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Unveiling China's True Population Statistics for the Pre-Modern Era with Official Census Data

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Abstract

Opinions have long been divided as to what the actual size of China's population was in the past and how it fluctuated over time. When trying to make sense of pre-modern Chinese population dynamics, most scholars have been forced to resort to crude estimates or mere guesses. More often than not, these estimates/guesses do not agree with each other. The margin of disagreement can be as great as a half of the population. As a result, statistics related to China's pre-modern population situation are marked by confusion and inaccuracies. Even though these estimates/guesses have become increasingly sophisticated over time, they are unsupported by China's own census records. As a consequence, they are untrustworthy.

By utilizing China's real-time, adjusted dynastic official censuses to obtain a clearer and more accurate picture of China's pre-modern population dynamics, the present research represents a departure from the typical methodological approach to the subject. Specifically, instead of avoiding the official data, this research tackles head on the seeming inconsistencies in China's official censuses by investigating the institutional reasons for the disparities in the form of different taxation policies implemented by various regimes over the long run. In order to control the influence caused by taxation policies on China's censuses, adjustments, minimal in nature, are made. The result is a consistent set of population data for the entire period of 2 A.D. throughout 1911. This is a breakthrough

A main task of this research is the vigorous testing of the accuracy of China's pre-modern official censuses. The tests strongly indicate that the census-based series are fundamentally sound: institutionally, economically, sociologically and biologically (i.e., in terms of human reproductive parameters). The conclusion is that Chinese official census data are actually more accurate and reliable than all the modern-day estimates or guesses.

This research sheds new light on how China's population grew and fluctuated. It also indicates how pre-modern Chinese society functioned, and how its economy performed over time.

