FEEDING THE PEOPLE, STARVING THE STATE:

China's Agricultural Revolution of the 17th/18th Centuries

Jack A. Goldstone

School of Public Policy

George Mason University

Paper Prepared for a conference in London, September 2003, sponsored by the Global Economic History Network and the Leverhulme Foundation

FEEDING THE PEOPLE, STARVING THE STATE:

China's Agricultural Revolution of the $17^{th}/18^{th}$ Centuries

The conventional wisdom on China's agrarian history – expressed by such distinguished authors as Perkins (1969), Maddison (1998), Huang (1990, 2002), and Bray (1984, 1986) – is that agriculture stagnated for centuries in pre-industrial China. This is usually considered to be in sharp contrast to pre-industrial Europe, where an "agricultural revolution" occurred in Britain in the 17^{th} and 18^{th} centuries (Overton 1996), built on technical advances imported from the Low Countries and involving new crops, new crop rotations, and new national patterns of land use.

Of course, it is widely recognized that China's population grew massively in its pre-industrial period – increasing from roughly 120 to 150 million in the late Ming (c. 1620) to 350 million c. 1800 (Lee and Wang 1999, pp. 6, 27) – and that throughout this period, Chinese agricultural output kept pace with population. Thus there was growth in Chinese agriculture, but this is thought to have a taken a particular form, commonly called "involution" (Huang 2002, Brenner and Isett 2002). In involutionary growth, the expansion of output reflects neither technical change in agriculture, nor gains in the productivity of labor. Rather, gains in output simply arise from the more intensive application of traditional and long-practiced techniques (e.g. putting more care and effort into seeding, transplantation, fertilizing, weeding, and harvesting). Since such techniques are labor-intensive, increased effort in their application raises the input of labor per unit of land farmed, in order to increase output per unit of land.

Authorities such as Bray (1986) and Huang (1990) claim that rice cultivation is particularly susceptible to extended long-term gains from such increased labor-intensive application of traditional techniques.

While increasing labor input per acre will allow an expansion of output, and thus allow the feeding of a larger population, the absence of any technical changes to boost productivity, coupled with the fact that increased labor inputs offset the gains in output, mean that although production may keep pace with population growth, the population emerges no better off. Put bluntly, if population doubles, but farmers react by working twice as hard on half as much land per family, then crop output per person, and per unit of labor expended, remain unchanged, even though output per unit of land doubles. Angus Maddison (1998, p. 32) offers a particularly clear statement of this view of China's growth; he presents data showing that grain output per person was flat and constant at 285 tons per thousand persons for four centuries, from 1400 to 1820.

Involutionary growth thus exhibits technical stagnation and stagnation in output per person, in contrast to the British agricultural revolution, which is held to have substantially increased labor productivity in farming, and thus to have raised family incomes and released labor from agriculture to manufacturing (Brenner and Isett 2002). The British agricultural revolution is held to be strongly associated with capitalism, in part because the gains in labor productivity arose from applying capital (in the form of new crops, animals, and fertilizers to land) and using wage labor, and in part because the gains in labor productivity are sometimes held to have been essential for the further capitalist development of other sectors of the economy (Jones 19??). Conversely, the absence of such an agricultural revolution in China is held to both demonstrate and be causally implicated in the absence of capitalist development in China (Huang 2002, Deng 1999). The ability to increase output and maintain output per capita by using ever more labor per acre, it has been argued, created its own kind of equilibrium or "lock-in" that prevented a capitalist modernization of China's economy (Elvin 1973, 1993).

While this is the conventional wisdom, it is strikingly inconsistent with reasonable assumptions regarding economic behavior. If, in fact, Chinese peasants could double the output of a unit of land by doubling their labor inputs to that land, using already well-known traditional technologies, they should have done so immediately, and not gradually in response to population growth. That is, if a Chinese peasant family could support itself by farming two acres of land at some point in the 15th century, and that same family could achieve the same output on *one* acre by working twice as hard on that one acre, they should have done so immediately. They would have the same total output and same total labor input (twice as much labor per unit of land on half as much land), but have an extra acre of land to sell or to rent for additional income.

Even if the family was at subsistence levels on the two acres (e.g., working as many hours as it could, and getting only enough to support itself), the same logic still applies. On the *one* acre, if doubling the labor input per acre will also double the crop output per acre, then the one acre would both absorb as much labor and produce as much output as before. The second acre would be a source of additional income, or could be sold to provide additional resources, and thus would have been especially valuable to dispose of for a family struggling at subsistence levels.

Of course, those who argue for involution – e.g. that increased intensification was a symptom of immiseration – would claim that peasants would not intensify agriculture on some of their land and sell or sublet the rest because with intensification they faced not constant returns to labor, but *diminishing returns*. That is, it might take half again as much labor to produce the second crop on a unit of land as the first; thus peasants would have to work harder than before just to produce the same output from a smaller unit of land. Their labor productivity would go down, hence they would prefer not to adopt more intense cultivation.

But this reasoning is misleading on several levels. Even if we allow that there were substantial diminishing returns to labor (which, it should be noted, is an assumption that has to be tested against detailed analysis of farm production vs. costs), *there is no reason to assume that diminishing returns to labor left peasants worse off if intensification raised net output.* For one cannot assume that, for a peasant family, an hour of labor is an hour of fixed cost, nor that all units of output are the same in value to the peasant family.

In moving from single cropping to double-cropping, peasants did increase labor input, but it was labor that was drawn from previously slack seasons. That is, the labor on a single crop of rice is concentrated in a six-month period; between harvest and spring planting, farm families had much slack labor. Planting a second winter crop put labor from the slack season to newly productive use. Thus – unless one assumes a large preference for leisure over increased food and income (for which there is little evidence or logic if we assume near-subsistence living standards for the peasantry) – a peasant household might be delighted if they could raise their net crop output by 50%, even at the cost of a 75% increase in labor, if that additional labor was drawn from a slack period in which it had far less alternative value.[1]

[1] To make this more precise, let us say a peasant family requires 15 days of labor per *mu* of land to produce a single crop of 2 *shi* of rice, while intensifying production by double cropping increases production by 50%, but requires 75% more labor. That is, it would require an additional 12 days of labor to obtain an additional 1 *shi* worth of a secondary crop. The family *seems* to be worse off, as crop output per drops from 1.33 *shi* per day of labor to 1.11 *shi* per day of labor, a decline in labor productivity of 20%. However, this assumes the additional labor was drawn from a use as valuable as the initial farm labor – which was never the case. Assuming the additional labor was drawn from slack time, where labor was (at best) only half as productively employed as in farming, then one has to consider that under single-cropping the family was only obtaining 2.75 *shi* worth of output for 27 days of labor (15 days in farming, 12 productively employed as in farming, then one has to consider that under single-cropping the family was only obtaining 2.75 *shi* worth of output for 27 days of labor (15 days in farming, 12 days in less productive pursuits). Under double cropping, with all 27 days put to use in farming, the output of 3 *shi* worth of product actually represents a 9% *higher* return per day of labor. That is, if intensification involves shifting labor from slack or unproductive use to more productive use in farming, then even with diminishing returns to farming, a family's total return on its labor will significantly increase.

Secondly, scholars who argue for involution overlook the impact of rent payments on their calculations of *net* returns and productivity to the peasant household. Generally, poorer peasants (for whom involution presumably is most acute) did not own land but rented their land, paying on average half of their rice crop in rent (Li 2002). Thus the peasants' *net* return on their primary crop was reduced by roughly half. However, this was not true of the secondary crop produced by double-cropping. Since the land rental was already paid from the primary rice crop, the *entire product of the second crop* (less costs of seed and fertilizer, of course) was retained by the peasant household. This meant that even if the secondary crop required almost twice as much labor per unit output, the return to the peasant household for its labor would still be as high or higher than on the secondary crop. That is, for diminishing returns to effectively lower peasants' *net* return on their labor, the gross labor inputs for the secondary crop would not only have to be higher, but more than twice as high per unit output, as on the primary crop.

