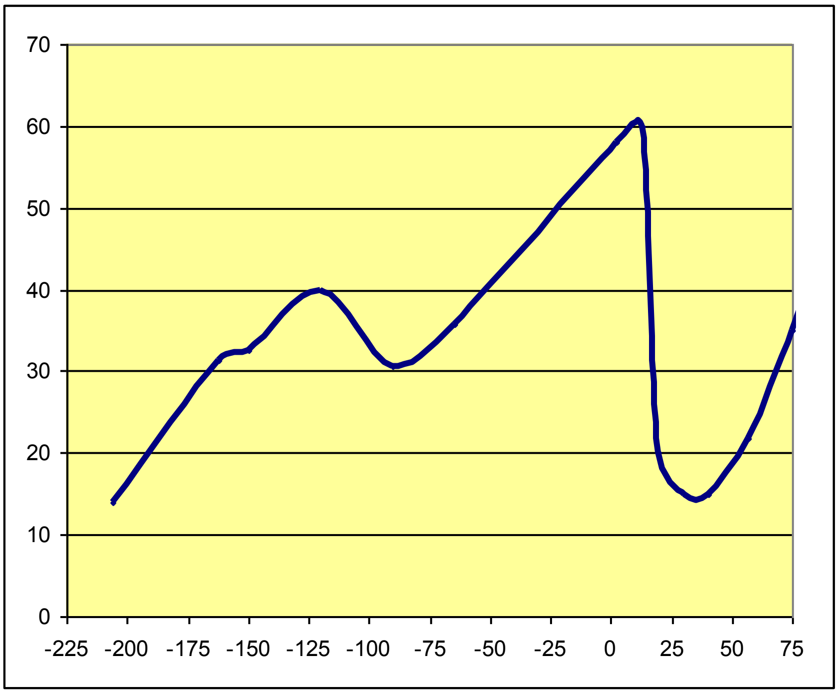
Korotayev, A., A. Malkov, and D. Khaltourina. *Introduction to Social Macrodynamics: Secular Cycles and Millennial Trends.* Moscow: KomKniga/URSS, 2006.
P. 47–88.

Chapter 2

Historical Population Dynamics in China: Some Observations

The estimates of Chinese population dynamics during the Western Han dynasty (206 BCE – 9 CE) look as follows (see Diagram 2.1):

Diagram 2.1. Population of China in millions: Western Han Cycle (206 BCE – 9 CE)

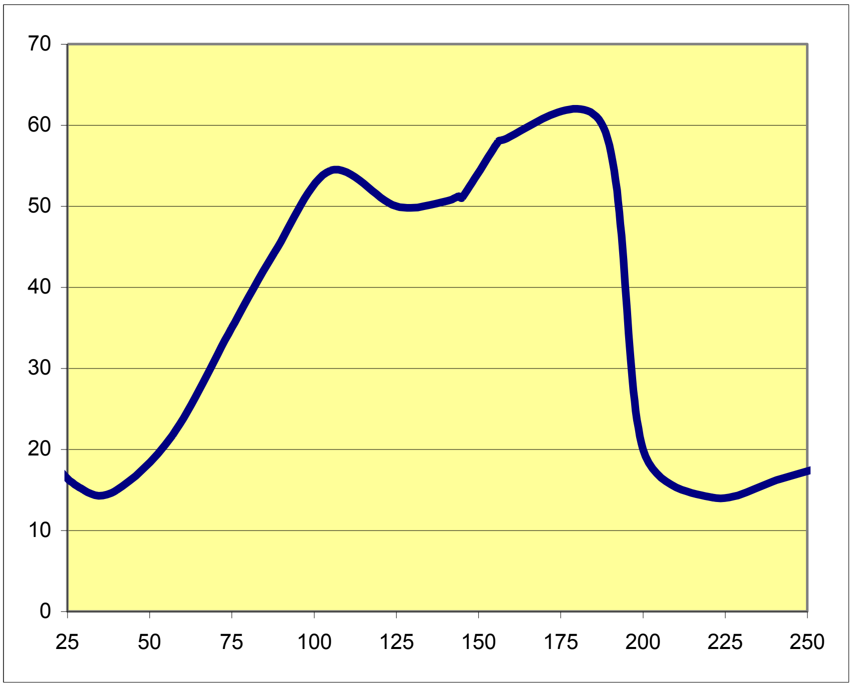


NOTE: estimates of Zhao and Xie (1988: 536).

For most of the cycle these are estimates. However, we have more or less reliable census data for 2 and 57 CE (*e.g.*, Bielenstein 1947: 126, 1986: 240; Durand 1960: 216; Loewe 1986b: 206). We also have abundant historical data evidencing a substantial period of extreme political instability separating the demographic collapse of the second decade (precipitated by the catastrophic flood of 11 CE) from the period of new demographic growth (*e.g.*, Bielenstein 1986). Thus, though we cannot be sure about the exact shape of the demographic cycle curve for Western Han, we can be quite confident about the fact that the new phase of demographic growth did not begin in this case immediately after demographic collapse.

Chinese population dynamics during the Eastern Han dynasty (25 – 220 CE) are delineated below in Diagram 2.2:

Diagram 2.2. Population of China in millions: Eastern Han Cycle (25 – 220 CE)



NOTE: estimates of Zhao and Xie (1988: 536).

For this cycle we have census data for 9 years (57, 75, 88, 105, 125, 140, 144, 145, 146, and 156 CE [*e.g.*, Bielenstein 1947: 126, 1986: 240–2; Durand 1960: 216; Loewe 1986c: 485, *etc.*]), which, in fact, document rather well two main phases of the cycle – a rapid growth from 21,007,820 in 57 CE to 53,256,229 in 105 CE, followed by population stagnation at the level strikingly close to the one from which the Western Han demographic collapse took place.[1]

Note that during the first phase the average annual growth rate was quite high, but in no way fantastic – just 2%, which according to Turchin (2003: 125) is just a normal growth rate for pre-industrial agrarian populations when they are adequately provided with resources in conditions of political stability. In the modern world such figures can, of course, be much higher. *E.g.*, in 1960 – 1962 in Costa Rica and 1965, 1967, and 1970 in Kuwait the natural annual population growth rate exceeded 4%. Even in poverty-stricken Yemen it was 3.7% on average in the last two decades of the 20th century, and in really poor Niger it was 3.3%. In Guinea the average growth rate in this period was 2.6%, whereas the life expectancy at birth in this country in 1980 was even lower (40 years)[2] than the one estimated for early Qing China (*e.g.*, Harrell and Pullum 1995: 148) when (according to Zhao and Xie 1988: 540–1) the population growth also approached 2%.

Hence, we do not see any grounds to exclude the possibility that between 57 and 105 CE the Chinese population, well provided with resources in conditions of considerable political stability and a well-functioning state apparatus, could experience 2% a year growth (at least for a few years). Note that the second half of the 1st century in China was described by contemporaries as indeed rather prosperous and stable (Lee Mabel Ping-hua 1921: 178–9; Bokshchanin and Ling 1980: 30; Krjukov *et al.* 1983: 32; Maljavin 1983: 30; Loewe 1986a: 292–7; Nefedov 2002a: 140). The state had sufficient resources and infrastructure to provide adequate relief in critical situations.[3] It is remarkable that for the post-105 CE period we have much evidence for overpopulation, poverty, state's depletion of resources, and its growing inability to provide sufficient relief in critical years (Lee Mabel Ping-hua 1921: 182–6; Maljavin 1983: 28–9, 77–80; Ebrey 1986: 621; Loewe 1986a: 301–16; Nefedov 2002a: 140–2), all of which correlates very well with the census data on the population stagnation at the carrying capacity of land level in 105 – 156 CE. Thus, though the actual popula-

---

[1] That the population stabilized in the Eastern Han period at a level lower than the one attested for Western Han might be somehow connected with the loss of some territories to Northern neighbors, and the incomplete recovery of lands controlled by Western Han in Southernmost China during the Eastern Han period. Note that the maximum area of cultivated land attested for Eastern Han (746,000,000 mu in 105 CE) is still lower than the one attested for Western Han (827,000,000 mu in 2 CE) (the data are compiled by Nefedov 2002a on the basis of Lee 1921: 436; Kul'pin 1990: 216; Krjukov *et al.* 1983: 41).

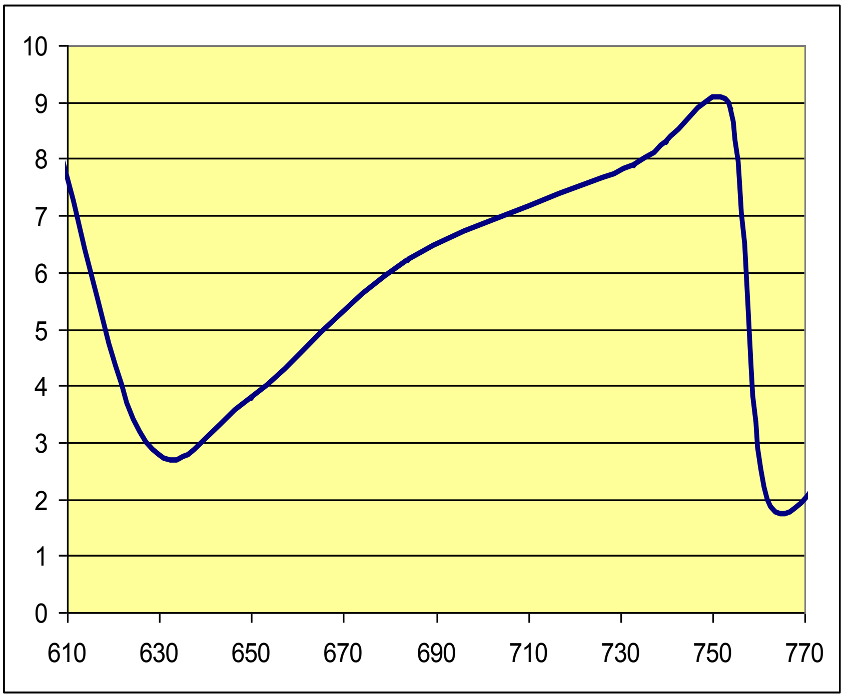
[2] The data on modern countries are from *World Development Indicators* (World Bank 2005).

[3] "The government was remarkably successful in coping with each crisis. Wang Ch'ung (A.D. 27 – ca. 100), a caustic critic who was seldom generous or complimentary in his judgments, thought that no ancient ruler could have handled relief programs any better than the senior statesman Ti-wu Lun (fl. A. D. 40 – 85) had during the cattle epidemic [of 76 CE – A.K., A.M., D.K.]" (Ebrey 1986: 620).

tion growth rate in 57 – 105 CE may well still have been below 2%,[4] in general, the census data seem to capture quite adequately the population dynamics during the first two main phases of the Eastern Han. We have also abundant historical evidence for demographic collapse and a very prolonged period of internal warfare and political instability at the end of Han period, as well as for a long time after it (*e.g.*, Bokshchanin and Ling 1980: 116; Krjukov, Maljavin, and Sofronov 1979: 13–37; Maljavin 1982; Beck 1986; Schmidt-Glintzer 1999: 34–55; Fairbank 1992: 72–3; Wright 2001: 60–1, *etc.*).

Chinese population dynamics during the Early T'ang cycle (618 – 755 CE) are delineated below in Diagram 2.3a:

Diagram 2.3a. Population of China in millions of households: Early T'ang Cycle (618 – 755 CE)

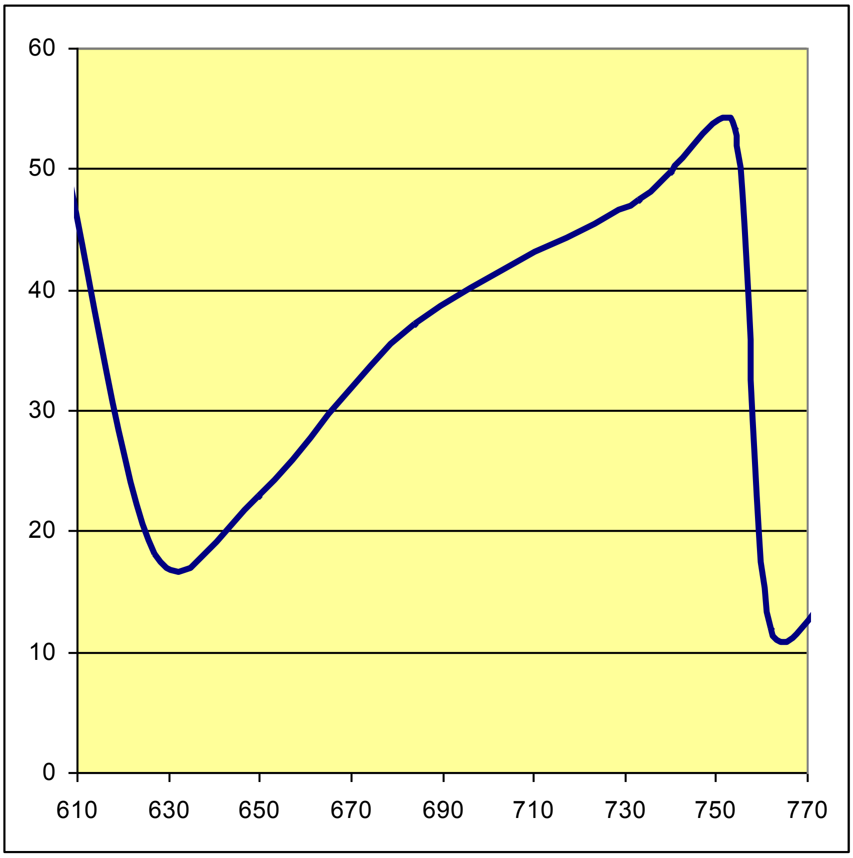


NOTE: The data are from Nefedov 1999c: 5; 2003: Fig. 10, on the basis of Lee Mabel Ping-hua 1921: 436, cp. Durand 1960: 223; Zhao and Xie 1988: 537.

[4] An alternative explanation could be that in 57 CE there was still a considerable underregistration of population, and the growth of registered population between 57 and 105 CE is to be accounted for both by the actual population growth and increase in the proportion of registered population (*e.g.*, Durand 1960: 218).