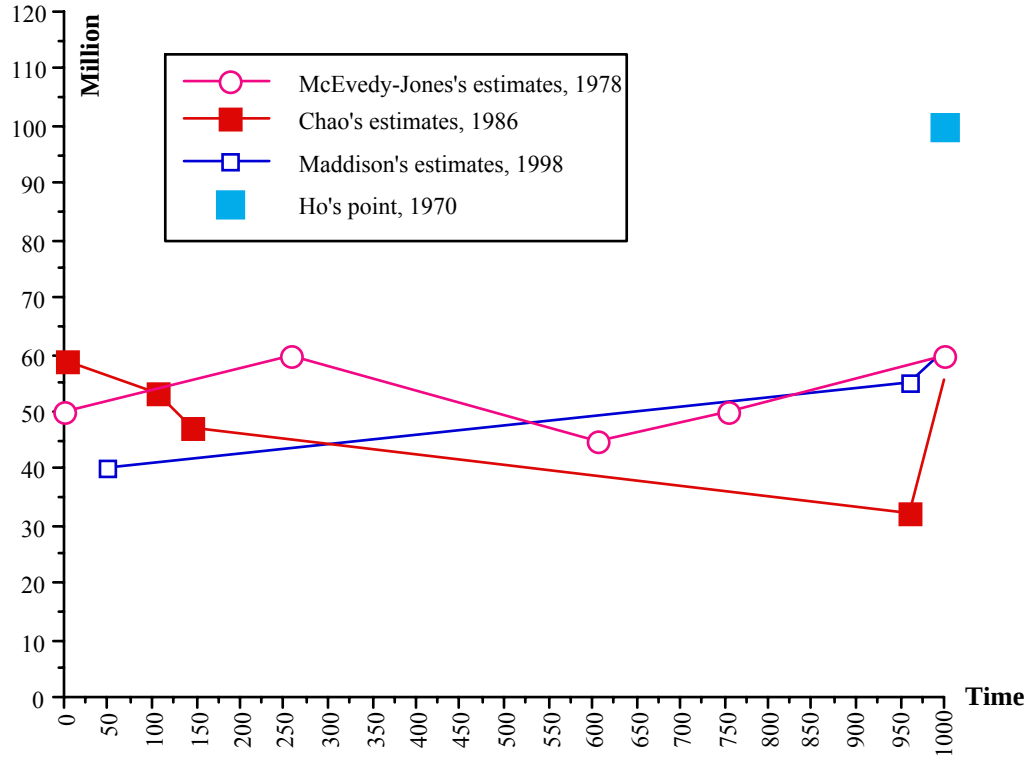
Keywords

China's pre-modern population, official censuses, tax regimes, data adjustment

A. The Issue and Problems

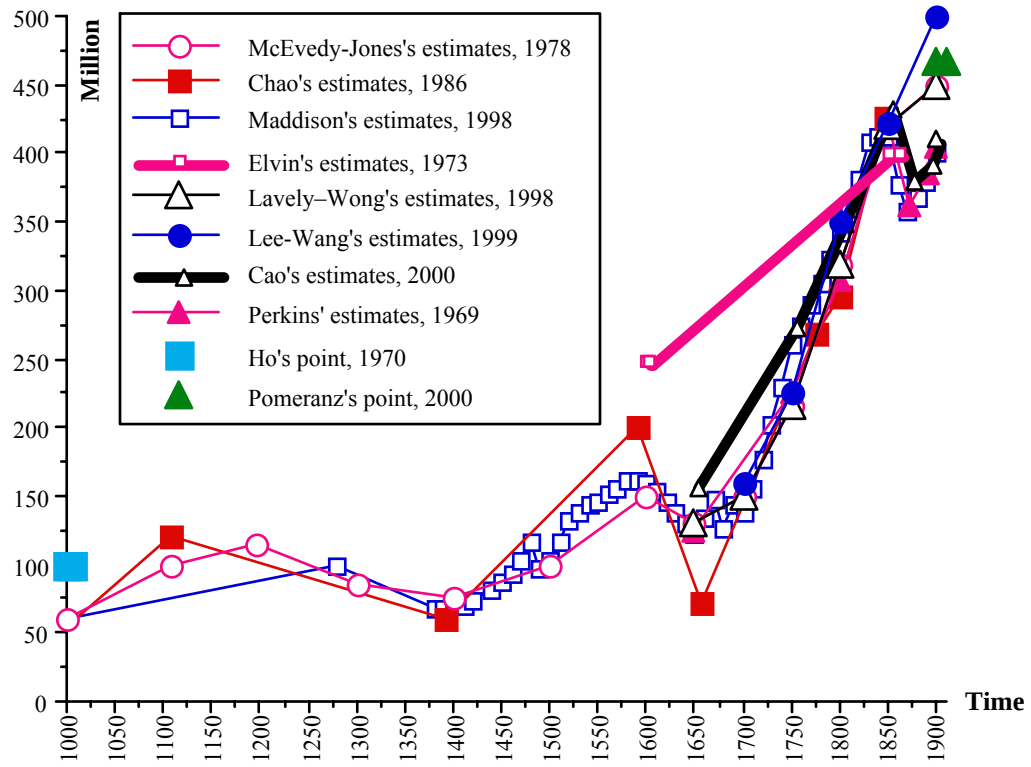
Despite the increased attention received in the field of Chinese economic history in the past half a century, basic quantities of some key factors have remained disagreed. Most noticeably, the picture of Chinese population during the pre-modern period is messy with widely divided opinions (see Figures 1a and 1b).

Figure 1a. Messy Situation of Estimates and Guestimates, 2–1000 A.D.



Source: Official censuses based on Liang 1980: 4–11; see also Lu and Teng 2000: Appendix. Estimates: Perkins 1969: Appendix A; Ho 1970; Elvin 1973: 129, 310; McEvedy and Jones 1978: 166–74; Chao 1986: 41; Lavely and Wong 1998; Maddison 1998: 267; Lee and Wang 1999: 28; Cao 2000: 690–772; Pomeranz 2000: 241.
Note: Tax regimes: T.T. – Period of the triplex tax regime; D.T. – Dual tax regime; S.T. – Single-track tax regime. For more detail, see Figures 2–4.

Figure 1b. Messy Situation of Estimates and Guestimates, 1000–1911



Source: Official censuses based on Liang 1980: 4–11; see also Lu and Teng 2000: Appendix. Estimates: Perkins 1969: Appendix A; Ho 1970; Elvin 1973: 129, 310; McEvedy and Jones 1978: 166–74; Chao 1986: 41; Lavely and Wong 1998; Maddison 1998: 267; Lee and Wang 1999: 28; Cao 2000: 690–772; Pomeranz 2000: 241.
Note: Tax regimes: T.T. – Period of the triplex tax regime; D.T. – Dual tax regime; S.T. – Single-track tax regime. For more detail, see Figures 2–4.