We pointed out in footnote 1 above in a simple example that a peasant family using slack labor to adopt double-cropping could increase its return on its labor by 9%, even if the second crop required 75% more labor to increase output by only 50%. But that calculation neglected the impact of rent on a family's net income. If we realize that under single cropping, half the primary crop (1 *shi*) went for rent, then the *net* retained gain to the family from double cropping, even with the stipulated diminishing returns in farming, would show an increase in return on a day of labor of 57%![2]

---

[2] After deducting rent, the initial product is 1.75 *shi* worth of output from 27 days labor, while the product under double-cropping is 3 *shi* worth of output for the same 27 days of labor. Of course, this does not include costs for additional fertilizer, water-pumping, and seed for either or both crops. We shall present more detailed calculations of all of these factors below. At this point, it is sufficient to note that these factors do not change the overall results by much. The point here is that diminishing gross returns to farming, even if substantial, do *not* imply diminishing *net* returns to total family labor, and can even coexist with large positive net gains to total family labor.

The attractions of intensification through double-cropping should thus have been overwhelming, especially for poor peasants. They could use slack-season labor to produce additional crops without paying any additional rent. This would have allowed them considerable extra family income from each unit of land, or to maintain family income from farming while selling or leasing a portion of their land.

In short, there is absolutely no logic to the notion that Chinese peasants could at any time increase output per acre by increasing labor input per acre with known traditional techniques, but did *not* do so at once, instead waiting for population pressure to gradually reduce family landholdings by subdivision of inheritance and only then, in reaction, intensifying their per-land unit efforts. This argument says that Chinese peasants simply ignored an immediate source of wealth and income that was always available to them.

Why should we assume that peasants would ignore this opportunity for gain? Some might argue that Chinese peasants were so backwards in their agriculture that they would not realize this potential, until forced into it; or that they were so irrational regarding land-holdings that they would not part with land even if it made them better off. Yet neither view is tenable. Preindustrial Chinese peasants (as we shall see in more detail below) used more advanced tools than European peasants up to the 19th century, quickly adopted new and varied crops and seed varieties, and actively bought, sold, leased, and subleased land, including a variety of separate topsoil and subsoil rights (Pomeranz 2000).

Rather, it is more logical to assume that the ability of Chinese peasants to simply increase output per acre by intensifying labor input per acre was *not* something that was always available. I shall argue that for much of the period prior to 1650, institutional and technical obstacles prevented such intensification of labor inputs, and only after 1650 were those obstacles lifted. At that point, there in fact *was* a rather sudden shift to smaller landholdings per family, more intensively farmed. Yet this did not merely reproduce traditional agriculture and involve stagnant productivity. Instead, the technical basis for intensification involved a large number of interlinked changes, including shifts in crops and crop rotations, in the *capital intensity* of agriculture (mainly through increased applications of new kinds of fertilizer and rented animal power), and in the more efficient allocation of family labor. Together, these changes created a new system of family farming that substantially increased labor productivity and output per family, fueling a boom in population, consumption, manufacturing and trade in mid-Qing China.

It is now well-known that late Ming and early-to-mid Qing China experienced striking increases in internal and international trade, especially of cotton textiles, but also of a wide variety of raw and manufactured materials, including soy, raw cotton, beancake, tea, ceramics, sugar, and silk, as well as a thriving internal luxury trade in books, artworks and art supplies, exotic spices and foodstuffs, to supply the elites of vast cities (Pomeranz 2000; Brook 19??, 19??; Frank 1999; Zurndorfer 19??). This trade was centered on the Yangzi delta, but embraced northern China, the upper Yangzi, and the southern coast. It is difficult to reconcile this great commercial expansion with a long-term constancy of output per capita and stagnant labor productivity in agriculture. I believe a more consistent picture of the economic flowering of the high Qing and the later decline of China's economy after 1800 is gained by identifying a technical change that allowed a one-time burst of increased labor productivity in agriculture from c. 1650 to 1750, and noting that this burst fueled an economic and population boom. Yet as demographic momentum led to further population increases, Chinese peasants could not readily boost output per capita by further intensification. Rather, from the late 1700s and early 1800s, declines in output per capita would have begun and then continued, leading to the poverty evident by the early 20th century after a period of comparative riches in the 18th.

In short, I will argue that China had an agricultural revolution in the 17th and 18th centuries very similar, in most respects, to that of Great Britain. This, of course, greatly intensifies the mystery of why the British economy industrialized and China did not, if Britain's agricultural revolution was not unique, and China had a capital-intensive, labor-productivity boosting shift in agriculture at roughly the same time. This is a problem I shall return to in the final section of this paper.

Agricultural Institutions and Techniques in Ming and Qing China

China's path to intensification of agriculture was blocked in the late Ming by both institutional conditions and technical obstacles. However, in the course of the Ming-Qing transition, the institutional obstacles were lifted, and technical changes in agriculture were developed and widely adopted.

The main intensification technique was double-cropping, or intercropping. There were numerous such systems for different crops. In northern China, where wheat and sorghum were the major cereal crops, double-cropping involved adopting faster-ripening varieties of grain and double-cropping with soybeans or rotating crops of grain and cotton. In different parts of Southern China and the Yangzi delta, intercropping of rice with mulberry trees for silkworm cultivation was practiced, and in drier parts of the delta cotton was grown in rotation with beans and rice. However, in this paper I shall for simplicity focus on one particular double-cropping scheme, which was the dominant pattern in the Yangzi delta after 1700. This involved a shift from raising a single crop of rice to raising a spring crop of early-ripening rice with a winter crop of wheat and/or rapeseed and beans.

All of these double-cropping and intercropping techniques involved more intensive cultivation and increased labor inputs to peasant land. For this reason, and given the evident poverty of late 19th and early 20th century China, it has seemed reasonable to argue that these increased labor inputs and intensive cultivation merely sustained, or even failed to sustain, constant levels of labor productivity.

Yet merely pointing to more intensive cultivation and greater labor inputs does not settle the question. During the British agricultural revolution, farmers fenced in lands for enclosure and built stocks to hold increased numbers of animals, intensively fertilized their fields with green manures and spread lime, and ploughed up former rough grazing lands to put under crops of turnips and barley. All of this too undoubtedly raised the labor inputs per acre. What counted was the precise change in outputs that was obtained. This cannot simply be guessed at. Rather, we need to look at the available evidence on the probable changes in output and net returns that resulted from specific changes in farming techniques.

Fortunately, new research by Chinese scholars on rural history, particularly that of Li Bozhong (1998) but also Shi and Fang (2000), Wu (2000) and Wang (2000), provide a basis for making such estimates. Moreover, work on their data by Allen (2002) has provided independent corroboration of some of the results I present below. In short, it appears that the techniques of more intensive agriculture substantially increased *both* labor productivity in agriculture *and* released labor from agriculture.

Let us first ask why such techniques were not widely adopted before 1650, and then examine more closely what these techniques were, and how they created net increases in labor productivity and family incomes.

The most pressing technical precondition for this mode of double-cropping was identifying early-ripening forms of rice that would mature in time for the fields to be drained and prepared for the winter crop of wheat. Moreover, early-ripening rice was of no value if it was not resistant to disease, or more demanding of water, or had smaller yields per plant. In addition, specific strains had to be matched with the micro-climate and hydrology of various locales.

Double-cropping of rice and wheat began to spread in the Yangzi delta in the Ming (16^{th} and 17^{th} centuries). The breakthrough innovation that made this possible in the 16^{th} century was the importation of early-ripening (Champa) varieties of rice from Indochina. However, it took time to adapt the new strains to the climate and growing conditions of China. In particular, it turned out that intermediate-ripening rice, which had lower fertilizer requirements and better yields, and varieties which could tolerate brackish water, were better suited for many areas. Thus even in the 16^{th} century the spread of double-cropping was slow and limited to specific regions.

