farming activity in the East Asian temperate zone. Evergreen broadleafs such as camellia, *shii* (Shiia sieboldii) and camphor tree are a common characteristic, while China's Cunninghamia is similar to Japanese conifers such as cryptomeria and cypress (*sugi* and *hinoki*). Divergence in East Asian forest history, therefore, cannot be accounted for by geographical factors.

Furthermore, Japan's comparatively better performance in keeping forest depletion in check does not necessarily mean that it was costless even in environmental terms. One obvious cost the Japanese paid is that the woodland became much less diverse. Now there are far more conifer plantations than it may have been if no human intervention had been made. It is the end product of a long historical process of felling old-growth stands of broadleafs and planting more homogeneous species of cryptomeria and cypress instead. According to the estimates by Himiyama et al., 44 per cent of the country's forestland in *circa* 1850 was covered by broadleaved woodlands, 38 per cent in 1950, and only 21 per cent in 1985. What increased instead was 'mixed' areas of a 2 km mesh, but a majority of those areas were mixed with small-scale conifer plantations. Since most of the broadleaf woods had been 'natural forests', a shift was away from natural growth to artificial planting[74]. Indeed, this shift must have already started in the Tokugawa period. According to an account of one district in the Inland Sea region, a list of trees in the 1720s included red pine, evergreen oak, maple, podocarp, chestnut, cherry as well as cryptomeria, cypress, and another kind of conifer, *Tsuga* (northern Japanese hemlock), a diversity of tree species[75]. Although this particular area was denuded by the mid-nineteenth century with only scattered stands of red

[74] Nishikawa et al. (1995), pp.4, 8, 10, 12.
[75] Chiba (1991), p.104.

pine and Japanese hemlock left, other similar areas in regions not far from Osaka and Kyoto must have been simply replaced by conifer plantations. There was a countervailing force operating; it was an expansion of small-scale woodlands of oak (*kunugi* and *konara*) in districts of commercially oriented charcoal making. The total area was expanding but could not counterbalance the strong growth of coniferous plantation forests[76].

Unlike broadleaved woodlands, coniferous plantations are monocultures. While intensive forestry of cryptomeria and cypress plantations played a crucial role in keeping the nation's forest cover more or less intact, there must be some negative effect of having such monocultures around our living space. How such adverse effects interacted with changing economic and market circumstances and with changing standards of our life in our past, we have to await further research by environmental historians.

To conclude, while there was a sharp contrast between China and Western Europe, Japan was also in marked contrast with both China and the West. The observed contrasts are believed to have reflected differences in the ways in which the sustainability of the forest resource base was sought in both early modern and modern periods, and differences in the ways in which 'tradition' played a role in the process of transition to modernity.

[76] Totman notes that since the climax of a natural succession in a temperate climate of the Japanese archipelago is broadleaved forest growth, 'even where governments vigorously promoted afforestation, and except in plantation stands, mixed forests came to dominate the mountains of Tokugawa Japan' (1989, p.182). Given what happened after Meiji, however, this is too optimistic an assessment.

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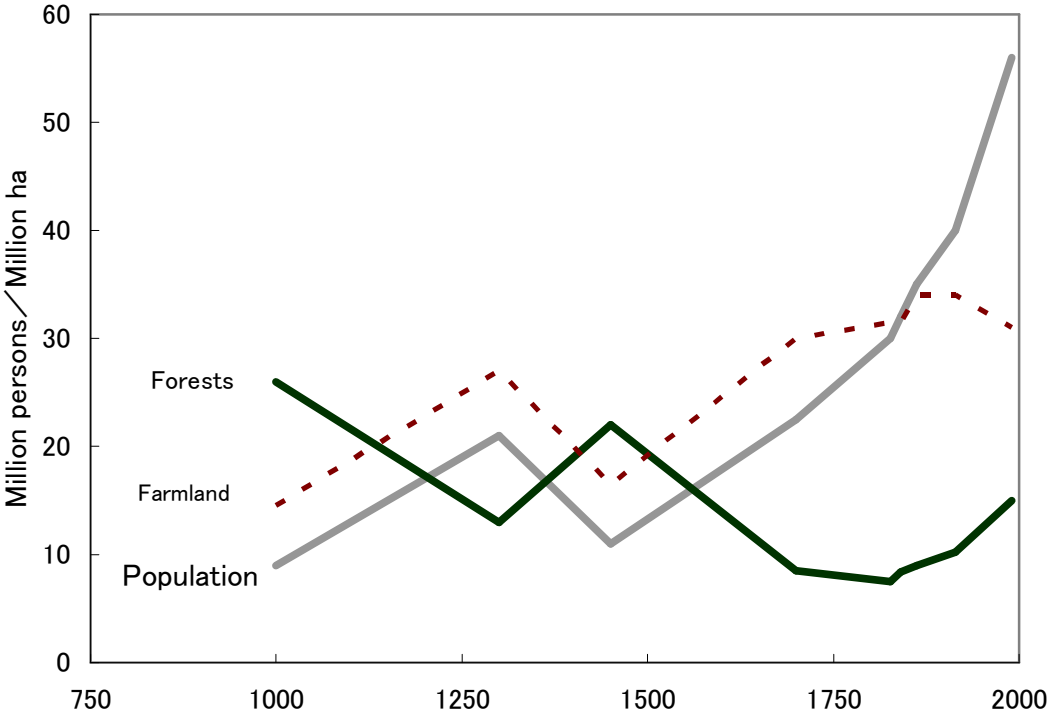
Figure 1　Population, farmland and forest areas in France, 1000-1990



Source: Morin (1996), p.19.