As a result, the gap between China's official figures and modern estimates can be as great as 200 million people; and 23–32 percent of the population are allegedly unregistered for taxes and military services. The gap is particularly large for the Song (57 percent; Song: 960–1279 A.D.) and the Ming–Qing (77 percent; Ming: 1368–1644, Qing 1644–1911).[1]

The first problem is conceptual. There is a tendency to smooth China's population growth. This was attempted first by John Durand who arbitrarily picked up mere two dozen census points from over 100 official observations, with a high miss rate of over 70 percent, to smooth the growth curve (Durand 1960).[2] After him, estimation has gradually taken over (see McEvedy and

[1] Based on the differences between Liang (1980: 4–11) on the one side and McEvedy and Jones (1978: 166–74), Chao (1986: 41), Maddison (1998: 267) and Llewellyn-Jones (1975: 24–5) on the other.

[2] For a recent follower of Durand, see Tong 2000: 373–8.

Jones 1978;[3] Chao 1986, Maddison 1998 and 2002; for followers in China, see Jiang 1998: 88–9). Given that a long-term smooth population growth needs many demanding conditions to achieve, a smooth growth should be an exception, not the rule.[4]

The second problem is methodological. Estimation of Chinese population is often based on very small samples. Also, throwing away historical data has been a common practice. Much has been depended on one's own 'gut feeling'. And, different 'gut feelings' have led to different estimates and guesstimates. Customarily, estimates are not vigorously tested.

The third problem is ideological. The Chinese empire system is seen as inefficient and backward when it came to numbers (Ho 1959: ix; Wang 1956: 24). There is deep distrust in Chinese own figures. It is a common view that no one, not even the Chinese themselves, knew their own numbers. With such a moral judgement, it becomes acceptable to discard Chinese official figures.[5]

B. Re-examination of China's Real Time Official Census Data

Considering the messy situation associated with those modern estimates, it is time to go back to China's real time official data and put them under comprehensive tests, a task that has not been tried so far. As the first step, two preliminary tests can be conducted from the technical and institutional angles to see whether Chinese were capable of counting their own numbers.

The first question is whether the Chinese were ever capable of conducting regular and accurate censuses. From the available evidence, the Chinese literati were well equipped with mathematical skills to deal with measuring land of all shapes and sizes, soil fertility of multiple grades, grain of different types, taxes of various shares and percentages and so forth (Needham 1959; Chao 1986: ch. 4). In terms of judging soil fertility for taxation purposes, for example, by the mid-Ming, the number of grades multiplied to 1,000 from its humble beginning of mere three grades under the Han (CBW 1980: 213).

There is no technical reason for Chinese not to count people correctly, a far easier task than measuring soil fertility. Indeed, the Chinese record was continuous after the mid-tenth century. This is shown in Table 1.

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[3] The methodology of McEvedy and Jones is deeply flawed in at least two ways. First, they view and portray the world as a convergent entity: all the main geographic regions – Europe, Africa, East Asia, South Asia Sub-continent, and the Americas – share the same smooth convex/arc-cotangent curve from 200 B.C. to 2000 A.D. (see McEvedy and Jones 1978). This arouses a strong suspicion that a European pattern is used for the rest of the world. If so, their approach is normative. Second, their samples are small and primary sources cited are extremely limited if not completely absent (at least in the case of China). This arbitrariness is most clearly reflected in their handling of the population fluctuations in China's periphery regions vis-à-vis that of China proper: their figures vary between one and five million for the whole period from 200 B.C. to 1300 A.D., and then 10 million for 1400 to 1800; and 25 million for 1900 (McEvedy and Jones 1978: 167, 171). There is not a shred of evidence to support their claims. It seems that they not only used a European pattern to guess at China but also used the guesstimated figure for China proper to guess at China's periphery.

[4] This is based on the assumption of a normal distribution of growth patterns for *Homo sapiens*: if we have a large enough sample covering all communities over a very long run, those groups that have managed to grow all the time and those that have become extinct would be the minority. The majority in the middle would have an on-and-off growth with constant fluctuations.

[5] See McEvedy and Jones 1978: 174.

Table 1. Real Time Official Censuses, 2 A.D.–1911

Period	Duration (years)	Number of censuses	Average interval (years)
(1) 2–157	155 (9.7%)	11 (10.6%)	14.1
(2) 263–370	107 (6.7%)	5 (4.8%)	21.4
(3) 464–847	383 (24.0%)	23 (22.1%)	16.7
(4) 959–1911	952 (59.6%)	65 (62.5%)	14.6
Long-term	*1,597 (100%)*	*104 (100%)*	*15.4*

Source: Based on Liang 1980.
Note: The four periods are separated by discontinuity of censuses due to political turmoil.