The lower Yangzi, roughly the area of imperial Jiangnan province, was divided into three distinct geographic/ecological regions. The southern and western half (about 46% of cultivated land), arcing from Nanjing to Hangzhou, was the most advanced and highest productivity region, consisting of valleys, hillsides and plains that were well-watered with rich soil. North and East of Lake Tai, however, the land was low-lying often waterlogged during wet winters. Further west, from Shanghai to Songjiang, much of the land was sandy and had very low yields. Li (1998, p. 6) points out that "on much of the Jiangnan plain, agriculture remained comparatively backward before the seventeenth century." Most importantly, the double cropping of rice with a winter dry field crop was limited "to the hillside plains and river valleys of western Jiangnan. On the low-lying lands of Suzhou and Changzhou, and the sandy hills of Tiachang and eastern Songjiang, agriculture remained simple, needing improvement in seed varieties, crop rotation, and fertilizer."

Double-cropping in the low-lying belt was not possible until the land was drained, both to improve rice yields and enable farming of dry-field winter crops. In the western, sandy areas, improvement lay in irrigation and shifting to cotton cultivation, which provided far greater returns than rice on these soils. These improvements only took place in the later seventeenth and eighteenth centuries; thus over this period the portion of land in Jiangnan that was double-cropped rose from 40% to 70%, while specialized cultivation of cotton in Songjiang and increases in mulberry plantings in the low-lying region also greatly expanded.

Moreover, to sustain soil fertility for the 2nd crop of wheat, additional fertilizer had to be added beyond what was needed for the main rice crop. This extra dressing was applied to the fields before the harvest of the rice crop, to break down and prepare the soil for the winter crop to follow. This also was a tricky matter – if the traditional fertilizer (mainly animal and human excrement) was applied at the wrong time, or in the wrong amounts, it could spoil the rice plants. Thus double-cropping was only feasible where additional fertilizer could be obtained and applied at reasonable expense and at the appropriate time. Peasants would have to purchase the additional fertilizer, as well as the new rice varieties. Matching the new rice varieties and fertilizing regimens to local ecology took time and experimentation, and even by the end of the 17th century, Li suggests that many peasants were still not very proficient.

The fertilizer problem was largely solved by the widespread use of oilcake fertilizers. This was the waste left from pressing soy, cottonseed, rapeseed for oil. Oilcake was lighter, being much higher in nitrogen per kg, and easier to store and spread than manure fertilizers. Oilcake became more readily available both through imports from cotton and soy growing regions in northern China, and from expanding local cultivation of cotton in the Yangzi delta.

Aside from these technical challenges, by the early seventeenth century, most peasants were in no position to invest in improvement of their lands. Failures in the Ming court allowed large landholders colluding with officials to escape taxes, which then fell more heavily on the peasantry. In order to avoid increasingly confiscatory taxation, peasants sought the protection of large landlords, who obtained their lands and their services in return for protection. As a result, the best lands of the Yangzi delta increasingly passed into the hands of owners of vast estates, with thousands of laborers, who treated their peasants as little better than serfs (Wu 2000, p. 12). When the Ming dynasty was overthrown by the Manchus, these bond-servants rose up against their former masters (Elvin 1996, p. 8; Marks 1998, p. 146).

The rise of the Manchu Qing dynasty led to a major reform in agrarian class relations, especially in the lower Yangzi region. In order to prevent the tax-evasions and landlord dominance of the late Ming, the new Qing rulers eliminated the land tax-exemption formerly enjoyed by officials and prohibited landlords from selling peasants or demanding labor services. In a major tax case in 1661 officials and their collaborating landlords were forced to sell half their lands to pay taxes. These new tax laws precipitated a huge sell-off of excessively large landholdings, and peasants received new tenures on very favorable terms. Rents were often "fixed in perpetuity at a certain amount of grain" usually half the average yield in the late 17th century, most commonly 1 *shi* per *mu* and sometimes less (Marks 1984, p.37). By the last quarter of the 17th century, where vast estates manned by enserfed labor had once dominated the landscape, there instead arose multitudes of small family-owned and run peasant farms, whose owners bought and sold, leased and subleased, land from officials, landlords, and other peasants with abandon (Marks 1984).

With an economy based on independent, peasant-run farms restored, the spread of double-cropping resumed. By the mid-18th century, Li estimates that the acreage under double-cropping of rice and wheat in the lower Yangzi increased to 70% of cultivated land. In addition, larger areas of the Yangzi delta began to specialize in sericulture and cotton production. The sandy areas of the eastern delta, especially Songjiang, which had been poor rice lands, largely converted to cotton or rotations of cotton, wheat, and rice, while the humid southern part of the delta increasingly intercropped mulberry with rice paddies. The spread of double-cropping was thus also accompanied by substantial increases in regional specialization, further boosting overall efficiency of agricultural production.

Finally, and perhaps most importantly, a new long-distance interregional trade arose in fertilizer, with the Yangzi importing oilcake fertilizer from the north. The Yangzi delta region exported cotton and silk textiles, and imported fertilizer and raw cotton, in exchange with the northern provinces. The delta region also exported textiles west to the upper Yangzi in exchange for rice, and exported raw cotton and textiles to the south for sugar and tea. In sum, the lower Yangzi became the focus for a vast trading system that spanned all of China, as well as international exports of silk and cotton and ceramics and tea to Europeans and Japanese.

Huang (2002) and Brenner and Isett (2002) downplay this trade expansion, claiming that Yangzi peasants turned to cotton production only because they could not raise enough food to feed themselves. But this was not the case. Rather, the importation of oilcake fertilizers considerably furthered the spread of double-cropping and cotton production. Oilcake, compared to excrement fertilizers, was unusually lightweight, easy to store and spread, and less damaging to crops. Importing oilcake fertilizers thus made it easier for peasants to adopt double-cropping or to increase cotton output. In addition, as we shall note below, one key value to double-cropping regimes was that while they increased the *male* labor employed in agriculture, they substantially reduced the *female* labor employed in agriculture. This released a large volume of female labor for additional textile production to augment family incomes. This release of labor fueled a major expansion of textile output, and thus underlay expansion of the textile (particularly cotton) trade.

In sum, all over China, regional specialization and inter-regional trade was increasing in the early Qing, reflecting the shift in agrarian relations and increased output in the Yangzi delta which was the center of this trading system. In northern China, increased cotton and soy production through double-cropping with sorghum and wheat allowed expanded trade of raw cotton and oilcake for Yangzi textiles. The Yangzi delta, aided by the availability of vast imports of oilcake fertilizer, expanded its double-cropping of wheat and rice and increased its regional specialization and output of mulberry and cotton crops. In addition, the substantial release of female labor from agriculture that accompanied the spread of double-cropping allowed a vast expansion of textile production and exports, which paid for the oilcake and other imports. Altogether, these interlinked and reciprocal changes underlay the booming economic prosperity that drew wide comment from both Chinese and European observers in the early 18th century (Marks 1998, p. 285).

Thus the broad outline; but this cannot be understood without a more detailed look at the precise mechanics of the Yangzi double-cropping wheat/rice regime.

How Large the Costs, How Large the Gains?

To follow the course of labor productivity across the 17th and 18th centuries in China, we need to look closely at the inputs and outputs to typical farms. Unfortunately, even experts disagree over the basic data – understandably, given the huge size of China, or even the Jiangnan area (whose population in in 1700, at 20 million, was comparable to that of France), there is such great local variation that it is hard to say what constitutes a "typical" or "average" farm.

Probably the best-researched area is Jiangnan, or the lower Yangzi delta, in large part because as the richest area of imperial China, its agriculture drew extensive commentary from contemporary Chinese observers. As noted, even Jiangnan, however, had three distinct regions, which gradually developed over this period. There were a rice/wheat region (the hills, valleys and plains of western Jiangnan plus the drained but-low lying regions of western Songjiang), which not only developed double-cropping of rice and wheat but also more complex rotations including rapeseed, beans, and barley; a "cotton belt" consisting of the sandy-soil regions of eastern Songjiang, Tiacang, and nearby regions,which developed complex crop rotations emphasizing cotton but also including rice, beans, and alfalfa; and a "silk belt" in southeast Jiangnan which featured increasingly complex intercropping of mulberry trees with rotations of rice and beans and specialized in silk production. In this paper, I shall focus on the intensification that occurred when double-cropping of rice and wheat/bean/rapeseed rotations replaced the single-cropping of rice that was the normal practice in the early and mid-Ming.