Table 1　Population and Forest Area estimates for England, France, Lingnan, south China, and Japan, 1000-1985

Year	Population (million)	Forest area (million ha)
England		
1086	2	1.9
1350	4	1.3
1688	4.9	1.0
1871	21.5	0.5
1992	48.0	0.96
France		
1000	9	26
1300	21	13
1450	11	22
1700	22.5	8.5
1827	30	7.5
1862	35	9
1990	56	15
Japan		
1600	17	27
1850	32.3	25.5
1900	43.8	24.3
1950	83.2	24.9
1985	121.0	24.8
Lingnan		
1700	11.5	18.3
1853	30.6	9.6
1937	47.6	2.9

Notes on sources:

England

1. Population figures for 1086, 1350 and 1992 are from Henderson-Howat (1996),

pp.23-24; 1688 and 1871 from Wrigley and Schofield (1981), pp.531-535.

2. All forest figures are from Henderson-Howat (1996), pp.23-24, except for 1871, which is taken from Coppock (1973), p.623. Figures for 1086, 1350 and 1688 are calculated from percentages forested, the first two of which are believed to have been based on Rackham (1990), pp.50-51, 55.

France:

3. Both population and forest area figures are from Morin (1996), p.19.

Japan

4. Population for 1600 is a provisional estimate by O. Saito, the 1850 estimate from Miyamoto (2004), and the other figures from Kokuritsu Shakai Hoshō Jinkō Mondai Kenkyūjo (2004), pp.8-10.
5. For estimate of forest area in 1600, see text. Other estimates are from Nishikawa et al. (1995), ch.1, pp.4, 6, 8, 10.

Lingnan

6. Population figures are from Marks (1998), pp.158, 280. 1700 and 1937 are interpolated from other benchmark years.
7. Forest areas are Ling Daxie's estimates quoted in Pomeranz (2000), pp.309-310. 1700 and 1937 are calculated from the percentages forested.

Table 2　Proportion forested (%)

	Japan	Lingnan	England	France
Medieval	—	—	15	47
Early modern	73	47	8	15
Mid-19th century	69	25	4	14
Early 20th century	65	7	—	19
Late 20th century	67	—	7	27

Source: Table 1 above.

Table 3　Per capita forestland (ha)

	Japan	Lingnan	England	France
Medieval	—	—	1	3
Early modern	1.6	1.6	0.2	0.4
Mid-19th century	0.8	0.3	0.02	0.3
Early 20th century	0.6	0.06	—	0.3
Late 20th century	0.2	—	0.02	0.3

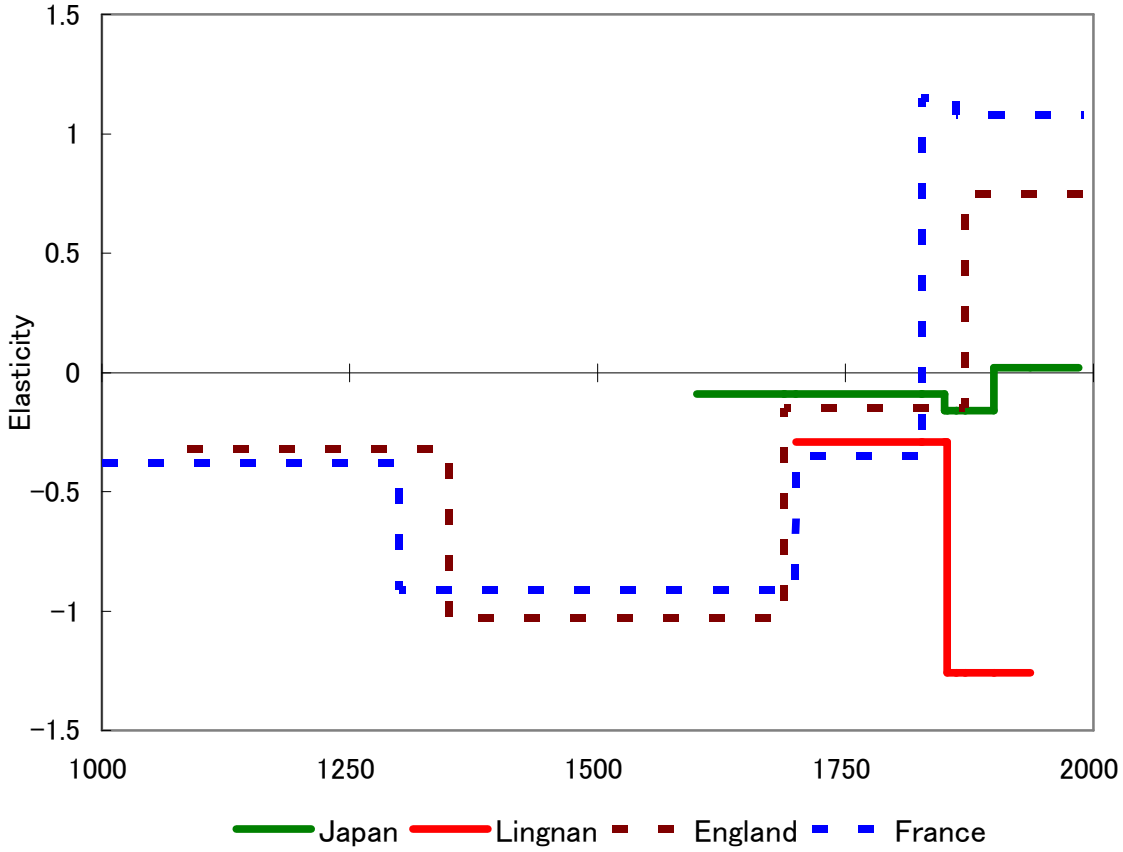
Source: Table 1 above.