The second question is whether the Chinese had institutions and incentives to produce accurate censuses. There might have been a good chance to distort China's population data at the grassroots level. However, there two crucial factors that created less incentives for villagers to cheat on census. First, the tax burden was overall low: under 10 percent of the peasant total output (Deng 1999: 160–4). Given the wide range of services provided by the state,[6] the net gain from tax evasion was rather low.[7] Second, by law, individual tax evasion and default automatically made the neighbourhood watch unit liable for punishment. The state was also prepared to press criminal charges against offending village leaders. For example, under the Tang law, if guilty of default in tax payment, the head of the neighbourhood was to face two-year imprisonment (Wang *c*. 982: vol. 19 Entry 'Xianling' ['County Magistrate']). So, the village was not a tax-evading haven. Table 2 shows an entrenched system at the village level to register population for taxation and army recruitment purposes, essential for the running of the empire.

Table 2. Grass-roots Monitoring Mechanisms

Period	Title and Responsibility
Five Dynasties till Northern Song	Warden of Neighbourhood Watch (*lizheng*), registering taxpayers and collecting taxes
Jin and Yuan	Warden of Neighbourhood Watch (*lizheng*), registering taxpayers and collecting taxes
Ming	Head of Neighbourhood Watch (*lizhang*), registering taxpayers, collecting taxes and maintaining local order
Qing	Head of Neighbourhood Collective Responsibility (*jiazhang*), registering taxpayers, collecting taxes and maintaining local order

[6] They included national defence, resource allocation (such as land and water distribution), public works for flood control, public granaries for food-price control and famine relief, and passages for emigration when local land was in extremely short supply. In the spiritual and moral form, the state provision included Confucian moral guidance and judiciary over disputes and crimes.

[7] A recent study of state-building suggests that from rational choice point of view the gain from of law and order generally outweigh its costs (Masters 1982: 446–7).

Source: Wang *c*. 982: vol. 19, Entry 'Xianling' ('County Magistrate'); Ma 1307: vol. 12 'Zhiyi Kao' ('History of Labour services'); Anon. *c*. 1323: vol. 16, Entry 'Tianling Limin' ('Edits on Land, Civil Organisations'); Tuo 1344: vol. 46, Entry 'Hukou' ('Census'); Anon *c*. 1398: vol. 4 Entry 'Hulu' ('Laws for Households'); Wang 1858: vol. 1 'Ji Mian Yaoyi' ('Exemption of Labour'); Kun 1899: vol. 134, Entry 'Baojia' ('Neighbourhood Watch and Collective Responsibility Network').

Fraud in censuses was a punishable crime (Table 3). A special department was attached to the throne in charge of internal investigation (called *sushi*) to screen crooks (Wei 1993:162–8, 269–74, 398–402). These institutions worked as a powerful deterrent. In this context, there was little incentive for villages not to get their population figures right.

Table 3. Punishment for Census Evasion

Period	Punishment
Qin	Warden of Neighbourhood Watch is fined in the form of a suit of armour
Sui	exile of Warden of Neighbourhood Watch
Tang	one-year imprisonment of Warden of Neighbourhood Watch; three-year imprisonment of the head of the guilty family
Ming	50 strokes with bamboo sticks on Warden of Neighbourhood Watch; 60 strokes on the head of the guilty family

Source: Pu 1990: 289, 442–3; Zhang 1992b: 175, 376, 424, 443 and 465.

Moreover, it was in the village's own interest to keep a good population record, a factor that has often been overlooked.[8] To take the annual task of 'crop patrol' (*kanqing*) as an example, it required the full participation of all able-bodied villagers to prevent plunder by outsiders. This alone necessitated internal population registration under some kind of locally agreed system. Otherwise, the problem of free-riding would almost certainly occur.

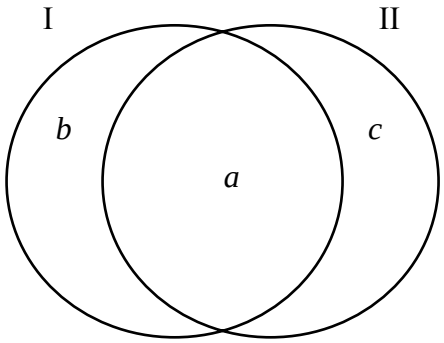
In this context, it is generally agreed that the Ming–Qing statistics at the grassroots level were trustworthy (Ho 1959; Ge 2000–2: vol. 4).[9] From the institutional viewpoint, this judgement is well founded. If so, the official data in its entirety may also be accurate thanks to the direct link between the village and the government. Such a link is institutionalised by the taxation system with three main patterns over time: (1) triplex taxation nets to capture individuals, households