Assuming 6 persons per household, this corresponds to the following population dynamics during this cycle (see Diagram 2.3b):

Diagram 2.3b. Population of China in millions:
Early T'ang Cycle (618 – 755 CE)



There is much historical evidence of a significant period of political instability following the late Sui demographic collapse (*e.g.*, Wright 1979: 128–49; Wechsler 1979a). In fact, there is not much doubt that the population of China did not decline as dramatically as would be suggested by a straightforward comparison between the Sui census of 606 CE, which listed more than 46 million persons and the first T'ang census (627 CE), which registered just 12,000,000 (*e.g.*, Durand 1960: 223).

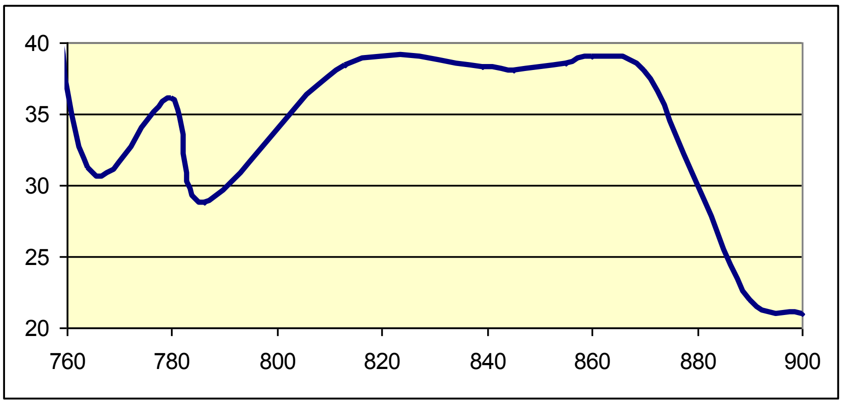
No doubt, this apparent decline is to be accounted for to some extent by underregistration (*e.g.*, Wechsler 1979b: 208–9; Twitchett and Wechsler 1979: 277). However, the rapid growth of registered households up to the early 660s seems to reflect to a very considerable degree actual population growth. Note that "T'ai-tsung's reign had in general been a period of prosperity and low prices, and these continued until the early 660s" (Twitchett and Wechsler 1979: 277; see also, *e.g.*, Wechsler 1979b: 209–10); additionally, for this period we have evidence of free resources (first of all, uncultivated land) still being available (*e.g.*, Lee Mabel Ping-hua 1921: 233; Shang Yue 1959: 205; Nefedov 1999c: 4), whereas the annual population growth rate for this period implied by the census data is just c. 2%, which is, as has been already mentioned above, just a normal growth rate for pre-industrial agrarian populations when they are adequately provided with resources in conditions of political stability.

On the other hand, for the subsequent period we have growing evidence of overpopulation and famines (*e.g.*, Twitchett and Wechsler 1979: 278; Lee Mabel Ping-hua 1921: 236–7; Nefedov 1999c: 4). It appears that this was the Empress Wu's reign (both unofficial and official), when the growth of registered household numbers seems to be accounted for more by the successes in registration rather than by actual population growth (see, *e.g.*, Guisso 1979: 293, 313). Thus, the actual decline of the population growth rate during this phase might have been much more considerable than is indicated in Diagram 2.4.

On the other hand, the accelerating population growth in the 730s – early 750s suggested by the T'ang census figures seems to reflect actual population dynamics rather than mere registration progress, and appears to have resulted from a series of more or less successful (at least in the short run) administrative reforms of the Hsüan-tsung government (Twitchett 1979: 400–1, 419–20), as well as, possibly, from technological innovations (*e.g.*, Bray 1984: 114), which helped to increase the carrying capacity of land and temporarily relieve the demographic crisis, though they did not much delay the demographic collapse ("the An Lushan Rebellion", caused, however, mostly by the imperfections of the Hsüan-tsung military organization [Peterson 1979: 468–74]). However, such innovations (which might also account for a short period of renewed population growth at the pre-collapse phase of the Eastern Han demographic cycle [*e.g.*, Bray 1984: 587–97]) were immensely important, as they created an overall millennial trend towards the rise of the carrying capacity of land (and, consequently, of population numbers). In fact, as we shall see below, in Sung China such mid-cycle innovations (both administrative and technological) turned out to be successful to such an extent that they resulted in the mid-cycle demographic crisis leading not to a demographic collapse, but to the radical rise of the overall carrying capacity of land.

Chinese population dynamics during the Late T'ang cycle (763 – 880 CE) are delineated below in Diagram 2.4:

Diagram 2.4. Estimated Population of China in millions: Late T'ang Cycle (763 – 880 CE)



NOTE: estimates of Zhao and Xie (1988: 537).

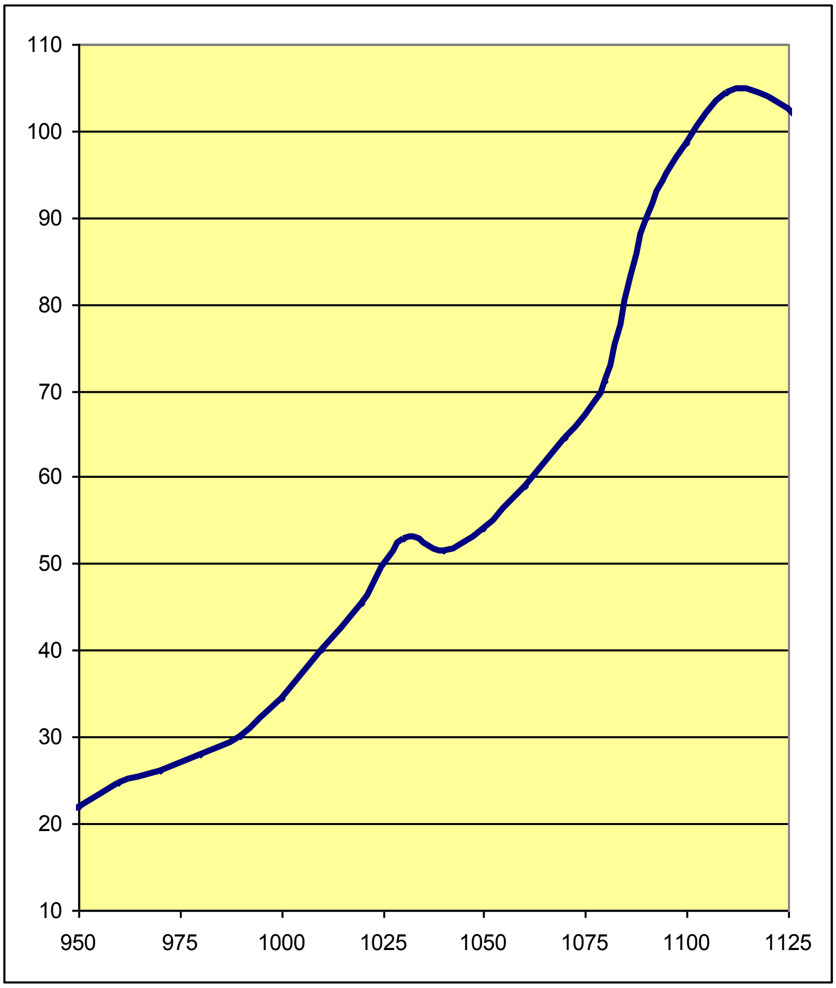
The post-780 population decline reflected both in Zhao and Xie estimates and in the T'ang census data (*e.g.*, Durand 1960: 223) is connected with the so-called Ho-pei rebellions of 781 – 786, which could be regarded as a direct continuation of the An Lushan Rebellion events (Peterson 1979: 500–7; Dalby 1979: 582–6). Again there is no doubt that the population of China did not decline as dramatically as this would be suggested by a straightforward comparison between the census of 755 CE, which listed almost 53 million persons and the census of 764 CE, which registered just 16,900,000 (*e.g.*, Durand 1960: 223). The actual population decline might have been even less than was estimated by Zhao and Xie, as the underregistration in the post-An Lushan T'ang Empire was especially heavy, because the T'ang administration did not have effective control over many vast and populous territories – above all, in Ho-pei (*e.g.*, Durand 1960: 223; Peterson 1979: 485).

Nobody, however, seems to doubt that the population of China remained well below the early T'ang maximum during the late T'ang cycle, though we might never learn the exact difference between those two levels. There is still some evidence of overpopulation, especially in the Lower Yangtze area (Lee Mabel Ping-hua 1921: 260; Nefedov 1999c: 7; Peterson 1979: 552–3). The fact that the demographic crisis began during the late T'ang cycle at a level far below the one reached by early T'ang might be connected with the fact that the overall carrying capacity of land declined as a result of the central administration heavily reduced ability to redistribute excessive population and resources between overpopulated and underpopulated areas. There is much historical evidence for a very long period of extensive internal warfare at the end of the T'ang period and during the T'ang – Sung intercycle (*e.g.*, Somers 1979;

Schmidt-Glintzer 1999: 70–8; Fairbank 1992: 72–3; Wright 2001: 83–8, *etc.*). On the other hand, it is not entirely clear that the Late T'ang period should not be regarded as a part of the T'ang – Sung intercycle rather than a separate cycle (*e.g.*, Fairbank 1992: 86).

Chinese population dynamics during the Sung cycle are delineated below in Diagram 2.5:

Diagram 2.5. Estimated Population of China in millions: Sung "Cycle"



NOTE: estimates of Nefedov (1999c: 10).

In fact, the official Sung census of 1103 lists only 45.98 million persons (but 20.52 million households) (*e.g.*, Durand 1960: 226). However, "the Sung statistics are unique in that they show very small average numbers of persons per household, ranging in most years from only 2.0 to 2.3 persons… The more probable explanation seems to be that the statistics of persons were limited to the male sex. It is unlikely that even the males were completely enumerated…" (Durand 1960: 227). In general, there seems to be an unusually high degree of consensus that in the early 11th century the population of China was over 100 million (*e.g.*, Ho 1959: 172; Durand 1960: 226; Banister 1987: 4; Fairbank 1992: 89; Feuerwerker 1995: 50–1; Deng 1999: 191; Mote 1999: 164; Nefedov 1999c: 10, etc).[5]

On the other hand, the official Sung statistics appear to describe adequately the overall trends of population dynamics[6] during this period. Indeed the Sung census suggest a relatively rapid population growth rate in early decades of the cycle, which correlate quite well with evidence of relative prosperity, relatively high consumption rates and availability of free resources during this period (Lee Mabel Ping-hua 1921: 270–6; Shang Yue 1959: 287; Smolin 1974: 100–1; Nefedov 1999c: 9, *etc.*).

This growth continues up to 1006, then it slows down but still continues, with some setbacks, until 1029, for which year the Sung census registered 10.56 million households (which corresponds to 53–64 million persons). After this, for three decades population stagnates, or even shows negative dynamics. This is rather expected, as by the late 1020s Chinese population appears to have approached the old ceiling of the carrying capacity of land, that is, the level at which the demographic collapses took place during earlier demographic cycles (starting from Western Han). Indeed, for the Sung mid-phase we have extensive evidence for all the symptoms of sociodemographic crisis preceding demographic collapse – undernutrition, rising rebellions *etc.* (*e.g.*, Lee Mabel Ping-hua 1921: 281–2; Smolin 1974: 311–57; Nefedov 1999c: 9, *etc.*).

However, the Sung mid-phase demographic crisis resulted not in a demographic collapse, but in the non-catastrophic solution of the crisis through the radical rise of the carrying capacity of land. For Sung we have extensive evidence for numerous administrative and state-sponsored (as well as spontaneous) technological innovations leading to this rise, culminating in Wang Anshi reforms (Ho 1956, 1959: 169–70, 177–8; Shiba 1970: 50; Chou 1974: 93–5; Bray 1984: 79, 113–4, 294–5, 491–4, 597–600; Mote 1999: 165). One of the most

---

[5] As the average household size at this time is usually estimated between 5.0 and 6.0, the different estimates, *e.g.* for 1103 CE, also vary between 103 and 123 million persons; this still gives a rather clear idea about the general level reached by the Chinese population by the early 11th century (that is why we speak about an unusually high level of consensus – *e.g.*, as we shall see below, for the early 17th century estimates vary between 99 and 300 million).

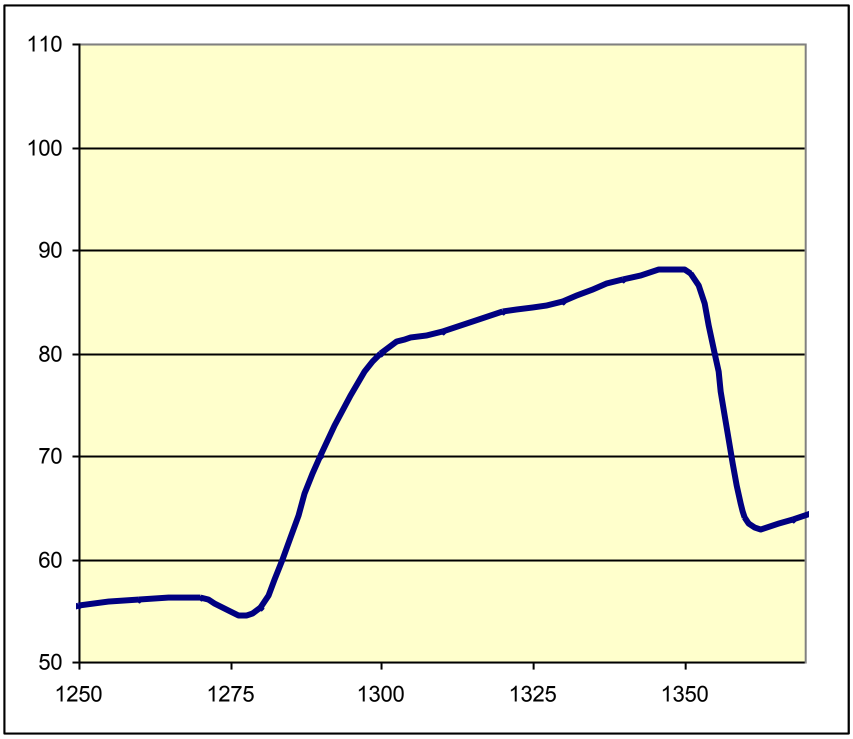
[6] Diagram 2.5 demonstrates these dynamics just according to these statistics, but with the number of households according to the Sung census having been multiplied by 5.0 (Nefedov's estimation of the average number of persons per household during this period).

spectacular and effective among them was the quite conscious, systematic and well-organized introduction and diffusion of new varieties of quick-ripening rices from Champa, accompanied by the peasants' development of still new varieties (Ho 1956; Perkins 1969: 38; Shiba 1970: 50; Bray 1984: 491–4, 598). In the early 12th century China appears to have reached a new ceiling for the carrying capacity of land, which resulted in a new sociodemographic crisis (Smolin 1974: 420–39; Nefedov 1999c: 10–1).