Table 1 shows the inputs and outputs in a typical single-cropped rice-producing farm in western Jiangnan, on a per-*mu* basis. To understand how this affect a farm family's total income, of course, we also need to know average farm size. This in turn depends on estimates of total population, rural population, and land under cultivation. To be frank, there is no firm agreement on such data in the literature. Thus I can only be wholly explicit in my specification of data and calculations, and hope that scholarly estimates will converge close to these figures.

Li (1998, pp. 19-22) gives the total population of Jiangnan in 1620 as 20 million, of which 15% (3 million) were urban, leaving 17 million rural. Assuming that 10% of the rural population was not farming families (e.g., rural landlords, service workers, and landless laborers), this would leave 15 million farming families. By 1750, this population had increased to 30 million, of which Li estimates 20% were urban. The increased percentage of non-farm families is consistent with a vast increase in commercial trade and manufacturing (which required and supported urban merchants and finishing industries) – Elvin (1996, p. 30) notes that the number of market towns in the Shanghai region increased from 12 in 1600 to 30 in 1750. The 20% urban percentage is also comparable with the most urbanized regions of Europe, and seems reasonable since Jiangnan was the most urbanized region in imperial China, featuring the major cities of Nanjing, Suzhou, and Hangzhou (which together comprised almost two million population). This leaves a rural population of 24 million; again assuming 10% were not farmers, this means a farming population of 22 million. Assuming five people per household, this means there were approximately 3 million farming families in Jiangnan c. 1600, and 4.4 million in 1850.

How large was the average single-cropped farm? There were 45 million cultivated *mu* of land in Jiangan throughout this period (Li 1998). That means an average farm size would have been 15 *mu* per family farm in 1600, and 10 *mu* in 1750. It remains unclear whether these sizes were "typical" or "representative," especially given that in 1600 much land would have been absorbed into vast estates using serf-like bondservant labor. However, by 1800, the notion that "one man farms 10 *mu*" had become commonplace as a description of rice/wheat double-cropped farms. Thus the latter figure seems to reasonably represent the typical family farm. The figure for 1600 is more dubious; however, given population size, it seems a reasonable upper limit for the size of the typical independent peasant farm. Li (1998, p. 39) suggests that in the Ming, a "typical" family farm was larger, about 25 *mu* in size. This might be the case if the Ming also had a vast number of landless laborers, leaving far fewer farm families. However, Li seems to select this size based on it being the largest farm size that a household unit (male, wife, and children) could work without hiring additional labor, not because evidence indicates such holding size was typical. Given the population and farmed area in Jiangnan in 1600, it would have been impossible for the average rural farm family to have held 25 *mu*; 15 *mu* is thus a more reasonable estimate of actual farm size.

The involutionist case, of course, depends on the notion that peasant farm size declined with population increase, forcing peasants to work more intensively to support themselves on smaller units of land. So to test the involutionary hypotheses, we should conservatively assume that farm sizes in 1600 were as large as possible, given the size of the population in farming. We therefore assume that average farm sizes declined by one-third, from 15 *mu* to 10 *mu* per typical farm family, from 1600 to 1750.

Not only farm size, but also yields per unit of land are controversial. It is universally agreed that rice yields improved from 1600 to 1750. Double-cropping improved rice output by adding additional fertilizer and additional ploughing, as well as drying the soil, which benefited the primary rice crop as well as the secondary crop; in addition new tools (rotary weeders, invented in Japan) and techniques (bone meal and oilcake fertilizers, treating seeds with arsenic as pesticides) also spread in this period (Bray 1986, pp. 16, 46; Elvin 1996, p. 73; Wang 2000, p. 28).

However, the level and degree of improvement varied across different regions. In the upper Yangzi in Szechuan, and in the south in the Pearl River Valley, areas with rich alluvial soils, peak yields are recorded as high as 4 *shi* per *mu* in 1700 (Shi and Fang 2000, pp. 117-118). Similar yields are recorded for high-grade land in the Suzhou and west Songjiang regions of Jiangan in the 1870s. But for Jiangnan in 1700, yields of 2 to 3 *shi* per *mu* were more common.

Estimates for the degree of change from the Ming to Qing periods range even more widely. At the extremes, Wang (2000, p. 26) suggests that yields rose only slightly in southern China from 2.6 *shi* per *mu* in the Ming to 2.8 in the Qing, while Li (1998, p. 139) suggests a much larger increase in yields in Jiangan in this period, from 1.7 *shi* per *mu* in the Ming to 2.5 in the Qing. Even Li, however, suggests that in the higher-grade rice/wheat land of western Songjiang, where levels were higher gains were less, going from 2.5 *shi* per *mu* in the Ming to 3.0 in the Qing. Brenner and Isett (2002) and Huang (2002) choose a typical rice yield of 2.25 *shi* per *mu* for 1800, which seems low, and a yield in 1600 of 2.0, showing very little change;; but these figures are derived largely from the eastern Delta, which was dominated by sandy soils and increasingly specialized in cotton, with rice as a secondary crop. Yields were clearly higher in the western delta, where the rice/wheat double-cropping regime predominated; thus Brenner and Isett acknowledge 2.5 *shi* per *mu* in 1750 may be more accurate for Jiangnan as a whole. Robert Allen (2002), an expert in British agriculture who has examined this controversy as an outsider, finds it most plausible that average rice yields rose from around 1.9 *shi* per *mu* in 1600 to 2.4 in 1800 – any smaller rise, he argues, would have been inconsistent with observed farm inputs. Faced with this disagreement, I shall estimate costs and outputs for a range of yields, to show that this is not a critical issue. For 1600, I use a rice yield of 1.8 to 2.1 *shi* per *mu.* For 1750, I use a rice yield of 2.5 *shi* per *mu,* which seems the most common estimate for this period, being close or equal to the figure used for Jiangnan as a whole by Li (1998), Allen (2002), Brenner and Isett (2002). Fortunately, all commentators agree that the yields of winter dry-field crops (wheat, barley, beans, rapeseed, alfalfa) were all about 1.0 *shi* per *mu.* However, these crops were less valuable than rice, by some 30% (in both market value and caloric value). Thus, to keep all quantities constant, I shall use *shi* of rice equivalents throughout Table 1. This implies a rice-equivalent yield of 0.7 *shi* per *mu* for the secondary crops.

Costs, as one might suspect, are also uncertain. There seems general agreement that the basic labor to till, plant, harvest, and husk rice was 10 days of work per *mu* planted. Additional work, however, was required to pump water and spread fertilizer. It also mattered greatly whether ploughing and pumping were done with the assistance of oxen or not. In the Ming, the use of oxen seems to have been rare; however, by the mid-Qing, rental of oxen for ploughing and pumping seems to have been relatively common (Marks 1984, p. 50; Li 1998, p. 45). The greater use of oxen in the Qing, like the use of oilcake fertilizer, seems to have been part of the technical ensemble of double-cropping, as Li suggests that without oxen to handle the preparation of the soil and pumping to flood and drain fields these essential tasks could not have been accomplished in time for a double-crop rotation.

Critics of Chinese agriculture have sometimes claimed that the near absence of draft animals (oxen and horses) from most farms indicates a backward, power-impoverished farm regime. Actually, the reverse is true, the secret being the curved cast-iron ploughshare developed in China at the turn of the millennium, and adopted in Europe only in the 1780s after imported by the Dutch, and known in England as "Rotterdam ploughs." The Chinese had been using the high temperatures of coal-fired reverberatory furnaces to create ceramics and smelt cast iron since the Han empire, roughly two millennia before Europe mastered the use of coal and high-temperature furnaces to create cast iron. As a result, the Chinese were able to cast iron into a variety of useful shapes, from cooking pots to curved, flanged ploughshares, while Europeans still hammered iron bar into shapes (Temple 1986, p. 20). European ploughs thus relied on iron tips to break the soil combined with flat wooden mouldboards to turn the soil aside, with the latter attached at a right angle to the direction of ploughing. While the mouldboard turned over the soil broken by the plough, the work required to drive the perpendicular and flat moldboard against the soil was enormous. By contrast, the one-piece curved, flanged ploughshare of Chinese ploughs smoothly broke and turned the soil over in one flowing motion; as a result it required far less effort to work against the soil. Where an entire team of oxen or horses was required to pull the European flat-mouldboard plough (and of course had to be fed and stabled when not engaged in work), a single ox could draw the Chinese curved, flanged, iron ploughshare, as the latter was "an extremely efficient device" (Bray 1984, pp. 174-178). Technology substituted for animal-power, rather than there being any power deficiency.