Table 4　Chaging population elasticities of deforestation, in Japan, Lingnan, England and France

Japan	
1600-1850	-0.09
1850-1900	-0.16
1900-1985	0.02
Lingnan	
1700-1853	-0.29
1853-1937	-1.26
England	
1086-1350	-0.32
1350-1688	-1.03
1688-1871	-0.15
1871-1992	0.75
France	
1000-1300	-0.38
1300-1700	-0.91
1700-1827	-0.35
1827-1862	1.15
1862-1990	1.08

Source: Table 1 above.

Figure 2　Changing population elasticities of deforestation



Source: Table 4.

Table 5　Osaka imports, 1714

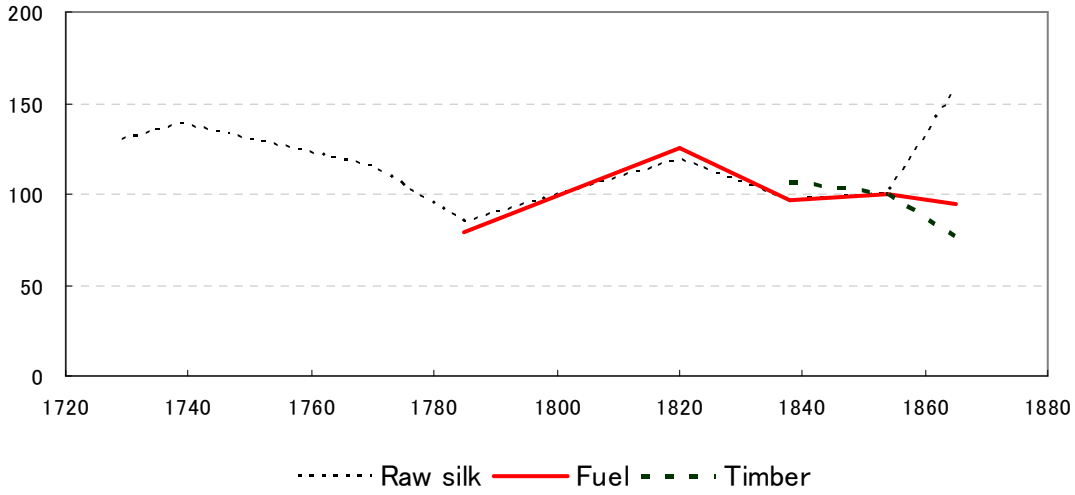
Commodity	Value ('000 silver *kan*)	Share (%)
Agricultural products and processed goods		
Grain	54	19
Other agricultural products	58	20
Cloth	31	11
Tatami and mats	7	2
Forest products and processed goods		
Timber	26	9
Firewood	9	3
Charcoal	3	1
Other forest products	4	1
Paper	14	5
Marine products	33	11
Mining products	21	7
Others	27	10
Total	287	100

Source: Oishi (1975), pp.154-167.

Notes:

1. 'Grain' does not include tax rice transported to Osaka by daimyo administrations. It amounted to nearly two-thirds of the total merchandise listed above.
2. In the 'share' column, the sum of percentages may not equal to 100 because of rounding.
3. This table differs from a similar table in Hauser (1974), p.28, and another in Shimbo and Hasegawa (2004), p.172. Hauser's table does not include grain in the total, while Shimbo and Hasegawa's seems to have adopted somewhat different grouping criteria for commodities (for example, their 'forest products' are too small).

Figure 3　Relative prices of raw silk, fuel and timber (relative to the general price index): Japan, 1729-1865



Source: Miyamoto (2004), pp.139-141.

Notes:

1. Benchmark years are as follows:
   1729 (trough), 1739 (peak), 1770 (trough), 1785 (peak), 1820 (trough), 1838 (peak), 1854 (trough), 1865 (peak).
2. Price indices are averaged over five years centring on the benchmark year. The 'fuel' price index is an average of firewood and charcoal indices. For the calculation of the general price index, see Miyamoto (2004), pp.121-122.