There are no grounds to exclude the possibility that Sung China had potential to solve this crisis too in a non-catastrophic way, eventually even escaping from the "Malthusian trap" (see, *e.g.*, Meliantsev 1996). However, the Sung cycle was interrupted quite artificially by exogenous forces, namely, by the Jurchen and finally Mongol conquests.

Chinese population dynamics during the Yüan cycle are delineated below in Diagram 2.6:

Diagram 2.6. Estimated Population of China in millions: Yüan Cycle



NOTE: estimates of Zhao and Xie (1988: 539).

The Yüan cycle was unusually short, and the population of China does not appear to have reached the Sung level.

There seems to be a rather straightforward and very convincing explanation for this:

"…It may be worth recalling that the fourteenth century was calamitous everywhere. Within and beyond the various Mongol empires, from Iceland and England at one end of Eurasia to Japan at the other, societies were suffering plagues, famines, agricultural decline, depopulation, and civil upheaval. Few societies were spared at least some of the symptoms. China was spared none of them. No fewer than thirty-six years in the fourteenth century had exceptionally severe winters, more than any other century on record. In the greater Yellow River region, major floods and droughts[7] seem to have occurred with unprecedented frequency in the fourteenth century. Serious epidemics broke out in the 1340s and 1350s. Famines were recorded for almost every year of Toghōn Temür's reign [1333 – 1368 – A.K., A.M., D.K.], leading to great mortality and costing the government vast sums in relief. These natural disasters created huge numbers of uprooted and impoverished people, fodder for the revolts that wracked the realm in the 1350s… It might well be the case that the long-term cumulative effects of such repeated natural calamities were too great for any government to handle and that if normal conditions had prevailed in China, the Yüan dynasty might have lasted much longer than it did" (Dardess 1994: 585–6).

Indeed, in pre-industrial history we appear to find a correlation between annual temperatures and population numbers, whereby radical declines in annual temperatures correlated with considerable declines in population numbers (or slowing down of population growth rates) in Europe, China, as well as in the world population numbers (*e.g.*, Malkov 2002: 297). Malkov provides the following explanation for this correlation: "Global warming appears to have led to growth of the demographic carrying capacities of territories (enhancing the survival conditions within given modes of nature exploitation), which resulted in growing population densities. On the contrary, the cooling resulted in relative overpopulation (excessive demographic pressure on the territory as a result of the decline of food production basis caused by the drop in the yields), which led to mass migrations, social cataclysms, wars, and, consequently to the decreasing population densities…" (Malkov 2002: 297).

Thus, in the 14th century the catastrophic decrease in annual temperatures (*e.g.*, Malkov 2002: Fig. 6) appears to have resulted in the decrease of the carrying capacities in most parts of Eurasia, leading (in conjunction with pandemics) to shortening of demographic cycles and the chain of premature demographic collapses. And China here seems to have been no exception.

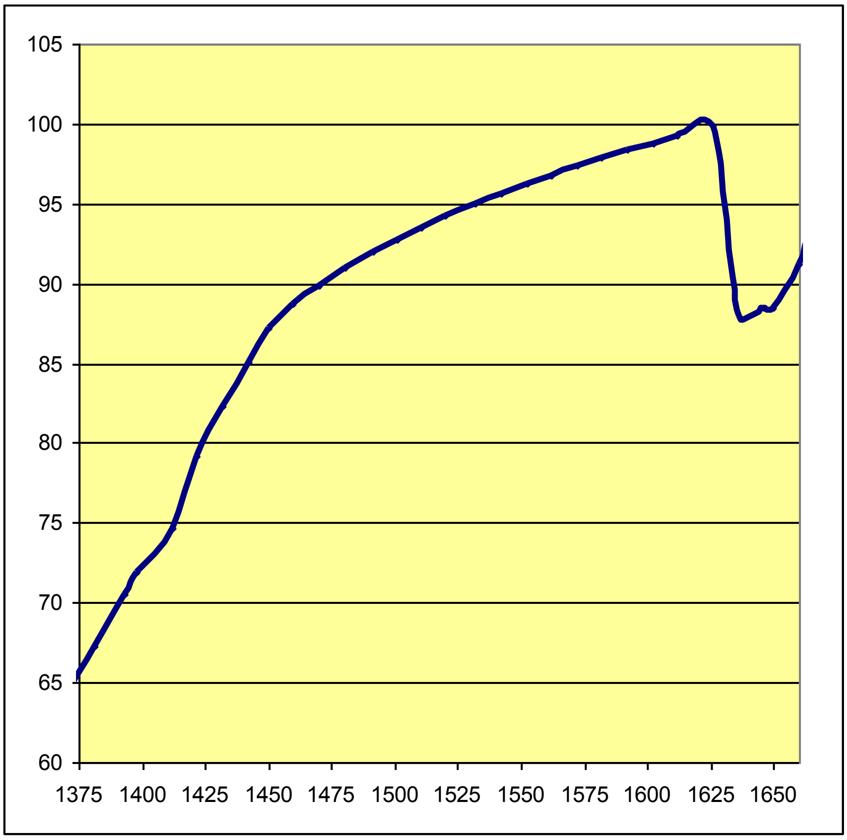
There is much historical evidence for a significant period of extensive internal warfare and political instability during the Yüan – Ming transition (*e.g.*, Mote 1988; 1999: 517–48; Dreyer 1988: 58–97; Dardess 1994: 580–4).

---

[7] Note that in many parts of Eurasia the global cooling was accompanied (rather counterintuitively) just by droughts and floods (*e.g.*, Korotayev, Klimenko, and Proussakov 1999).

Chinese population dynamics during the Ming cycle are delineated below in Diagram 2.7:

Diagram 2.7. Estimated Population of China in millions: Ming Cycle (version 1)



NOTE: estimates of Zhao and Xie (1988: 539–40).

The official Ming census records give much lower figures, indicating that the population grew up to 60.5 million by 1393 and then fluctuated between a bit more than 50 million (1431 – 1435, 1487 – 1504) and 63–65 million (1486, 1513, 1542 – 1562); in 1602 it was 56.3 million, in 1620 – 1626 it was 51.7 million (*e.g.*, Durand 1960: 231–2).

There is a perfect consensus that the actual population of Ming China was much higher. What is more, this appears to have been clear to the Ming Chinese themselves:

"The official census records were hopelessly out of touch with demographic reality. The compiler of a Zhejiang gazetteer of 1575 insisted that the number of people off the official census registers in his county was three times the number on. A Fujian gazetteer of 1613 similarly dismissed the impression of demographic stagnation conveyed by the official statistics: 'The realm has enjoyed, for some two hundred years, an unbroken peace which is unparalleled in history,' the editor pointed out. 'During this period of recuperation and economic development the population should have multiplied several times since the beginning of the dynasty. It is impossible that the population should have remained stationary.' A Fujian contemporary agreed: 'During a period of 240 years when peace and plenty in general have reigned [and] people no longer know what war is like, population has grown so much that it is entirely without parallel in history.' Another official in 1614 guessed that the increase since 1368 had been fivefold. China's population did not grow between 1368 and 1614 by a factor of five, but it certainly more than doubled" (Brook 1998: 62).

Thus, nobody appears to doubt that the actual population of Ming China was much higher than it is indicated by the Ming census (what is more, many Ming Chinese do not seem to have had doubts about this either); however, there is no consensus at all as regards just how much higher it was. In fact, the estimates by Zhao and Xie are among the lowest. Most experts suggest for the end of the Ming much higher figures: 150 million (Ho 1959: 264), 120–200 million (Perkins 1969: 16), 175 million (Brook 1998: 162), 200 million (Chao 1986: 89), or even 230–290 million (Heijdra 1998: 438–40; Mote 1999: 745).

As can be seen, Heijdra and Mote propose the most radical revision of the Ming census data, of the earlier estimates, and, in fact, of the population history of Late Imperial China in general. Indeed, their suggestions provide an entirely new vision of not only Ming, but also Qing population history. Heijdra (1994; 1998) who collected evidence for this revision, starts with re-estimation of population data for 1380, arriving at 85 instead of 60 million (Heijdra 1994: 52; 1998: 437); he then suggests that population growth rates tended to decrease from early Ming till late Qing. As regards the concrete estimates of population growth rates, Heijdra suggests three sets of figures ("low", "middle", and "high" hypotheses):

"The high hypothesis envisages a 0.6 percent increase in population per year from 1380 to 1500, 0.5 percent from 1500 to 1600, and 0.4 percent from 1600 to 1650 (from which could be subtracted losses through war and disasters, *although those are probably covered in the lower rate for the final fifty years*[8]). The middle hypothesis envisages growth rates of 0.5 percent, 0.4 percent, and 0.3 percent respectively. An implausibly low set of growth rates for the same three periods would be 0.4 percent, 0.3 percent, and 0.2 percent. The results of applying these figures are… revealing. The high hypothesis gives 175 million by 1500, 289 million for 1600, and 353 million for 1650. The last figure is almost equal to the official figure from the year 1812, which is perhaps the most reliable

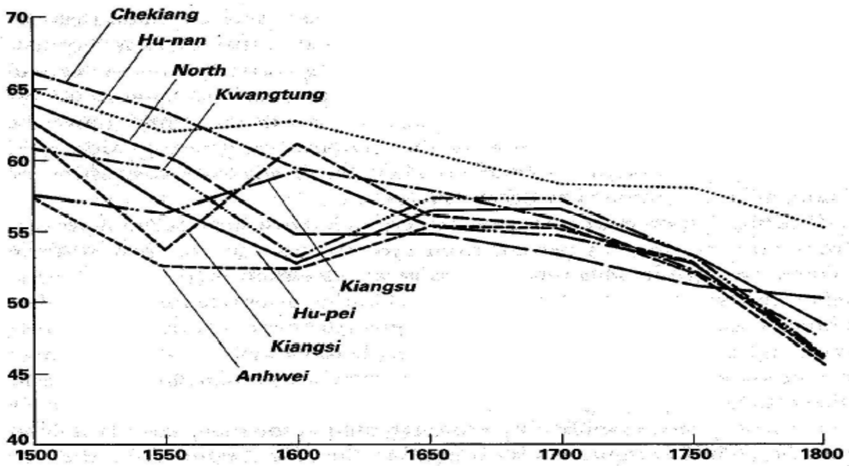
[8] The emphasis is ours – A.K., A.M., D.K.

official figure after 1393.[9] The middle hypothesis gives figures of 155, 231, and 268 million for the three dates, while the quite implausible[10] lower hypothesis gives 137, 185, and 204 million" (Heijdra 1998: 438).

As was mentioned above, this suggests a radical revision of not only Ming, but also Qing population history. For example, it implies the absence of separate Ming and Qing demographic cycles, suggesting their merging into one cycle (note that this was already suggested in 1990 by Kul'pin [p. 123]; hence, we may speak about the Kul'pin – Heijdra – Mote revision, though it was only Heijdra who provided any significant substantiation for this hypothesis).

Heijdra bases his revision mainly on the data (extracted from genealogical [*chia-p'u*] materials) on the life expectancy dynamics in Ming and Qing China, which he usefully summarizes in the following diagram (see Diagram 2.8):

Diagram 2.8. Regional Life Expectancy from 1500 to 1800 (= Fig. 9.3. from Heijdra 1998: 437).



NOTE: "The figures indicate the average age at death of the population already having reached the Chinese age of 15" (Heijdra 1998: 437).

However, let us study this diagram more attentively. Note first of all a very sharp and uniform decline of life expectancies in the 18th century (relatively slow in the first half of the 18th century [when, as we shall see below, according to conventional accounts the population growth was relatively slow], and very

[9] Note that this implies that in the 18th century (generally believed to be the period of the fastest population growth in the pre-20th century Chinese history) the population of China actually stagnated. As we shall see below, this hypothesis appears to be totally implausible – A.K., A.M., D.K.

[10] In fact, as we shall see below, these estimates are the most plausible (at least for the years 1500 and 1600) – A.K., A.M., D.K.

fast in the second half of this century when the population growth rate was especially high). In fact, this is entirely congruent with the data of other scholars (*e.g.*, with the materials of Liu 1995: 118–9, or Harrell and Pullum 1995: 148, who find in their 3 datasets life expectances at birth of 50–54 for the 17th century, 31–41 for the 18th century and just 25–28 for the years 1800 – 1874; see also, *e.g.*, Lavely and Wong 1998: 721). However, in conjunction with the data on the equally rapidly decreasing per capita acreage and consumption rates (*e.g.*, Chao 1986: 89, 218–9; Wang 1992: 40–5, 48, 50, 57–8, 63; Li 1992: 77; Wong and Perdue 1992: 133; Nefedov 2000b: 19, *etc.*), what this actually suggests is precisely a very rapid population growth.

Another salient feature of Heijdra's diagram is that though within both the Ming and (especially) Qing we observe rather explicit trends towards decline in life expectancies, the situation is not as evident during the Ming – Qing transition, when three out of eight sample populations show significant growth of life expectances, and two display significant slow down in their decline. The data of other scholars suggest that this trend was much more salient than could be seen in Heijdra's diagram (*e.g.*, Liu 1995: 118–9). Incidentally, Liu makes a very relevant observation:

"The low mortality rate reflected in these data recorded from the early years of a lineage should not be considered as representing the real situation of the time when cohorts were active, for the data were apparently biased by a tendency for those men who lived longer to become founders of lineages or lineage branches. In other words, a lineage would not have formed if its ancestors were all very short-lived" (Liu 1995: 119; see also Harrell and Pullum 1995: 148; Lavely and Wong 1998: 722–3; Lee and Feng 1999: 173).