The more efficient use of oxen meant that far fewer animals were needed per acre farmed; as a result the Chinese developed a system of some peasants specializing in maintaining oxen, and renting them to farmers for specific tasks (mainly ploughing and powering pallet pumps for moving water into and out of fields). This arrangement was far more efficient than the European system, which required far more animal power to farm each unit of land, and hence far more land devoted to pasture and fodder crops.

In the Ming, when oxen use was rare in single-cropping, it appears an additional 2.5 days of labor were required for pumping water, and a further 1.5 days for spreading fertilizer. Thus a total of 14 days of labor was required per *mu* of rice planted. In the Qing, the use of oxen for ploughing and pumping reduced human labor input. Li (1998, p. 83) suggests that oxen reduced human labor in soil preparation from 2 days to .33 days. Assuming similar savings in pumping reduces that labor requirement to from 2.5 to 2 days. The use of oxen thus would save a total of 2.2 days. However, the use of an additional dressing of oil-cake fertilizer in double-cropping would add another .5 day per *mu*, and of course the costs of oxen rental and the fertilizer must be added. Li (2002) notes that in Songjiang in the early 19th century, pumping cost rice farmers .125 *shi* per *mu*; this is the figure I use for oxen rental. To account for the use of oxen in ploughing, which involved a similar substitution in terms of labor, I use the same cost; thus a total of 0.25 *shi* per mu went for oxen rental. Li also notes that at the same time, the oilcake dressing used as additional fertilizer cost .225 *shi*. Although these prices are for the early 19th century, they were given in coin, and I have converted to rice equivalents at the same prices. In the absence of different figures for the 18th century, I have assumed that the relative costs of rice, ox rentals, and beancake remained the same. While cotton textile costs in fact declined substantially relative to rice from the 18th to the 19th century, I have seen no evidence that other relative prices moved as sharply. I thus use these input prices *faut de meaux*. For comparison, this cost of production (.34 *shi* per *mu*) is almost identical to the production costs that Brenner and Isett give for rice production in 1750 of 15% of output, which comes to .375 *shi* per *mu* for production of 2.5 *shi* per *mu*. However, they do not allow for extra fertilizer costs, which I specify separately.

In regard to total labor inputs, these must be divided between men and women. The season for summer rice production under single-cropping was roughly six months, using late-ripening rice, in which a man working 25 days per month could reasonably do 150 days of agricultural labor. This leaves 60 days of labor for women. This division seems reasonable, as by the Ming the Jiangnan region was already heavily involved in cotton production, with output of some 50 million bolts, or roughly 15 bolts per year for every rural (farm and non-farm) family in Jiangnan (Li 1998, p. 109). Of course, not all families were engaged in cotton production; perhaps a fifth of the women in Jiangnan were involved mainly in silk-production; others specialized in other craft pursuits. Still, if we say that at least three quarters of rural women in Jiangnan engaged in cloth textile production, then each such farm household would have produced 20 bolts of cotton per year. At seven days labor to produce a bolt of cotton from raw materials, this implies 140 days per year spent in spinning and weaving. Women could have readily done this much work and the 60 days of agricultural labor, and still had time for other demanding farm and family tasks.

By 1750, under double-cropping, the field labor is clearly all male labor. The required labor for rice – 118 days – is less than was previously required of males under single cropping. Thus there is no longer any need for women to work in agriculture. Similarly, the 70 days used for winter dry-crops, occurring in what was previously a slack season, can also be done by men. Thus, from the Qing period on, we find increasing comment on the system of "one man works ten *mu,*" and "men plough and women weave" as the expected norm for peasant familes (Wu 2000, p. 5) Thus the double-cropping regime allowed men to shift 70 days from slack season work to agriculture, and allowed women to move anywhere from 60 to 120 days out of agricultural labor and into other pursuits.

Finally, seed costs were modest, due to the very high yield-to-seed ratio of rice, amounting to only .09 *shi* per *mu* planted (Li 2002, p. 11). Wheat seed, however, was similar, as evidently seed drills and other techniques conserved seed much more than in Europe.

For 1750, we also need to specify the labor and cost inputs of the winter dry-crops. Here, we follow Brenner and Isett (2000) in estimating the labor requirement at 7 days per *mu* planted, and the production costs at 1 *shi* of rice equivalent.

Lastly, I should explain why I have left rent constant at 1 *shi* per *mu* in both periods. Many observers (e.g. Allen 2002) have assumed that rents were always one-half of the rice crop. In fact, as we pointed out earlier, in the early Qing every effort was made to establish a peasantry under favorable tenures, and rents were widely fixed at one half the yield c. 1675. Shi and Fang (2000, p. 136) observe that in their study of late 18th century lawsuits over rent, except in Henan, they found that fixed rents or money rents were far more common than sharecropping. Indeed, the latter only appeared in 97 out of 888 lawsuits (11%). By the 19th century, they add, sharecropping was negligible. Thus it appears by far the most common situation in the late 18th century was for peasants to be paying a fixed rent in *shi* of rice.

Having assembled this data from various sources, we are now in a position to see whether a reduction in farm size, and the shift from single to double-cropping, followed an 'involutionary' pattern of declining returns to peasants or not.

Involution or Revolution?

Li Bozhong (1998) – whose data I heavily drew upon in composing Table 1 – claims that China experienced an 'agricultural revolution' in the late Ming and early Qing, in which a cluster of new techniques, including expanded use of imported oilcake fertilizer, use of rental oxen for labor, better seed varieties, and increased regional specialization in rice/wheat, cotton, and mulberry production, boosted productivity and incomes. We have not examined gains in cotton and mulberry production here, but we can ask whether his data is consistent with his conclusions, especially in the context given here where Li's data is combined with that of other scholars.

Table 2 provides the relevant calculations from the data in Table 1. First, it should be clear that double-cropping did not lead to immiseration; rather even on reduced landholdings of 10 *mu*, agriculture provided a comfortable income. It is generally thought that comfortable consumption levels of rice for a family are the equivalent of 3.0 *shi* per person. The double-cropping farm provided at least as much retained product, and possibly considerably more (depending on how one estimates rice productivity gains). Either way, the retained product of 15.35 *shi* per family would provide for a family of five. And this calculation omitted eggs and meat from chicken and ducks, and meat from pigs and pond-raised fish, that would have been a modest, but typical, part of peasant's resources (Li 2002).

However, the findings as to whether there was an 'agricultural revolution' appear far more ambiguous. The data suggest that the shift to double-cropping *at a minimum* provided a net *increase* in labor productivity with regard to peasant household's retained product. That is, the peasants' net product retained per day of labor grew from a range of .057 to .721 *shi* per day's work to .082 *shi* per day's work. The amount of increase depends, not surprisingly, on the degree to which rice productivity improved. If the gain was from 1.8 to 2.5 *shi* per *mu,* then peasants would increase their net retained product by 44%; if the gain was from 2.1 to 2.5 *shi* per *mu*, then peasants' increase in net retained product was only 14%.