Liu's correction, of course, suggests that the life expectances in Ming China were not as high as is indicated by the genealogical data. On the other hand, as during the Ming – Qing transition life expectancies tended to grow notwithstanding "Liu's effect", their actual growth must have been considerably higher than it is indicated by these data (especially, due to the strong bottleneck effect observed during massive depopulations). This is actually very congruent with the data indicating the decline of the per capita acreage, and the growth of per capita consumption observed in the early Qing period as compared with late Ming, thus confirming conventional accounts of a rather significant population decline during the Ming – Qing transition (*e.g.*, Shang Yue 1959: 515; Chao 1986: 89, 218; Wang 1992: 40, 48, 50; Nefedov 2000b: 14).[11]

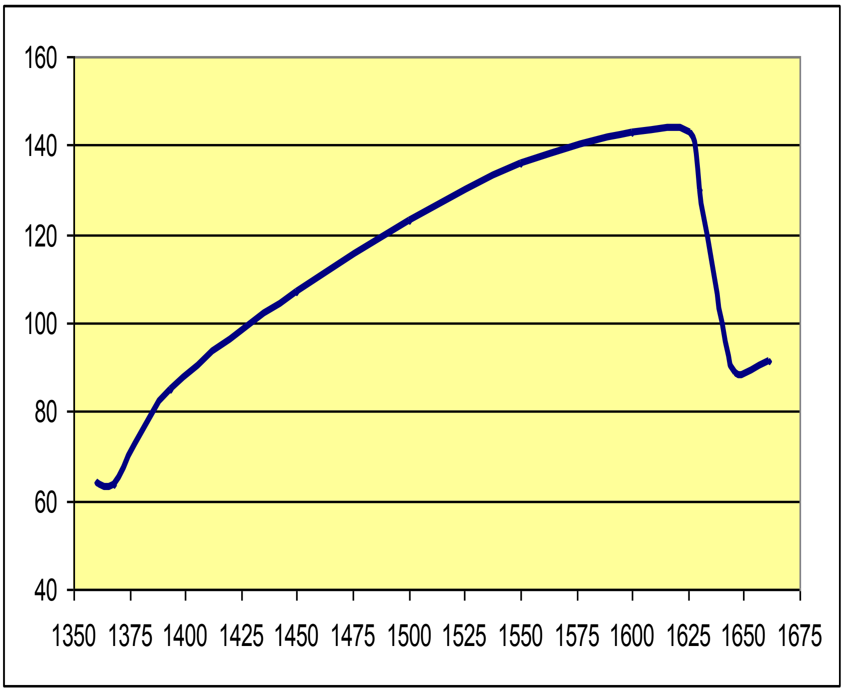
An improbable feature of Heijdra's reconstruction is his assumption that the population can grow at a rate of say 0.6% a year for 120 years. In fact wherever we have more or less reliable population figures, we do not find anything like this. In agrarian society within fifty years such population growth leads to diminishing of per capita resources, after which population growth slows down;

[11] For additional critique of the Kul'pin – Heijdra – Mote revision see Marks 2002.

then either solutions to resource problems (through some innovations) are found and population growth rate increases, or (more frequently) such solutions are not found (or are not adequate), and population growth further declines (sometimes below zero).

On the other hand, the evidence produced by Telford (1995: 69) suggests that the population growth rates experienced a sharp decline to close to zero levels by the end of the Ming period, and to negative values during the Ming – Qing transition. Assuming Heijdra's estimation of Chinese population for the year 1380, initial growth rate 0.4 and decline of population growth as 0.1 percent every 50 years we would get the following picture of the Ming population dynamics (see Diagram 2.9):

Diagram 2.9. Estimated Population of China in millions: Ming Cycle (version 2)

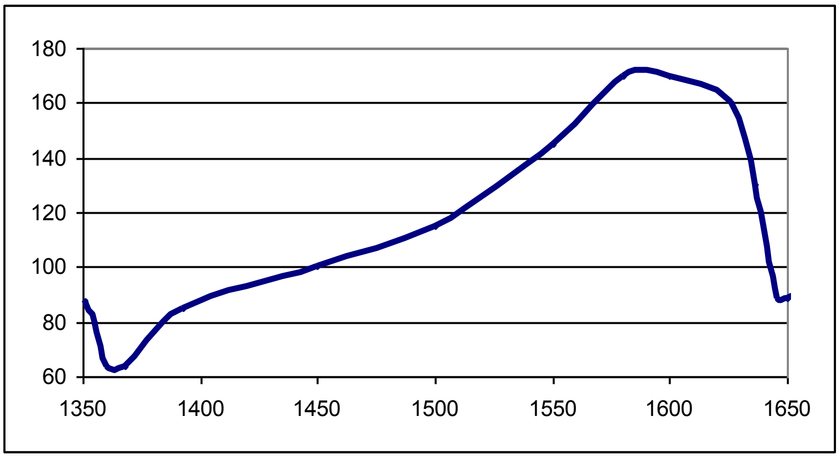


These estimates, perhaps, should be regarded as rather conservative. Of course, there do not seem to be sufficient grounds to rule out the possibility that the initial population growth rate was higher than suggested (and, hence, that by 1600 the Chinese population reached some figure between 150 and 200 million).

In general the estimates suggesting that the population during the Ming cycle exceeded significantly the level achieved during the Sung cycle look quite plausible against the background of the very large number of the carrying capacity enhancing innovations evidenced for the Ming period, from the introduction of some New World crops to the use of new fertilizers and increasing agricultural labor intensification (Ho 1955; Ho 1959: 172, 179, 183–4; Perkins 1969: 48–51; Bray 1984: 294–5, 526, 600–1; Chao 1986: 195; Twitchett and Mote 1998: 4–5; Heijdra 1998: 517, 519–23, Mote 1999: 749–50). Due to a high degree of unreliability of the pre-1741 Qing statistics (*e.g.* Ho, 1959: 24–35; Durand 1960: 234–8) the population estimates for Early Qin period vary greatly (*e.g.*, Ho, 1959: 24–35; Durand 1960: 234–8; Perkins 1969: 209; Peterson 2002: 5; Rowe 2002: 475, *etc.*); thus, the population of China well might have declined during the Ming – Qing transition to a level considerably over the one indicated in the diagram above. Note that this would not still affect the general shape of the Ming population dynamics.

However, it cannot be excluded that this shape was more like the Sung one – with two periods of relatively fast population growth (at the beginning of the cycle, and in the 16th century, with the second decline of this growth towards its end [as is suggested by data mentioned, *e.g.*, by Skinner 1985: 274–9; Shepherd 1988: 416], see Diagram 2.10):

Diagram 2.10. Estimated Population of China in millions: Ming Cycle (version 3)



There is extensive historical evidence for a rather long period of political instability and internal warfare during the Ming – Qing transition (Simonovskaja 1966; Atwell 1988: 603–40; Struve 1988; Dennerline 2002; Spence 2002: 120–150; Nepomnin 2005).

Chinese population dynamics during the Qing cycle are delineated below in Diagram 2.11:

Diagram 2.11. Population of China in millions: Qing Cycle

NOTE: estimates of Zhao and Xie (1988: 539–40).

Though there is considerable disagreement as regards exact figures for Chinese population, especially for the pre-1741 period, there is a very high degree of agreement as regards the general features of the Qing population dynamics: a rather fast growth in the 18th century, followed by a very significant slow down of population growth during the pre-collapse phase of the cycle (Ho 1959: 36–64; Durand 1960: 234–44; Perkins 1969: 202–9; Lavely and Wong 1998: 717–20; Nefedov 2000b; Myers and Wang 2002: 571; Rowe 2002: 475). The only contesting view is suggested by the Heijdra – Mote revision, which has been shown above to be untenable.

The population growth during the Qing cycle was sustained by a very considerable number of carrying capacity enhancing innovations (to a considerable extent supported and stimulated by the state), *e.g.*, the continuing introduction and wide diffusion of the New World crops, development of new varieties of previously known cultivated plants, agricultural labor intensification, land reclamation *etc.* (Ho 1955; Ho 1959: 173–4, 180, 185–9; Lee 1982; Bray 1984: 452, 601; Perkins 1969: 39–40; Dikarev 1991: 69–70; Fairbank 1992: 169; Lavely and Wong 1998: 725–6; Lee and Wang 1999: 37–40; Mote 1999: 750, 942; Nefedov 2000b: 17; Myers and Wang 2002: 599, 634–6; Rowe 2002: 479; Zelin 2002: 216–8). As a result of these innovations the carrying capacity of land during this cycle was raised to a radically new level.

The main revision here has been proposed by Lee, Feng, Lavely, Wong, and Campbell (Lee and Campbell 1997; Lavely and Wong 1998; Lee and Feng 1999, *etc.*), who deny altogether any demographic cycle dynamics during the Qing period, as they deny the decline of consumption levels, life expectancies *etc.*, predicted by demographic cycle models. However, the evidence that they present in support of this revision is not convincing. First of all, they dismiss too easily the massive evidence which has accumulated, by now, in support of the decline of the consumption rates, living standards, life expectancies *etc.* during the Qing cycle. Thus, the massive evidenced compiled by Chao Kang (1986: 193–220), which shows a dramatic decline in real wages during the Qing cycle, is dismissed outright by Lavely and Wang (1998: 731) as "hazardously thin", and is just not mentioned by Lee and Feng (1999).

However, as we shall see below, it is the evidence produced by the "revisionists" in support of their revision which is really "hazardously thin", especially in comparison with the massive and representative dataset compiled by Chao Kang. The above mentioned massive evidence for the very significant decline of the life expectancies during the Qing cycle compiled on the basis of genealogical data is dismissed in the following way alluding to what we called above "Liu's effect":

"Harrell and Pullum [1995: 148] themselves acknowledge these problems [with genealogical data – A.K., A.M., D.K.]: 'The apparent decline over time in the expectation of life in each genealogy is so great that it must be regarded as spurious. It is likely that in the seventeenth century, the chance that an individual would be included in the genealogy was positively related to that individual's longevity' " (Lee and Wang 1999: 173; a fairly similar argument is made by Lavely and Wong 1998: 722–3).

Lee and Wang do not appear to have understood what Harrell and Pullum meant. In fact, they do not imply that their data cannot be considered as rather firm evidence for a considerable decline of life expectancies in respective populations. They only mean that the decline in life expectancies might have been somewhat smaller than is suggested by their data, but in no way do they imply that a considerable decline of life expectancies did not occur at all. In fact as has been shown by Liu (1995: 119), "Liu's effect" is really strong only for very early periods (15th and especially 14th centuries), whereas "from the 1498 – 1557 cohorts on, as number of observations became large enough and the distribution of deaths covered almost every age group, the bias toward high age at death seems to have diminished". Indeed, as we saw above, Liu's effect fails to eliminate totally the trend towards the increase in life expectancies during the Ming – Qing transition predicted by demographic cycle models. Still, as is suggested by Harrell and Pullum, Liu's effect may still be felt in the 17th century data. However, the influence of this effect in the 18th century (and especially, the second half of the eighteenth century) must be negligible. However, this period of the most rapid population growth is precisely the period for which the genealogical data indicate the most rapid decline in life expectancies (see above Diagram 2.8 and comments to it).

On the other hand, for the earliest phases of the Qing demographic cycle, when the Liu's effect must have been greatest within the Qing period (but when the population growth rate was relatively low, and hence according to the demographic cycle model one does not have to expect significant declines in life expectancies), the genealogical data do indicate only rather small declines in life expectancies. All this, of course, suggests that the decline in life expectancies indicated by genealogical data for the Qing period evidences first of all actual decline (caused by demographic cycle mechanisms), and is accounted for to only a rather small degree by Liu's effect.

However, what positive evidence do the "revisionists" produce in support for their claim that during the Qing cycle there was no decline in consumption rates, living standards and life expectancies of commoner population? To start with, Lee and Wang (1999) present considerable amounts of convincing evidence showing the growth of per capita grain production, productivity of labor, stature, life expectancy, decline of mortality *etc.* in China. Yet, all these data refer to the 20th century.[12] Such evidence for Qing China is "hazardously thin".

On the one hand, here the "revisionists" rely to a disproportionate extent on the data referring to the Qing elites, first of all, the Qing imperial lineage. In fact, they showed quite persuasively that the life of the Qing elites was much better than the one of the commoners (actually, who would doubt this?[13]) and

[12] In fact, it demonstrates rather convincingly that in the second half of the 20th century China managed to escape quite successfully from the "Malthusian trap".

[13] In fact, it was earlier already shown by Telford (1990) that the Qing (and not only Qing) elites lived longer than commoners.

tended to improve: their life expectancies grew sharply in the 18th century (Lee, Wang, and Campbell 1994: 401; Lavely and Wong 1998: 723), health care improved and child mortality declined (Lee, Wang, and Campbell 1994; Lee and Wang 1999: 46–7).

Of course, this tells us nothing about such trends among the commoner population. For the growth of labor productivity in Qing China the "revisionists" rely solely on the Li Bozhong (1998) study (Lee and Wang 1999: 31). However, Li Bozhong's data only refer to the Lower Yangzi area, and have been shown to be totally unreliable and misinterpreted (Huang 2002).

As regards the data on increasing food consumption per capita in Qing China, it is derived mainly from late imperial agricultural handbooks, which indicate that "whereas an ordinary farm laborer in the sixteenth century was provided with meat 10 days a month *during the busy season* (our emphasis – A.K., A.M., D.K.), this allotment increased to 15 days a month in the seventeenth century and to 20 in the nineteenth" (Lee and Wang 1999: 34). Note, however, that these handbooks were compiled by a sort of exemplary literati – farm owners, and in no way reflect the general situation (Heijdra 1994: 308–10). Note also that handbooks indicate not an increase in real wages, but rather in increase in food provided by farmer owners to feed their workers in the field *during the busy season.* One wonders if this was not designed to compensate the decreasing real wages (Chao 1986: 193–220) and to avoid the workers' productivity of labor falling below a critical level during hard work at harvest time.

The other source used by the "revisionists" to prove the increase of living standards of commoner population in Qing China is the study by Pomeranz (2000) comparing living standards of the population of the most developed area of Qing China, the Lower Yangzi, and Western Europe in the second half of the 18th century (Lee and Wang 1999: 34–5). As has been shown by Huang (2002) Pomeranz significantly overestimates the living standards of the Yangzi Delta commoner population.[14] However, this is not the most important point.