A somewhat different picture emerges if we look at total value added (which looks at gross output before deduction of rent). There we see almost no improvement at all. The estimated value added per day of labor in 1750 is right in the middle of the estimated range for 1600; thus from the point of view of China's agricultural economy as a whole, gains were slight

or non-existent, even though gains to peasant households were substantial. This is because the major effect of double-cropping was to allow peasants to spend more time working for themselves (on secondary crops and techniques to raise rice output) and less time working to pay rents. The proportion of their total product paid as rent drops from roughly one-half to one-third. It should be noted that peasants in the Qing also paid no taxes; rather poll taxes and land taxes were paid only by owners of land, which excluded roughly 90% of the peasantry (Li 2002).
In short, the pattern of gains under double-cropping is not far from involution *for the agrarian economy as a whole* – that is, output increased in line with population, but the cost of additional inputs was such that the net value added remained roughly constant. However, as output increased, a significantly larger portion of the gross product was retained by the peasant household. Thus for the peasantry, double-cropping offered real gains in labor productivity; ranging from 14 to 44 percent, depending on the degree to which rice yields improved in this period.

Yet this should just be considered a first pass. As we noted above, we cannot treat all labor as the same – labor has opportunity costs which should be factored into the household budget. For men, their participation in agriculture has gone up from 150 days per year to 188 days, but previously those additional 38 days were used in non-agricultural activities. Conversely, for women, their participation in agriculture has fallen away altogether, allowing them to specialize in textile production. At a minimum, they gained 60 days of additional labor time to work in textiles; or possibly, if women's agricultural labor accomplished only one-half as much as men, then they would have had 120 days of labor transferred from agriculture to textiles. We need to include the opportunity costs of these labor shifts in our calculation of household incomes.

In the Ming, cotton textile manufacturing was already well established in Jiangnan. However, from the Ming to the Qing, Jiangnan's cotton output increased both overall and per-capita. Li (1998, p. 109) claims that Jiangnan's production increased from 50 million bolts in the early 17th century to 100 million bolts in the late 18th century. Since Jiangnan's population only increased by 50% in this period, these figures suggest that cotton cloth output per household in Jiangan increased substantially. If most cloth spinning and weaving was done by rural peasant households (leaving the more expensive fulling and finishing steps for urban workshops), then the figures given earlier – noting total rural (farm and non-farm) population in Jiangnan increasing from 17 million to 24 million in this period – suggest an increase in per capita rural output of cotton textiles of 42%. Some of this could have come from increased productivity per household, but productivity only increased by 15% in this period (time to produce a bolt of cloth fell from 7 days to 6 days, in part because of greater specialization and skill, and in part because of adoption of multi-spindle machinery which significant cut the time for spinning (Elvin 1996, p. 40). Thus most of the increase (roughly a 30% increase per household) must have come from additional production by peasant families.

Involutionists such as Huang (1990, 2002) and Brenner and Isett (2002) have argued that such an increase in textile production from rural households would only occur by necessity, as families sought to offset the loss of agricultural income by turning to manufacturing. However, the data in Table 2 show that this explanation is highly unlikely. Under double-cropping, families up to 1750, at least, still produced quite sufficient agricultural output to feed a family of five. Rather, it seems the increase in textile output was a natural response to the release of female labor time from agriculture afforded by the double-cropping regime.

In the mid-Qing, Jiangnan produced roughly 100 million bolts of cotton cloth per year. Again, if we assume the three-quarters of rural households produced cotton textiles, then those households would have produced an average of roughly 28 bolts per household. At six days of labor to produce a bolt of cloth, this implies an average of 168 days of labor per household. Earlier, we estimated that in the Ming similar households would have spent 140 days in spinning and weaving; thus only about half of the 60 days of labor released by double-cropping would have been used for additional cloth production; presumably the other time would have been used for marketing, family care, consumption time, or other net benefit.

What is interesting here is that these 'averages' suggest that families – even rural families – did not exhaust their productive potential in raising food and producing textiles. The average family described above spent 188 days of male labor in agriculture and 140 days in textile production in the late Ming. While in any real society many families will be richer and poorer than the notional average, it does not seem reasonable to suggest that the majority of Jiangnan families in 1750 were working from dawn until dusk and yet barely able to meet their subsistence needs.

It is difficult to know how to value the opportunity cost of this 'slack' time. Clearly, since women turned some of their time released from agriculture to textile production, the return on that activity – up to some level – was preferred to leisure. For men, it is not clear that time not spent in agricultural labor was productive at all. While fixing the home and other useful pursuits may have provided some useful occupation of slack time, common knowledge suggests that men during slack time will spend a good deal of time drinking, gossiping, and in sports or other leisure time. Such pursuits may be useful, but since they add nothing to family income, we would have to consider any transfer of time from such pursuits to agricultural labor as a net gain.

I shall therefore make the following assumptions. First, the additional 38 days of labor in agriculture that men do under double-cropping was drawn from time that was otherwise unemployed, and therefore of low value. We therefore value that time as worth one-quarter of its use in agriculture. This means that for those 38 days, the net cost of their use is 9.5 days, not 38 days. They are "cheap" since drawn from the reserve of slack labor. For women, we assume that one-half the time released from agriculture is employed in textile production, providing a net gain to family income. There is some controversy over returns to labor in textiles (Pomeranz 2002). Wang (2000, p. 35) gives a price of .2 *shi* of rice per bolt of cotton produced for late Ming and early Qing, and Li (1998, p. 149) gives a price of .23 *shi* for 1680 and .19 *shi* for 1750. This difference seems too small to worry over. The real drop in cotton textile prices came after 1750, with prices falling to .1 *shi* by 1850. We use Li's early and late prices for the early and later periods. The figures in Table 2 would then be modified as shown in Figure 3:

Clearly, labor in textile production was less productive than in agriculture – the value added and net product per day of labor in Table 3 are clearly less than in Table 2. Thus the involutionists would be right that declining farms size would dramatically *reduce* productivity if this forced families to shift labor out of agriculture and into farm labor. But the irony here is that reducing farm size by adopting the wheat/rice double-cropping routine in fact does *the reverse*. It allows families to turn slack labor into productive agricultural labor time, while at the same time releasing *surplus* female labor from agriculture for use in textile production. Far from being forced into textile production to maintain incomes, the double-cropping regime released so much female labor that only a portion of it was apparently allocated to textile work.

Although the labor-value adjustment in the lower half of Table 3 is crude, it does capture the fact that labor was being allocated more productively. What we find simply reconfirms, even more dramatically, the pattern revealed earlier – at an aggregate level, the intensification of double-cropping *was* involutionary. While families were able to boost output sufficiently to support themselves on less land, the additional expenditures on labor and input costs produced no net gain. Value added per day of labor changed hardly at all, even when adjusting for the use of formerly slack labor: we estimate it at roughly .09 *shi* per day in both 1600 and 1750. Yet while the economy as a whole showed no gains in labor productivity or output per capita, this was emphatically not true for peasant households. They enjoyed impressive gains. Peasants' net product in 1750 was over 20 *shi* per family, some 30 percent over the normal consumption requirements of a family of five. While the amount of net increase depends on estimates of changes in rice yields, the bottom line remains an impressive total income.

In regard to return on their labor, the results are more impressive still. The increase in net return on labor to peasant families is large and clear – here the estimated range is a gain of roughly 20 percent to 50 percent! As noted before, the rewards of adopting double-cropping were overwhelming to peasants. Surprisingly, we have something of a paradox – involution at the level of the Jiangnan economy as a whole, but highly impressive gains for peasant households who enjoyed high incomes and apparently voluntary leisure. The resolution of this paradox lies in something I believe has not been widely noted – that under the institutional conditions and agrarian class relations of Qing China, intensification by double-cropping resulted in a considerably larger fraction of value-added being retained by the peasantry.

Starving the State?

These results suggests new insights into the decay of Qing China, and more particularly into its striking cycle of boom and bust. In the early Qing, the shift to double-cropping apparently would lead to peasants choosing to more intensively farm smaller plots, and reallocating labor across seasons and within the household, in order to retain a larger portion of the fruits of their labor. Indeed, there is the potential for a consumer "boom" here as family incomes could well have risen by 1/3 from the Ming to the early Qing (assuming the larger change in rice yields). The pattern of trading cloth textiles, importing oilcake fertilizer, and releasing labor to boost textile production would not only have improved peasants' return on their labor, but would have supported large increases in interregional trade. These prosperous conditions help to explain the growth in trade and manufacturing, and the population boom of the early Qing.

However, these were, to a large extent, one-time gains. Two major developments then altered conditions for Jiangnan households. First, northern China, which in the Ming and early Qing had exported raw cotton and imported Jiangnan cloth, itself became a cotton textile producing region. The invention of spinning cellars, which preserved sufficient moisture to spin cotton without the fibers becoming brittle and breaking, allowed northern households to spin their own yarn. This did not eliminate Jiangnan's export markets – Jiangnan cotton was still sold to the upper Yangzi and the southern coastal regions. But it did lead to a major drop in cotton textile prices, which fell in value from roughly .2 *shi* per bolt in 1750 to .1 *shi* per bolt in 1850. This would not have created starvation (farm output would have been sufficient to feed a family). But it would have eliminated much of the spending surplus in family budgets, or forced peasants to work harder (as we have seen, there were still in 1750 ample reserves of unused days of labor on which to draw) in order to sustain family purchasing power. Thus after 1750, true involution likely would have begun to set in even at the household level.

Second, the next step in boosting productivity – shifting from double-cropping rice and winter dry crops to double-cropping two rice crops on the same land – did not offer the same gains as the winter dry crops, inasmuch as the labor and cost demands of rice were much greater. Shifting to double-cropping of rice likely sustained population increase without net gains even to peasant households.

Thus the great prosperity of peasant farming households gained from the late Ming to the mid-Qing likely would have begun to falter after 1750, and indeed to erode with the price of cotton textiles and the spread of wheat/rice double-cropping to its ecological limits.

In addition, although peasant households enjoyed greater prosperity, this came without any increase in the resources available to elites and the state through rent and taxation. For political reasons, the Qing state had fixed rents and taxes early in its reign in ways highly favorable to peasants. This certainly achieved its aims of encouraging a prosperous peasantry. Yet as that peasantry grew in numbers, it was not possible to fund an equally rapidly-growing official elite. The agricultural surplus taken through rents would have steadily fallen as a portion of total product and in relation to total population. Of course, local elites could tap the peasant households' surplus in other ways – through pawnbroking and fees for education, ceremonial services, and investment in trade. To the extent that peasant surpluses were spent in the market, this provided an opportunity for elites to gain wealth.

However, this would not necessarily benefit the state. Like the French agronomists, the Chinese statesmen believed that all wealth was fundamentally agricultural. Freezing rents and taxes of course helped peasants to produce wealth. But over time, as the peasantry became more numerous, the administrative and welfare tasks facing the government would naturally increase, without any assured increase in resources to meet these burdens. Once to this normal imbalance was added the strains of the Opium wars and massive intrusion of foreign powers in China's trade, as well as the burdens of reparations to western powers, it is hard to see how the Chinese state could survive. By the mid-19th century, the one-off household gains of the 17th and 18th centuries were likely exhausted by further population growth and the shifts in prices we have noted. As a result, by 1850 the Qing government would have found itself with increased responsibilities, a population roughly three times as large as when it took power, but a smaller agricultural surplus from which to draw resources.

An Agrarian Basis for Industrialization?

In Britain, rather the opposite distributional effect occurred. Instead of peasants growing more prosperous, in the sixteenth early seventeenth centuries they increasingly were reduced to landless laborers as agrarian class relations allowed landlords to capture the lion's share of productivity gains through rising rents. In the later seventeenth and early eighteenth centuries, real wages rose slightly, but in the later eighteenth and early nineteenth century, the earlier trends continued. By the 19th century, England's agrarian population was dominated by relatively poor landless laborers (with, according to Allen [2002], lower incomes than Chinese farming peasants), working on large farms rented by a minority of well-to-do tenant farmers, who in turn rented from a fabulously wealthy landlord/gentry class. But England was not the only high-productivity region in Europe. The Netherlands and Belgium were also highly productive in agriculture, and had a peasant-based rural farm structure closer to that of China than the large-landlord structure of England.

Thus we have at least four high-productivity agrarian regions in the 18th century: Jiangnan, Britain, the Netherlands, and Belgium. Only one of them industrialized. Clearly, a highly productive agriculture may be necessary for industrialization, but it is far from sufficient.

However, it is difficult to draw a direct causal line from an agrarian structure dominated by large landlords to industrialization, precisely because large landlords were among the most determined opponents of industrial growth. Through the Corn Laws, the landlord-dominated Parliament acted against the interests of manufacturers in keeping grain wages low; through their control of Parliament via rotten boroughs, Parliament tried to keep manufacturing centers outside of Parliament. Perhaps Marx was right – industrial classes rose in Britain in the teeth of opposition, rather than through support, of industrial growth.

It used to be argued by Marxists – such as Brenner and Isett (2002) – that large landlords nonetheless served a purpose in the development of British capitalism. By expropriating workers, and overseeing an agriculture that was productive enough to feed a multitude of workers in industry, it was argued that British agricultural development paved the way for industrial growth. But we have seen that Chinese agricultural development also released massive amounts of labor into manufacturing, and was sufficiently productive to boost labor productivity in agriculture for peasant households.

It is important to address one final confusion in comparing British and Chinese agriculture. The gains in labor productivity in British agriculture were much like those in China in that the gains in productivity are only visible if one counts productivity *per farm worker,* and not per head of total population. English agriculture was more productive per laborer in agriculture in the 18^{th} century than the 16^{th} century, but only because the agricultural population remained relatively constant while output increased. Yet the non-agricultural population grew even faster than output. Thus by the late 18^{th} and early 19^{th} century, England could no longer feed its population from its own agriculture, and relied on imports (Allen 1999, Overton 1996).

In both England and in China, higher labor productivity by agricultural labor did not mean more food per head for society as a whole – it simply meant greater returns for the fraction of the population which dominated agriculture; in Britain the landowners and large farm-tenants, in China the peasant farming households. But greater returns for a fraction of society may not benefit society as a whole.

Thus the conundrum of industrialization remains. Both England and China experienced major changes in agriculture from the 16th and to the 18th centuries. In the former, output per farm laborer rose, but not output per head of total population. In the latter, retained output per day of labor expended by peasant families rose substantially, but not output per head of total population. Different systems, but in agriculture, a similar result.

REFERENCES

Allen, Robert. 2002. "Agricultural Productivity and Rural Incomes in England and the Yangtze Delta, c. 1620-c. 1820." Paper presented at Convergence and Divergence in Historical Perspective: The Origins of Wealth and Persistence of Poverty in the Modern World, All-U.C. Group in Economic History Conference, University of California, Irvine, November 8-10, 2002.

Beckett, J.V. 1990. *The Agricultural Revolution*. Oxford: Basil Blackwell.

Brenner, Robert and Christopher Isett. 2002. "England's Divergence from China's Yangzi Delta: Property Relations, Microeconomics, and Patterns of Development." *Journal of Asian Studies* 61: 609-662.

Bray, Francesca. 1984. "Biology and Biological Technology." In Joseph Needham, ed., *Science and Civilization in China, Part II: Agriculture*, vol. 6. Cambridge: Cambridge University Press.

-------.1986. *The Rice Economies: Technology and Development in Asian Societies*. Oxford: Basil Blackwell 1986)

Clark, Gregory. 1993. "Agriculture and the Industrial Revolution." In Joel Mokyr, ed. *The British Industrial Revolution*. Boulder, CO: Westview.

-------. 2002. "The Agricultural Revolution? England 1500-1912." Unpublished .ms, University of California, Davis.

Deng, Gang. 1999. *The Premodern Chinese Economy: Structural Equilibrium and Capitalist Sterility.* London: Routledge.

Fang Xing, Shi Qi, Jian Rui and Wang Shixin. 2000. "Capitalism during the Early and Middle Qing (1)." Pp. 165-246 in *Chinese Capitalism, 1522-1840*, edited by Xu Dixin and Wu

Chengming. New York: St. Martin's Press.