Pomeranz may still be mostly right in his basic argument that the living standards in the most developed part of Qing China in the second half of the 18th century might not have been so much lower than the contemporary European ones. Yet, this study is simply not relevant for the revision of Qing demographic history. The main problem with it here is that it is synchronic rather than diachronic, and hence cannot be used to support or reject any hypothesis on the demographic *dynamics.* What would be relevant here is the comparison

[14] Paradoxically, Rowe (2002: 501) uses Lee and Wang's data to criticize (in an entirely appropriate way) the assertion that the standard of living in late 18th century China was not lower than in contemporary Western Europe: "Their remain, however, reasons for caution in our appreciation of the mid-Ch'ing as an era of plenty. Lee and Wang themselves, while arguing that rising nutritional levels support their thesis that prosperity bred relaxed population controls, admit that the pronouncedly lower stature of the pre-Modern Chinese in comparison with contemporary Europeans indicates lower living standards".

between the living standards of this area's population, say, in 1750 – 1770 and 1820 – 1840. If such data show an increase in living standards during this period, this could be considered as some support for the "revisionist" hypothesis. However, such a verification/falsification of a dynamic hypothesis simply cannot be done on the basis of synchronic studies.

In general, the "revisionists" appear to have failed to produce convincing evidence in support of their hypothesis, and to disregard evidence to the contrary; thus, their hypothesis has to be rejected (for additional critique of the Lee *et al.* revision see, *e.g.*, Wolf 2001; Huang 2002).

Note that the historical demographic data of Lee *et al.* on Han banner population in Liaoning (for 1774 – 1873) do not contradict conventional accounts, though this is claimed by the "revisionists". For example, Lavely and Wong claim that "although there are some fluctuations [in the Liaoning time series] over the four decades for which Lee and his associates present data, there is no discernable trend" (1998: 723 with reference to Lee, Campbell, and Anthony 1995: 177, Figs. 7.1 and 7.2).

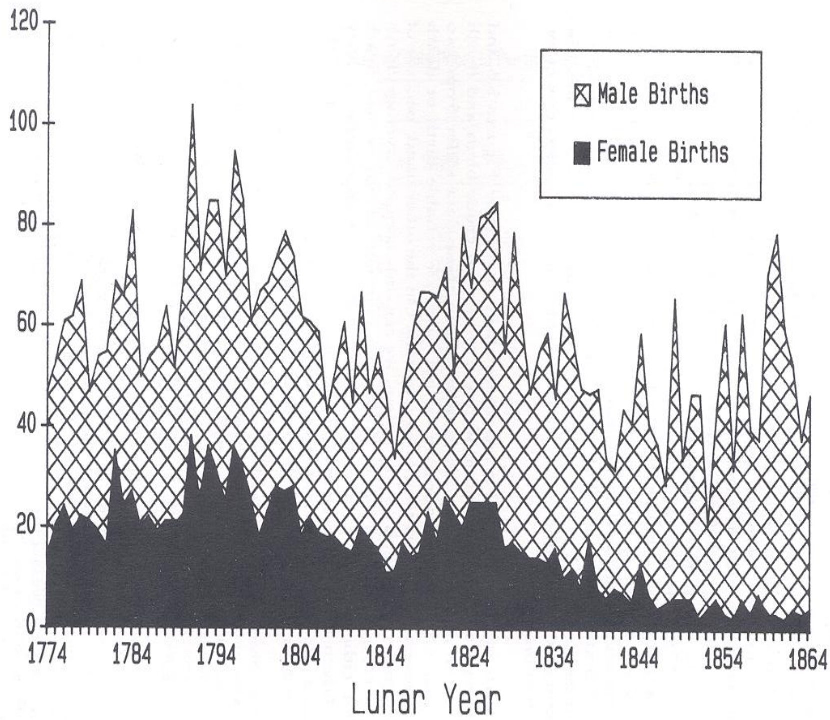
However, a careful inspection of these two diagrams does reveal a significant (though not very strong) trend towards increasing mortality and decreasing life expectancies (with the lowest mortality rates at the beginning of the period under consideration, in 1772 – 1780, and with the lowest life expectancies at the end of the same period, in 1819 – 1840). In fact, Lavely and Wong themselves notice that in their sample life expectancy at birth in 1798 – 1801 was 43 years, but in 1837 – 1840 it was just 33 (1998: 721, Table 3A, where they display other data confirming the presence of a general trend towards declining life expectancies within the Qing cycle[15]).

An important contribution of Lee *et al.* was that they demonstrated how important female infanticide was as a factor of population dynamics in pre-Modern and early Modern China. Though the importance of this factor was well known at least since the pioneer work of Fei Hsiao-t'ung (1939: 22, 33–4; see also *e.g.* Ho 1959: 58–62, 274–5), Lee *et alii*'s findings suggest that the decline of population growth rates towards the end of the Qing cycle might be accounted for by the growth of female infanticide to a larger extent than by the growth of adult mortality. Indeed, their findings suggest an enormous growth of the female infanticide rates in the latest phases of this cycle[16] (see, *e.g.*, Diagram 2.12):

[15] The only exception they mention belongs squarely to that very type of exceptions, which only confirm the rule – this is just the Qing imperial lineage (Lavely and Wong 1998: 721).

[16] We would also like to note their very interesting mathematical specification of the effects of female infanticide on population growth rate (Lavely and Wong 1998: 736–8). We believe that in the future this model should be definitely taken into account for development of advanced models of demographic cycles.

Diagram 2.12. Crude Birth Rates in Daoyi, 1774 – 1864
(per 1,000 married women aged 15–45)
(Lee, Campbell, and Tan 1992: 164, Fig. 5.5)



Another important finding of Lee *et al.* was their discovery of rather strong and significant correlations between the staple prices and female infanticide rates (*e.g.*, Lee, Campbell, and Tan 1992: 158–75). This of course suggests that the growth of female infanticide was caused by the declining living standards, as was already noticed, for example, by Mann: "The … decline in population growth during the nineteenth century owed much to a rise in female infanticide, itself a direct response to declining economic opportunity" (Mann 2002: 451).

Thus, we believe Lee *et alii*'s data do not prove the absence of demographic cycles in Chinese history; rather they enrich our knowledge of concrete mechanisms of functioning of those cycles.

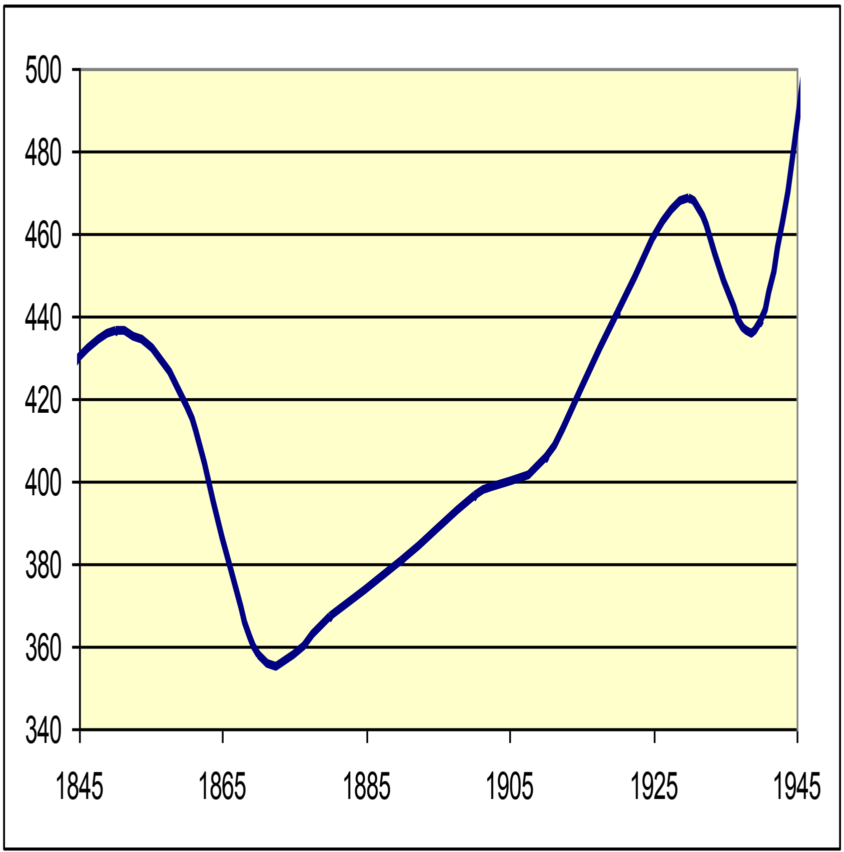
Note, for example, that female infanticide was not just an innocuous "preventive check":

> "Recent research in Chinese legal history suggests that the same subsistence pressures behind female infanticide led to widespread selling of women and girls… Investigations into case records show that the buying and selling of women were so widespread that litigation stemming from such transactions accounted for perhaps 10 percent of all civil cases handled by the local courts… Another related social phenomenon was the rise of an unmarried "rogue male" population, a result both of poverty (because the men could not afford to get married) and of the imbalance in sex ratios that followed from female infanticide. Recent research shows that this symptom of the mounting social crisis led, among other things, to large changes in Qing legislation vis-à-vis illicit sex… Even more telling, perhaps, is the host of new legislation targeting specifically the 'baresticks' single males (*guanggun*) and related 'criminal sticks' of bandits (*guntu, feitu*), clearly a major social problem in the eyes of the authorities of the time. As with the mounting problem of trafficking in women and girls, the Qing state promulgated no fewer than eighteen substatutes to deal with the new social problem" (Huang 2002: 528–9; see also, *e.g.*, Hudson and Den Boer 2002).

There is considerable evidence on the population decline and significant period of political instability and internal warfare after 1851 (Iljushechkin 1967; Perkins 1969: 204; Larin 1986; Kuhn 1978; Liu 1978; Nepomnin 2005 *etc.*). In fact, the extent of the late Qing demographic collapse might have been even higher than is indicated in Diagram 58: "Cao Shuji's new research, based on exhaustive use of local gazetteers and prefecture-by-prefecture reconstructions of population totals and changes, suggests a total death toll from these devastations between the years 1851 and 1877 of a whopping 118 million" (Huang 2002: 528). The Qing demographic cycle might look exceptional in sense that the demographic collapse at its end did not lead to the immediate fall of the Qing dynasty. However, the same is observed for the early T'ang cycle. And here again it may be argued that the demographic collapse was "the beginning of the end" of the dynasty.

Finally, one wonders if we cannot speak about one more demographic cycle in the Chinese history, the "Republican" one, with the late 1930s demographic collapse resulting finally in the "Mandate of Heaven" changing its hands once again (see Diagram 2.13):

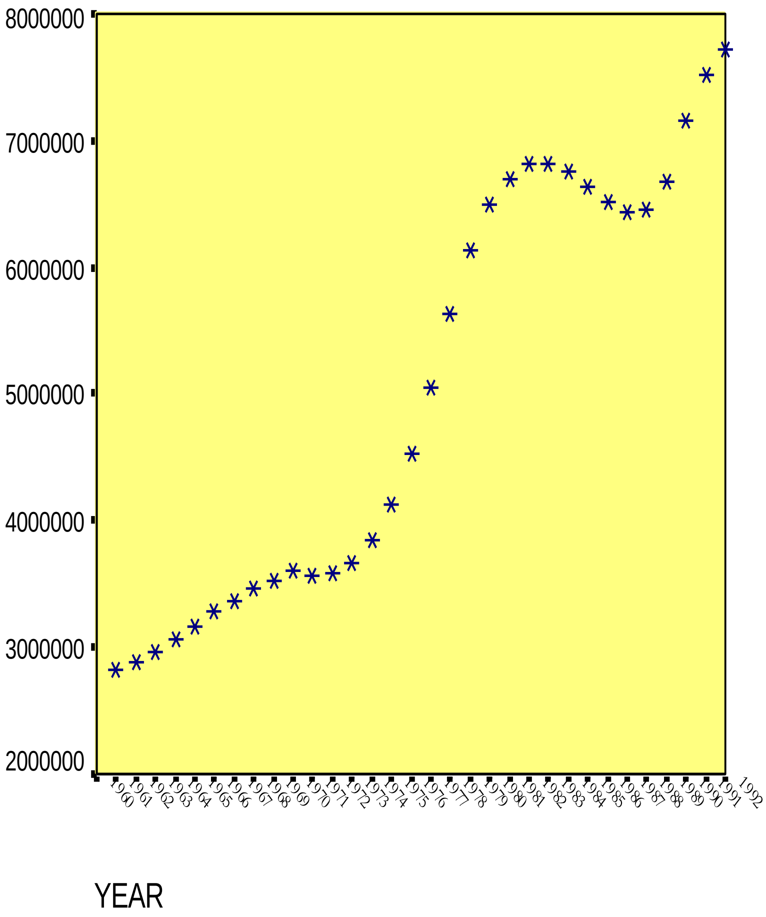
Diagram 2.13. Population of China in millions: "Republican" Cycle?



NOTE: estimates of Zhao and Xie (1988: 543).