Frank, Andre Gunder. 1998. *Reorient: Global Economy in the Asian Age.* Berkeley and Los Angeles: University of California Press.

Goldstone, Jack A. 1991. *Revolution and Rebellion in the Early Modern World*. Berkeley: University of California Press.

-------. 1998. "*Social History of the Orient* 41: 249-284.The Problem of the 'Early Modern' World." *Journal of the Economic and*

-------. 2000. "The Rise of the West -- or Not? A Revision to Socio-economic History." *Sociological Theory* 18: 157-194.

-------. 2002. "Efflorescences and Economic Growth in World History: Rethinking the 'Rise of the West' and the Industrial Revolution." *Journal of World History* 13: 323-389.

-------. 2003. "Neither Late Imperial nor Early Modern: Efflorescences and the Qing in World History." In *The Qing Formation in World History*, edited by Lynn Struve. Cambridge, MA: Harvard University Asia Center.

Huang, Philip C.C. 1990. *The Peasant Family and Rural Development in the Yangzi Delta, 1350-1988*. Stanford: Stanford University Press.

-------. 2002. "Development or Involution in Eighteenth Century Britain and China? A Review of Kenneth Pomeranz's *The Great Divergence.*" *Journal of Asian Studies* 61: 501-538.

Lee, James and Wang Feng. 1999. *One Quarter of Humanity: Malthusian Mythology and Chinese Realities*. Cambridge, MA: Harvard University Press.

Li Bozhong. 1998. *Agricultural Development in Jiangnan, 1620-1850*. New York: St. St. Martin's Press.

-------. 2002. "Involution or Not: A Case Study of Farm Economy in Songjiang, 1823-34." Paper presented at Convergence and Divergence in Historical Perspective: The Origins of Wealth and Persistence of Poverty in the Modern World, All-U.C. Group in Economic History Conference, University of California, Irvine, November 8-10, 2002.

Leboutte, René. 2002. "Intensive Energy Use in Early Modern Manufacture." Paper presented at the 34th International Institute of Economic History, Prato, Italy.

Maddison, Angus. 1998. *Chinese Economic Performance in the Long Run*. Paris: Organization for Economic Cooperation and Development (OECD).

Mokyr, Joel. 1993. *The British Industrial Revolution*. Boulder, CO: Westview.

Overton, Mark. 1996. *Agricultural Revolution in England: The Transformation of the Agrarian Economy 1500-1800.* Cambridge: Cambridge University Press.

Pan, Ming-te. 1997. "Were they Better Off? Living Standards in the Rural Yangzi Delta: 1650-1800." Paper Presented to the All-UC Economic History Conference, Davis, California.

Perkins, Dwight H. 1969. *Agricultural Development in China, 1368-1968*. Chicago: Aldine.

Pomeranz, Kenneth. 2000. *The Great Divergence: China, Europe, and the Making of the Modern World Economy*. Princeton, NJ: Princeton University Press.

Shi Qi and Fang Zhuofen. 2000. "Capitalism in Agriculture in the Early and Middle Qing Dynasty." Pp. 113-162 in *Chinese Capitalism, 1522-1840*, edited by Xu Dixin and Wu Chengming. New York: St. Martin's Press.

Snell, K.D.M. 1985. *Annals of the Labouring Poor: Social Change and Agrarian England, 1660-1900*. Cambridge: Cambridge University Press.

van Zanden, Jan Luiten. Forthcoming. "The 'Revolt of the Early Modernists' and the 'First Modern Economy,' An Assessment."

Wang Shixin. 2000. "Capitalism in the Late Ming Dynasty." Pp. 23-110 in *Chinese Capitalism, 1522-1840*, edited by Xu Dixin and Wu Chengming. New York: St. Martin's Press.

Wong, R. Bin. 1997. *China Transformed: Historical Change and the Limits of European Experience*. Ithaca, NY: Cornell University Press.

Wu Chengming. 2000. "Introduction: On Embryonic Capitalism in China." Pp. 1-20 in *Chinese Capitalism, 1522-1840*, edited by Xu Dixin and Wu Chengming. New York: St. Martin's Press.

Table 1: Farm Size, Output, and Costs in Ming and Qing China

Single-cropped rice farm, c. 1600 (Ming China), 15 *mu*

Output per *mu*:	Total Farm Output:
Rice: 1.8 to 2.1 *shi*	Rice: 27 to 31.5 *shi*
Costs per *mu*:	Total Farm Costs:
Rent: 1 *shi*	Rent: 15 *shi*
Seed: .09 *shi*	Seed: 1.35 *shi*
Fertilizer: 0 (produced from farm sources)	Fertilizer: 0
Labor Input per *mu* (including pumping and and fertilizing; no oxen):	Labor Input:
14 days	210 days 150 male + 60 female)

Double-cropped rice farm, c. 1750 (Qing China), 10 *mu*

Output per *mu*:	Total Farm Output:
Rice: 2.5 *shi*	32 *shi* of rice equivalent
Winter Crops: 0.7 *shi* of rice equivalent	
Total: 3.2 *shi* rice equivalent	
Costs per *mu*:	Total Farm Costs:
Rice:	Rice:

Rent: 1 *shi*	Rent: 10 *shi*
Seed and oxen rental, rice: .34 *shi*	Seed, oxen: 3.4 *shi*
Fertilizer: .225 *shi*	Fertilizer: 2.25 *shi*
Wheat:	Wheat:
Seed: .1 *shi*	Seed: 1 *shi*
Labor Input per *mu* (including pumping and and fertilizing; no oxen):	Labor Input:
Rice: 11.8 days	Rice: 118 days (male)
Winter Crops: 7 days	Winter Crops: 70 days (male)

Table 2: Changes in Chinese Productivity, 1600 to 1750 (All measures in *shi* rice equivalents)

1600

Total Output: 27 to 31.5 *shi*

Total Costs:

Rent 15.00 *shi*

Seed: 1.35 *shi*

Total Value Added (output minus inputs): 25.65 to 30.15 *shi*

Peasants' Net product (output minus costs and rent): 10.65 to 15.15 *shi*

Total Labor: 210 days

Value Added per Day of Labor: .122 to .144 *shi* per day

Peasants' Net product per Day of Labor: .0507 to .0721 *shi* per day

1750

Total Output: 32 *shi*

Total Costs:

Rice

Rent 10.00 *shi*

Seed, oxen: 3.4 *shi*
Fertilizer: 2.25 *shi*
Wheat
Seed: 1 *shi*

Total Value Added (output minus inputs): 25.35 *shi*

Peasants' Net product (output minus costs and rent): 15.35 *shi*

Total Labor:
Rice: 118 days
Winter Crops: 70 days

Value Added per Day of Labor: .135 *shi* per day

Peasants' Net product per Day of Labor: .082 *shi* per day
Table 3: Changes in Chinese Productivity, 1600 to 1750, adjusted for change in labor allocation and textile production

---

1600

Total Value Added in Agriculture (output minus inputs): 25.65 to 30.15 *shi*
Value Added in Textile production by 20 bolts per family: 4.6 *shi*
Total Value Added: 30.25 to 34.75 *shi*

Peasants' Net product (output minus costs and rent): 15.25 to 19.75 *shi*

Total Labor: 210 days (150 male plus 60 female) in agr; 140 in textiles; 360 total days

Value Added per Day of Labor: .084 to .096 *shi* per day

Peasants' Net product per Day of Labor: .0424 to .055 *shi* per day

---

1750

Total Value Added (output minus inputs): 25.35 *shi*
Value Added in Textile production by 28 bolts per family: 5.32 *shi*
Total Value Added: 30.67 *shi*

Peasants' Net product (output minus costs and rent): 20.67 *shi*

Total Labor:
Rice: 118 days

Winter Crops: 70 days
Net 38 days drawn from slack time, worth 9.5 days
Total opportunity-cost-adjusted labor cost of production: 159.5 days
Labor in Textiles: 168 days
TOTAL adjusted labor days: 327.5 days

Value Added per Day of Labor: .0936 *shi* per day

Peasants' Net product per Day of Labor: .063 *shi* per day