Note that the famous Buck's Chinese Farm Survey (Buck 1937) indicates the presence of all the pre-collapse symptoms. For example, the Princeton reanalysis of this survey found life expectancy at birth in the early 1930s Chinese countryside being as low as 24 years (Barclay *et al.* 1976). However, the data on "Republican" demographic cycle could scarcely be used for the reconstruction of pre-Modern population dynamic patterns, as it seems to be closer to Modern Third World demographic cycles, characterized by relatively short durations, very short periods of pre-collapse slow-downs, the fast demographic growth restarting almost immediately after the demographic collapse, *etc.* (see, *e.g.*, Korotayev and Khaltourina 2006: Chapters 7–8 and Diagram 2.14):

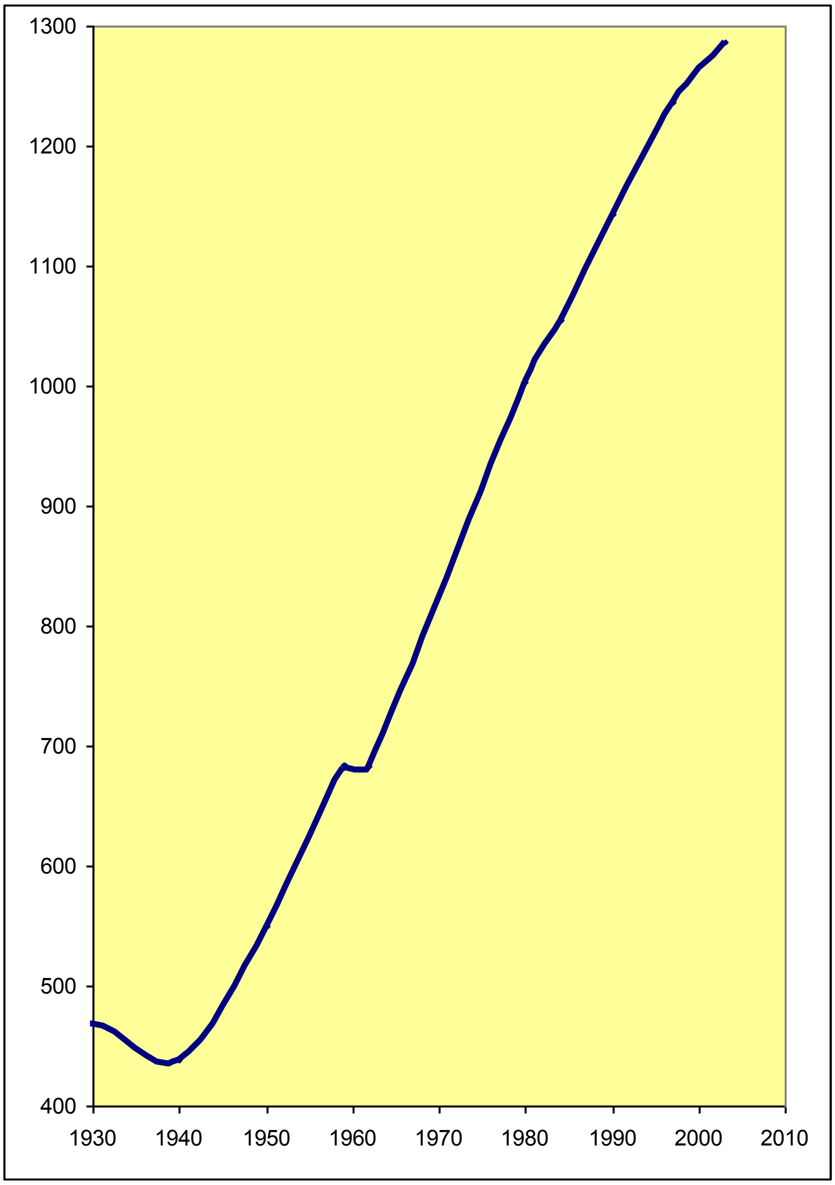
Diagram 2.14. Somalian Political-Demographic Cycles (1960 – 1990)



Data source: World Bank 2005.

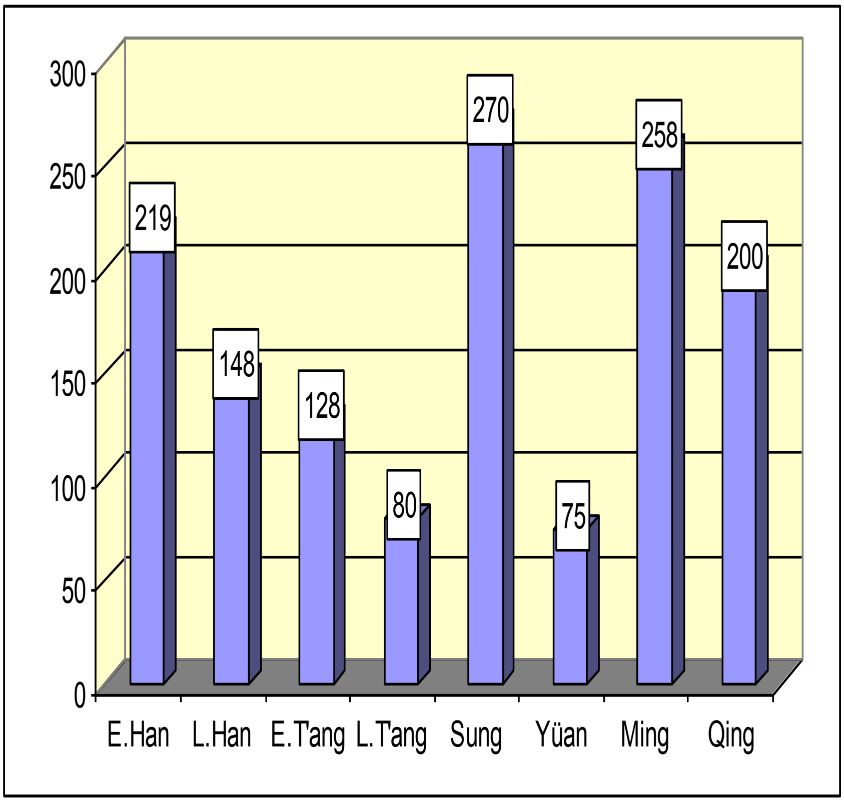
Finally, though the population dynamics curve for "Communist" China (see Diagram 2.15) bears some superficial resemblance to previous demographic cycles, we have no grounds to speak about a demographic cycle in this case, as the decline of population growth took place against the background of rising living standard and life expectancy, as well as decreasing mortality, and was accounted for by decreasing birth rates (*e.g.* Lee and Wang 1999):

Diagram 2.15. Population of China in millions: Communist/Postcommunist Pseudocycle



Let us summarize some observations on the patterns of demographic cycles in pre-Modern China. First of all, note that at first glance the data do not reveal any significant trend to the lengthening (or shortening) of the demographic cycle durations (see Diagram 2.16):

Diagram 2.16. Duration of Demographic Cycles



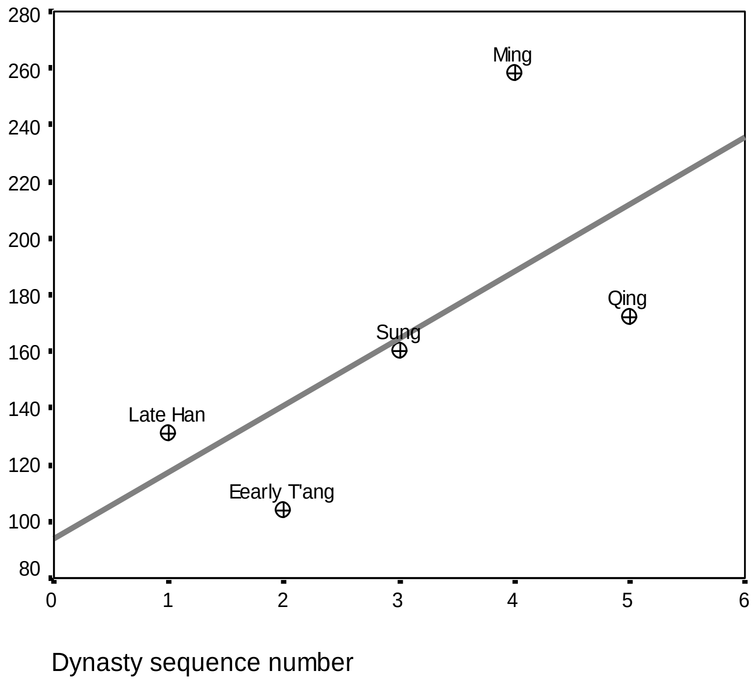
NOTE: Rho = .095, p = .82. Incidentally, as we see, a typical duration of a Chinese demographic cycle is 150–250 years.

However, we find a definite trend towards the increase in the growth phase lengths if we consider only the cycles for which direct historical demographic evidence is available, and omit the Late T'ang period[17], as well as the evidently prematurely collapsed Yüan dynasty (see Table 2.1 and Diagram 2.17):

[17] As it is not entirely clear if the Late T'ang period should not be regarded as a part of the T'ang – Sung intercycle rather than a separate cycle; see above.

Table 2.1 and Diagram 2.17. Growth Phase Lengths of Chinese Political-Demographic Cycles

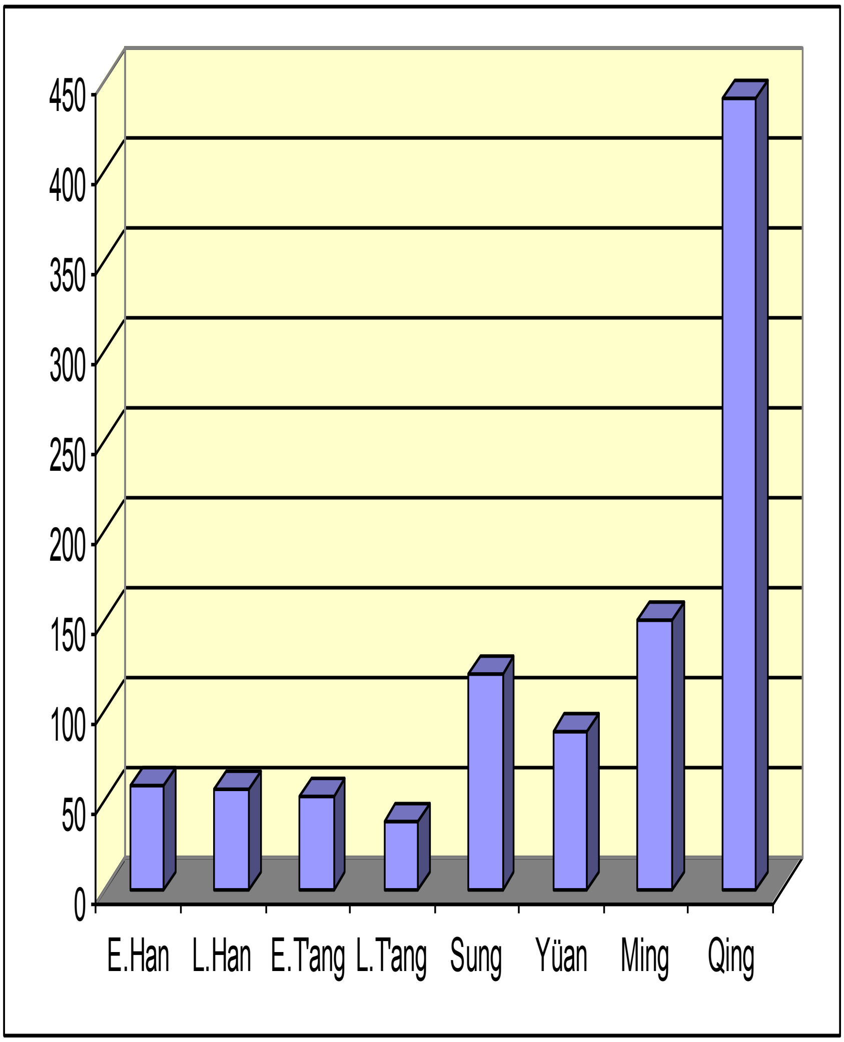
Cycle Name	Beginning of growth phase (CE)	Beginning of demographic collapse (CE)	Growth phase length (years)
East (Late) Han Cycle	57	188	131
(Early) T'ang Cycle	650	754	104
Sung Cycle	960	1120	160
Ming Cycle	1368	1626	258
Qing Cycle	1680	1852	172



NOTE: Rho = .8, p = .05 (1-tailed). The reasons for the use of a 1-tailed significance test here will become apparent in the next chapter.

On the other hand, it is hardly surprising that the data indicate an unequivocal upward trend for the maximum population numbers reached within a cycle (see Diagram 2.18):

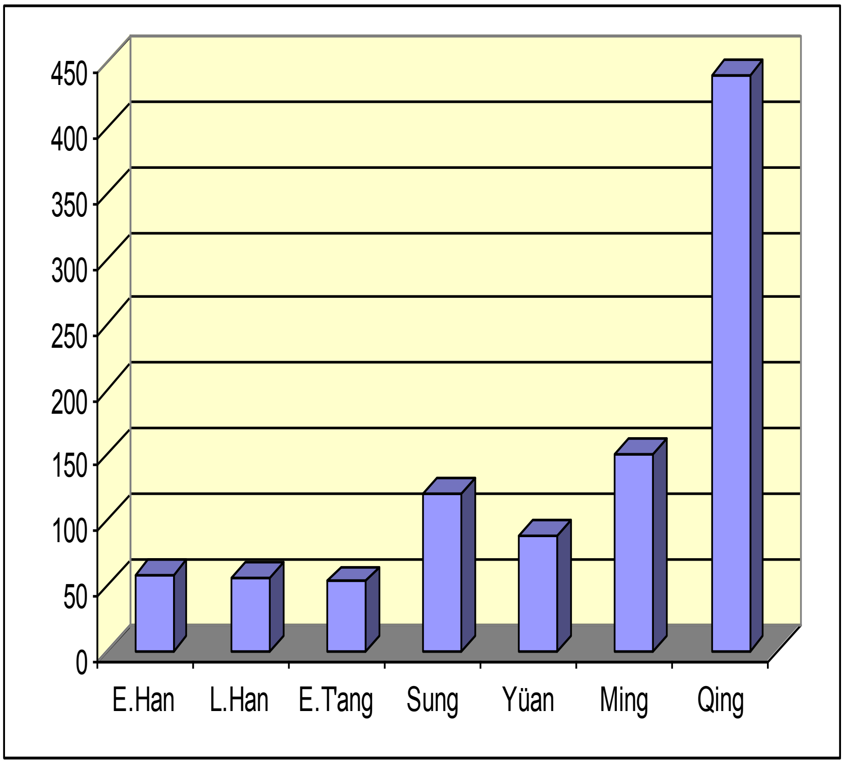
Diagram 2.18. Highest Population Numbers Reached during Dynastic Cycles (version 1).



NOTE: Rho = .74, p = .037.

If we use estimates of Zhao and Xie (1988: 536–7) for Han and Early T'ang, and consider the Late T'ang period as a part of an intercycle, rather than as a separate cycle, the trend will be even more pronounced (Diagram 2.19):

Diagram 2.19. Highest Population Numbers Reached during Dynastic Cycles (version 2).

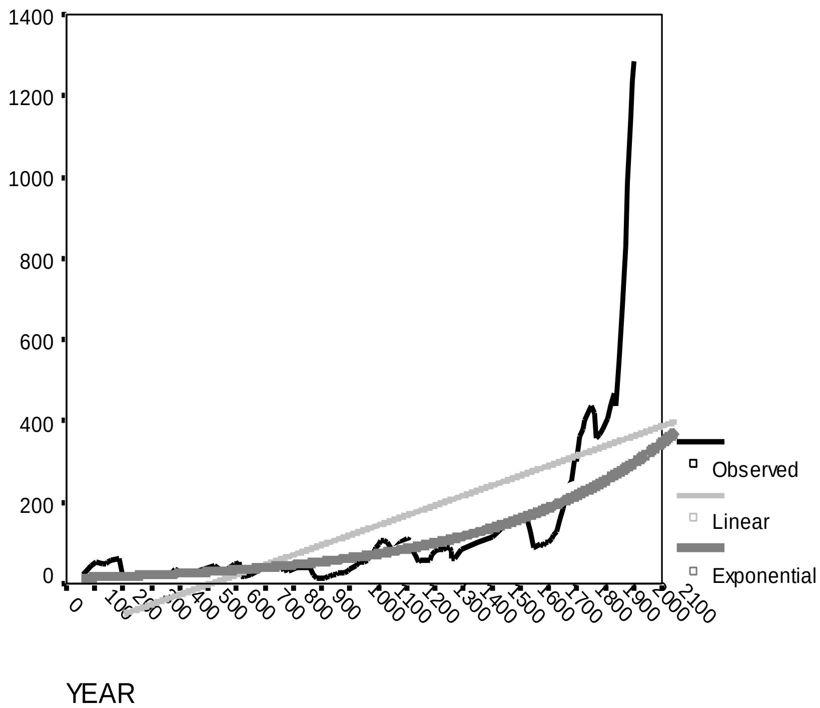


NOTE: Rho = .93, p = .003.

What kind of trend do we observe here? Linear regression suggests a statistically significant ($p < 0.001$) relationship with $R^2 = 0.398$.[18] Exponential regression produces an even stronger result with $R^2 = 0.685$ ($p < 0.001$); see Diagram 2.20:

[18] All regressions for pre-industrial and industrial periods combined were calculated for years 57 – 2003.

Diagram 2.20. Curve Estimations for Chinese Population Dynamics, millions, 57 – 2003 CE (linear and exponential models)

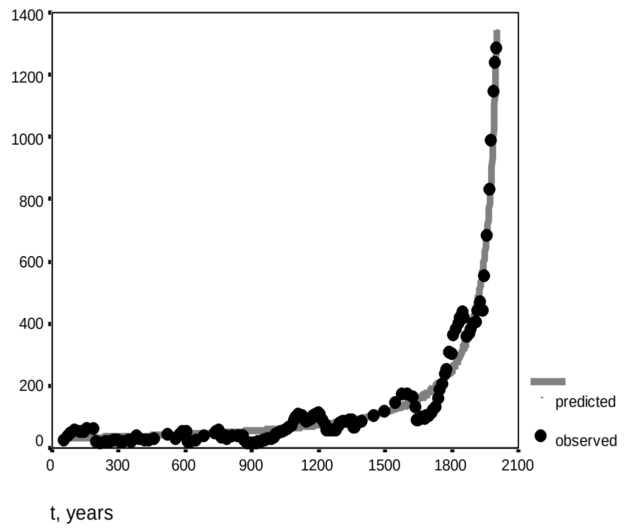


NOTES: The thin black line corresponds to the observed population dynamics surveyed in this chapter. *Linear regression*: $R = 0.631$, $R^2 = 0.398$, $p < 0.001$. The respective best-fit thin light grey line has been generated by the following equation: $N_t = 0.2436t - 124.25$. *Exponential regression*: $R = 0.828$, $R^2 = 0.685$, $p < 0.001$. The respective best-fit thick dark grey line has been generated by the following equation: $13.3575 \times e^{0,0015t}$. The best-fit values of parameters have been calculated with the least squares method.

However, a simple hyperbolic growth model produces a much better fit with the observed data ($R^2 = 0.968$, $p << 0.001$[19]), see Diagram 2.21:

[19] In fact, to be exact, statistical significance of the fit in this case reaches an astronomical level of 1.67×10^{-19}.

Diagram 2.21. Population Dynamics of China (57 – 2003 CE), millions, correlation between the observed values and the ones predicted by a hyperbolic growth model



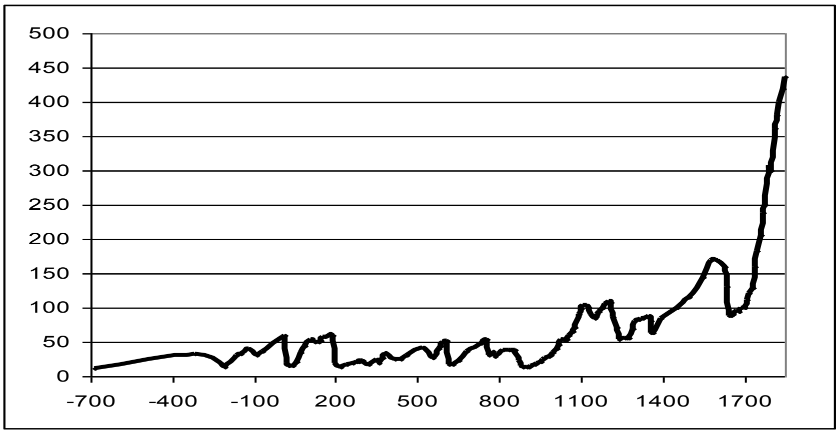
NOTE: R = 0.984, R^2 = 0.968, $p = 1.7 \times 10^{-19}$. The black markers correspond to empirical estimates surveyed in this chapter. The grey solid line has been generated by the following equation:

$$N_t = \frac{63150.376}{2050 - t}.$$

The best-fit values of parameters C (63150.376) and t_0 (2050) have been calculated with the least squares method.

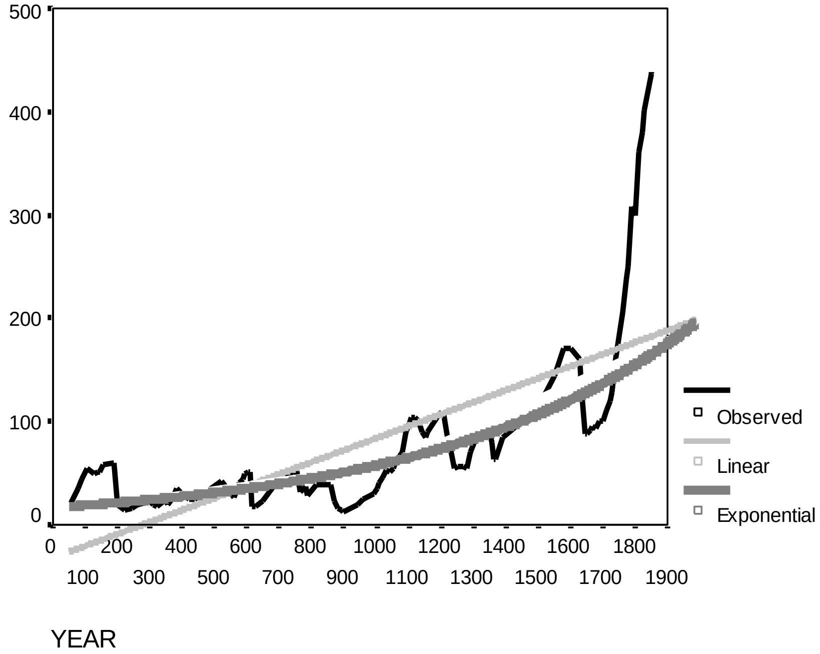
Yet, even if we consider only the pre-Modern history of China (up to 1850), we will still find the hyperbolic growth trend for this part of Chinese history too (see Diagrams 1.22–3):

Diagram 2.22. Population Dynamics of Pre-Modern China (700 BCE – 1850 CE)



What kind of trend do we observe here? Linear regression again suggests a statistically significant ($p < 0.001$) relationship with $R^2 = 0.469$. Exponential regression again produces an even stronger result with $R^2 = 0.593$ ($p < 0.001$); see Diagram 2.23:

Diagram 2.23. Curve Estimations for Pre-Modern Chinese Population Dynamics, millions, 57 – 1850 CE (linear and exponential models)

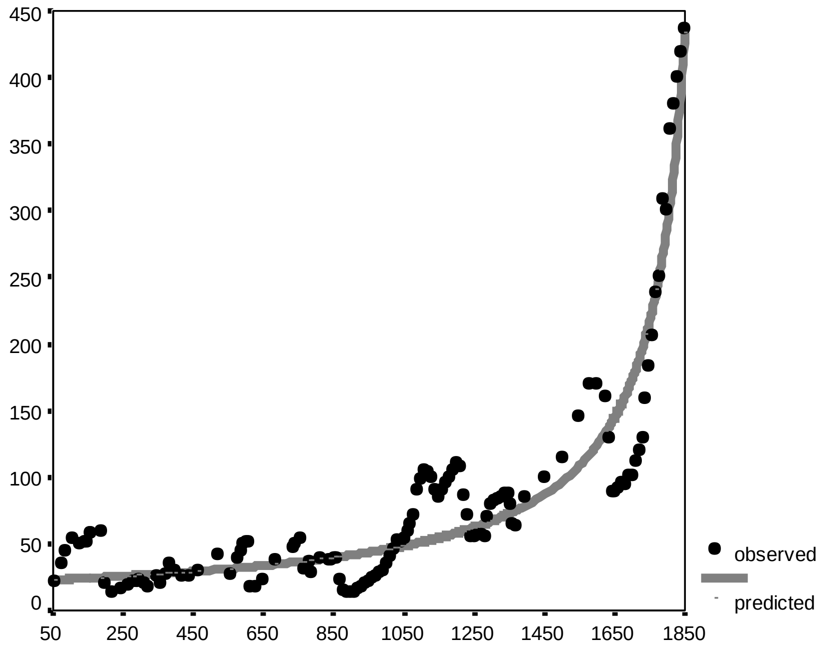


NOTES: The thin black line corresponds to the observed population dynamics surveyed in this chapter. *Linear regression*: $R = 0.689$, $R^2 = 0.469$, $p < 0.001$. The respective best-fit thin light grey line has been generated by the following equation: $N_t = 0.1098t - 27.97$. *Exponential regression*: $R = 0.770$, $R^2 = 0.593$, $p < 0.001$. The respective best-fit thick dark grey line has been generated by the following equation: $16.9785 \times e^{0,0012t}$. The best-fit values of parameters have been calculated with the least squares method.

However, a simple hyperbolic growth model once more produces a much better fit with the observed data ($R^2 = 0.884$, $p << 0.001$[20]), see Diagram 2.24:

[20] To be exact, statistical significance of the fit in this case again reaches an astronomical level (2.8×10^{-19}).

Diagram 2.24. Population Dynamics of Pre-Modern China (57 – 1850 CE), millions, correlation between the observed values and the ones predicted by a hyperbolic growth model



NOTE: R = 0.94, R^2 = 0.884, $p = 2.8 \times 10^{-19}$. The black markers correspond to empirical estimates surveyed in this chapter. The grey solid line has been generated by the following equation:

$$N_t = \frac{33430.518}{1915 - t}.$$

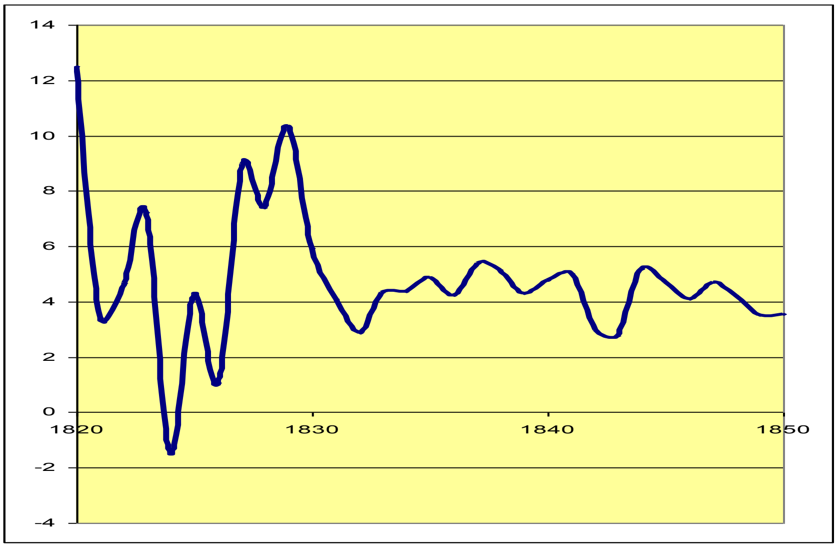
The best-fit values of parameters C (33430.518) and t_0 (1915) have been calculated with the least squares method.

Thus, the trend observed in the Chinese historical population dynamics (both for the whole Chinese history, and for its pre-industrial part) is not lineal; it is not even exponential, but is in fact just hyperbolic.

As was mentioned above, this trend is accounted for by the innovations in the raising of the carrying capacity of land. The most massive innovations of this kind took place during the Sung and Qing cycles, which accounts for their shapes being rather different from the rest of the cycles in that they include very strong "trend-creating" components.[21]

After detrending, a typical Chinese population cycle looks as follows: its dynamics are characterized by a relatively fast population growth at the initial phases of the cycle, followed by rather long periods (normally, of an order of a century, or even more) of a very slow and unsteady population growth rate. This is accompanied by increasing significant, but non-critical annual fluctuations in the annual growth (occasionally dropping to zero, or even negative values). These fluctuations are mostly caused by annual fluctuations in climatic conditions causing fluctuations in annual yields, and hence rises of population growth rates in good years, and their drops in lean years (accompanied by famines, minor epidemics, rebellions *etc.*). These fluctuations tended to be smoothed during the initial phases, when the countercrisis potential was at its peak, but tended to increase in magnitude during the pre-collapse phases, with decrease both in the effectiveness of functioning of relief sub-systems, and in average consumption levels. For example, Zhao and Xie (1988: 542) provide the following estimates of the annual population growth rates on the basis of the official Qing statistics for the pre-collapse decades (see Diagram 2.25):

Diagram 2.25. Annual Population Growth Rate Fluctuations in Late Qing China (1820 – 1850, in ‰)



[21] As was mentioned above, rather massive innovations in the raise of the carrying capacity of land appear to have taken place also during the Ming cycle, though this does not seem to be adequately reflected in the Ming population dynamics reconstructions described above.

There are considerable doubts about the accuracy of the data on those fluctuations (*e.g.*, Durand 1960), but they still seem to reflect some reality, as for this period we have much historical data on occasional famines poorly mitigated by relief systems whose effectiveness was very low at this phase, increasing severity of floods (caused by the decline of the effectiveness of the flood-preventing subsystem), rebellions *etc.* (*e.g.*, Mann Jones and Kuhn 1978).

Nefedov's model captures rather well this part of population dynamics; however, there are a few problems with it. Within this model after a relatively short initial period of rapid growth, population stagnates and fluctuates at the carrying capacity level. Yet, in none of the cases analyzed above do we observe exactly this. The closest fit to this model is found for the Eastern Han cycle (see Diagram 2.2), whose dynamics seem to have been overgeneralized by Nefedov. In fact, the point that 20–30 years after 105 CE the population registered by the Chinese census did not increase is accounted for, first of all (and this, incidentally, was acknowledged by Nefedov [1999e: 8] himself), by the lost of significant territories in the North-West by the Han state. Hence, the decrease of population registered by the census reflects, above all, the loss of control by the Han state over some of its territory (and population) rather than actual population decline.

Note that as Nefedov's (2004) own data suggest, after the territory controlled by the Eastern Han Empire had stabilized, the population growth resumed again. So actually, in the history of China the periods of fast population growth tended to be followed by periods of much slower growth (with considerable fluctuation), rather than population stagnation. Of course, this growth can be accounted for partly by carrying capacity enhancing innovations; but as our model suggests, some such growth could take place in the pre-final phases of a cycle even if the carrying capacity of land remained stable. The other problem with Nefedov's model is that within it fast population growth starts immediately after demographic collapse, whereas, as we saw above, in reality the periods of new fast population growth were always separated from demographic collapse by significant "intercycles", when the population growth is suppressed by continuing internal warfare.

The overall functional scheme of Pre-Modern Chinese demographic cycles, outlining most of the mechanisms of demographic collapse which we have found in the literature, is presented below in Diagram 2.26:

Diagram 2.26/1. Functional Scheme of a Pre-Industrial Chinese Demographic Cycle (pre-collapse and collapse phases) (Part 1)

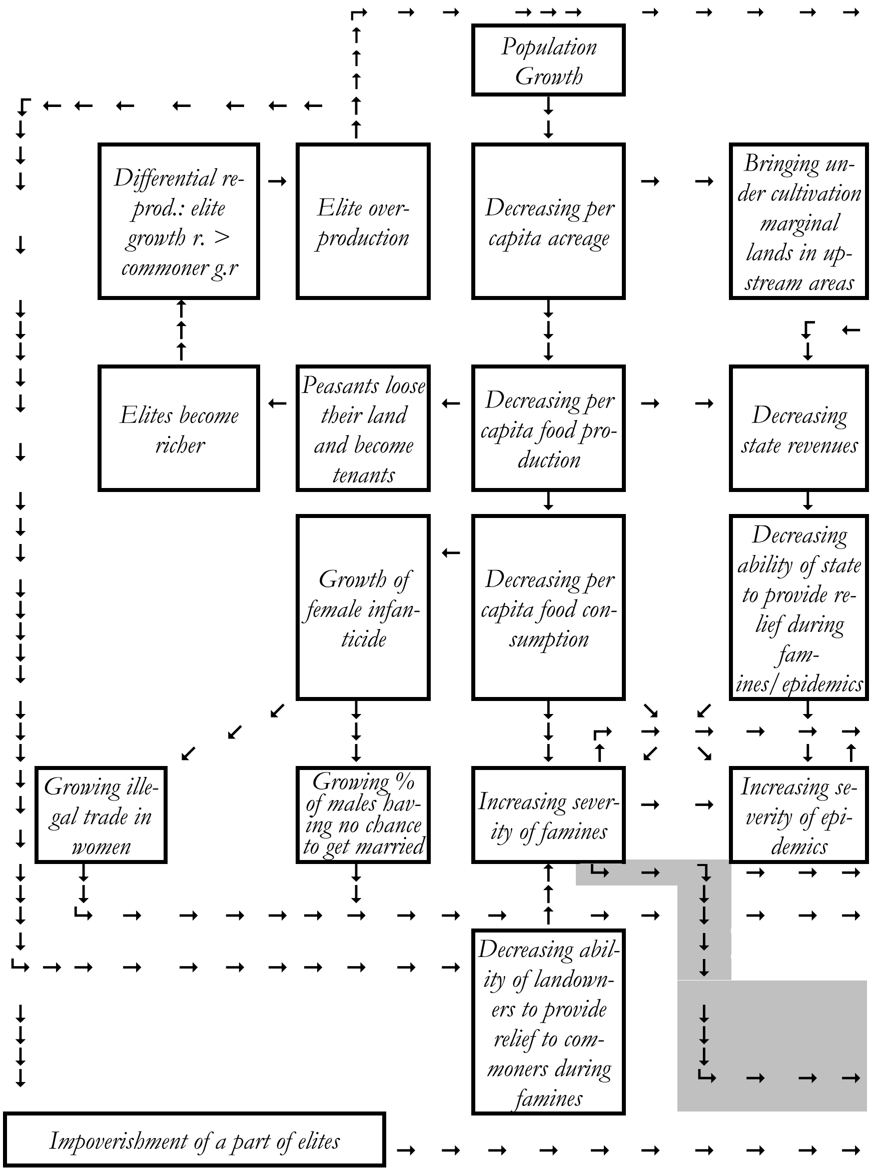
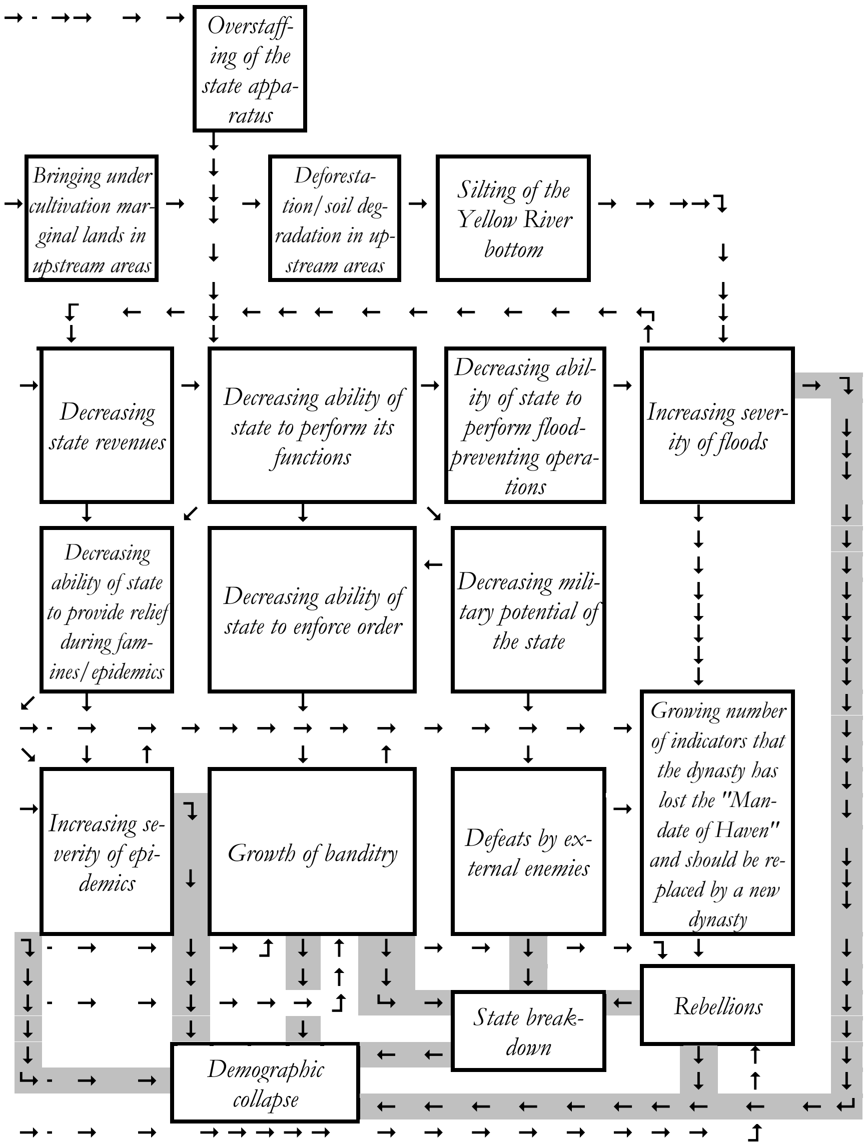


Diagram 2.26/2. Functional Scheme of a Pre-Industrial Chinese Demographic Cycle (pre-collapse and collapse phases) (Part 2)



Due to the shortage of space it turned out to be impossible to mark in the scheme above all the relationships.

For example, defeats by external enemies and growth of banditry lead to further declines in state revenues; increasing severity of famines leads to growth of banditry, which in its turn contributes to the rise of rebellions.

Only some peasants who loose their lands become tenants.[22] As was shown by Nefedov (2002a; 2004), it does not make sense for a landlord to rent out his land in plots barely sufficient to provide subsistence for a tenant and his family. As the standard rent rate in China was 50%, such plots would be at least twice as large. Hence, if two poor peasants having minimum size plots each have to sell their land, only one of them will be able to accommodate himself in his village as a tenant. The other will have to accommodate himself in some other ways. One of the possibilities was to find an alternative employment in non-agricultural sector, *e.g.*, in cities. As was suggested by Nefedov, the very process described above would in fact tend to create new possibilities for such employment, as landowners were more likely than poor farmers to buy goods produced in cities. This is confirmed by historical data indicating that the fastest growth of cities (and, hence, overall sociocultural complexity) tends to occur during the last phases of demographic cycles. However, not all the product paid by tenants to the landlords would find its way to those landless who tried to accommodate themselves in the non-agricultural sector of economy; hence, some of them would tend to accommodate themselves through illegal means, thus, leading to the growth of banditry. Other important relations not indicated in the scheme are the negative feedbacks between famines, infanticide *etc.* and population growth.

With respect to the relationship *Elite Overpopulation – Overstaffing of the state apparatus – Decreasing ability of state to provide relief during famines* the following illustration seems to be relevant:

"By Chia-ch'ing times (1796 –1820 – A.K, A.M., D.K.) this vast grain administration had been corrupted by the accumulation of superfluous personnel at all levels, and by the customary fees payable every time grain changed hands or passed an inspection point… The grain transport stations served as one of the focal points for patronage in official circles. Hundreds of expectant officials clustered at these posts, salaried as deputies (*ch'ai-wei* or *ts'ao-wei*) of the central government. As the numbers of personnel in the grain tribute administration grew and as costs rose through the eighteenth century, the fees payable for each grain junk increased accordingly. Where in 1732 fees had ranged from 130 to 200 taels per boat, by 1800 they had grown to 300 taels, in 1810 to

[22] As was shown by Shepherd (1988), this was just one of the sources of the origins of tenancy. Another was created by the capital investments of landowners in various land-improvement schemes (irrigation, land reclamation *etc.*). What is more, Shepherd suggests that in Late Imperial and especially Republican China the second source was even more important than the first. However, his own data also indicate that during earlier cycles the first source of tenancy was more important than in the latest periods of Chinese history.

500, and by the early Tao-kuang period (1821), to 700 or 800 taels" (Mann Jones and Kuhn 1978: 121).

Note that we are dealing here with a system that had been extremely effective during earlier phases of the cycle:

"In the autumn and winter of 1743 – 1744, a major drought afflicted an extensive portion of the North China core, resulting in a virtually complete crop failure. The famine-relief effort mounted by the court and carried out by ranked bureaucrats was… stunningly effective. Ever-normal and community granaries were generally found to be well stocked, and the huge resources of grain in Tongzhou and other depots were transported in time to key points throughout the stricken area. Networks of centers were quickly set up to distribute grain and cash, and soup kitchens were organized in every city to which refugees fled. In the following spring, seed grain and even oxen were distributed to afflicted farming households. As a result of this remarkable organizational and logistic feat, starvation was largely averted, and what might have been a major economic dislocation had negligible effect on the region's economic growth" (Skinner 1985: 283).

Floods: "Crises in the grain transport system were part of a general breakdown of public functions in the early decades of the [19th] century, stemming in part from bureaucratic malfeasance. In the case of grain transport, malfeasance merely compounded physical difficulties in a complex canal system that was joined at its mid-point to the Yellow River Conservancy (responsible for flood-prevention activities – A.K., A.M., D.K.). The physical difficulties of the system stemmed from silting caused by heavy soil erosion… By the late eighteenth century, the bed of the Yellow River had risen to dangerous heights, threatening the dikes and causing observers to predict the change in its course which finally came in 1853… Carelessness, ill-advised economies and intentional negligence in the Yellow River Conservancy had become a marked concern in official memorials after 1780, and corruption continued to plague the administration in the early nineteenth century. By many accounts, the aim of the water conservancy administration appears not to have been flood prevention, but rather the keeping of a careful balance whereby floods could occur at intervals regular enough to justify a continuing flow of funds into the water conservancy administration. Stories of three-day banqueting circuits and continuous theatrical performances along the south river conservancy suggested that only 10 per cent of the sixty million taels that annually supported the water conservancy were spent legitimately… By the Tuo-kuang era (1821 – 1850 – A.K., A.M., D.K.) the water conservancy, like the Grand Canal, had become a haven for unemployed bureaucrats" (Mann Jones and Kuhn 1978: 121).

It appears important to note that the functional scheme above does not account for negative feedbacks (*e.g.*, the negative feedback between the growth of female infanticide rates [ultimately caused by population pressure] and the population growth rates). Note that not all such negative feedbacks have been adequately spelled out even yet – *e.g.*, the influence of the growth of monasticism (caused to a considerable extent ultimately by population pressure) on population growth rates.

Some of the mechanisms outlined in the scheme above are rather China-specific, for example, *Bringing under cultivation marginal lands in upstream areas* → *Deforestation/soil degradation in upstream areas* → *Silting of the Yellow River bottom* → *Increas-*

ing severity of floods → *Growing number of indicators that the dynasty has lost the "Mandate of Haven" and should be replaced by a new dynasty* → *Rebellions*. One could hardly find this mechanism working in, say, Egyptian political demographic cycles (see the next issue of our *Introduction to Social Macrodynamics* [Korotayev and Khaltourina 2006: Chapters 2–5]).

Some other factors have countervailing effects. For example, female infanticide, on the one hand, delays demographic collapse by decreasing population growth rate; but, on the other hand, it speeds it up by promoting the growth of banditry, as well as numbers of males having no chance to get married, who make ideal potential recruits both for bandit networks and for rebel armies. Though such factors are immensely important if we would like to model dynamics of many particular variables during demographic cycles (for example, life expectancies at age 1 and higher [as was convincingly demonstrated by Lavely and Wong 1998: 736–8])[23], it seems possible to ignore them on the level of basic models of demographic cycles. Hence, in the next chapter we will restrict ourselves to the modeling of just a few of what we consider the most basic mechanisms of political-demographic cycle dynamics.

[23] And we believe such factors should be taken into account in future more comprehensive models.