[8] One only has to mention the grassroots organisation known as the 'Neighbourhood Watch and Collective Responsibility Network') called *lijia* (literally 'Organised Neighbourhood') or *baojia* (meaning 'Collective Responsibility for the Neighbourhood'), which is often mistaken as the evidence of the state penetration into Chinese villages. What has been overlooked is that the government had no say about which households were to be grouped in a particular neighbourhood watch unit (*li* or *jia*). Nor did it have the power to decide who acted as the headman of the group. The grouping seems to have been voluntary; and the head, elected. All of these were deeply rooted in the local clans/lineages establishments. By definition, ordinary local clans/lineages were not a branch of the state. So, the *lijia* resembled at best a state-endorsed guild for taxes than a branch of state apparatus. After all, no one from the *lijia* was on the government payroll (see Zhao 2002).

[9] According to Ho, the official figures became dodgy only after the total collapse of the empire in 1911 with constant under report of 20–30 percent of land under cultivation to evade taxation (Ho 1959: 129, 131).

and landowners, (2) dual taxation nets to cover individuals/households and landowners, and (3) a single net to catch landowners (Figures 2 and 4).[10]

Figure 2. China's Dual Tax System



Source: (1) Han Period, see Ban 82 A.D.: vol. 2 'Huidi Ji' ('Biography of Emperor Hui'), vol. 7 'Zhaodi Ji' ('Biography of Emperor Zhao'), and vol. 24 'Shihuo Zhi' ('Economy'). (2) Wei Period, see Chen *c.* 280 A.D.: vol. 1 'Wudi Ji' ('Biography of Emperor Wu'). (3) For the Northern Period, see Wei 554 A.D.: vol. 2 'Taizu Ji' ('Biography of Emperor Taizu'), vol. 3 'Taizong Ji' ('Biography of Emperor Taizong'), vol. 4 'Shizu Ji' ('Biography of Emperor Shizu'), and vol. 110 'Shihuo Zhi' ('Economy'); also Wei 656 A.D.: vol. 24 'Shihuo Zhi' ('Economy'). (4) Southern Period, see Shen 494 A.D.: vol. 6 'Wudi Ji' ('Biography of Emperor Wu'); Xiao 514–26 A.D.: ch. 'Wudi Ji' ('Biography of Emperor Wu'); Yao 636a A.D.: vol. 5 'Xuandi Ji' ('Biography of Emperor Xuan'); Yao 636b A.D.: ch. 'Liangli Zhuan' ('Biographies of Model Officials'); Li 659 A.D.: vol. 2 'Song Benji Zhong Di-er' ('Entry Two of the Song biographies'). (5) Late Tang, see Liu 945 A.D.: vol. 48 'Shihuo Zhi' ('Economy'); Wang 961 A.D.: vol. 83 'Zushui Shang' ('Taxes'), vol. 84 'Zushui Xia' ('Taxes, continued'), and vol. 85 'Ding Hu Dengdi' ('Tax Classification of Households'); Ouyang 1060: vol. 52 'Shihuo Zhi' ('Economy'). (6) Song, see Ma 1307: vols 4–5 'Lidai Tianfu Zhizhi' ('Land Tax regimes'), and vol. 11 'Lidai Huko Dingzhong Fuyi' ('Population and Poll Tax Regimes'); Tuo 1345: vol. 174 'Shihuo Zhi Shang' ('Economy'); Xu 1809: Entry 'Shihuo Qi' ('Economy • Seven'), Entry 'Shihuo Jiu' ('Economy • Nine') and Entry 'Shihuo Shi-er' ('Economy • Twelve'). (7) Ming, see Zhang 1735: vol. 78 'Shihuo Er' ('Economy • Two'). (8) Early Qing, see Anon. 1646; He 1826: vols 29–30 'Huzheng Wu' ('Taxes and Taxation Policies'); Wang 1858/1985: pp. 111–13.
Note: I – Poll/Household Tax; II – Land Tax; *a – c*: taxpayer groups.

In Figure 2, Section *a* covers those households with land properties, qualified to pay both the household and land taxes. Section *b* is relevant to those households or individuals with no land, qualified to pay the poll tax (as during the Han, Southern, Song, Ming and early Qing periods) or the household tax (as during the Wei, Northern and Tang dynasties). Section *c* includes those unmarried landowners who are qualified to pay the land tax (as during the Wei, Northern and Tang dynasties). Given China's high marriage rate (which was easily 99 percent for all women),[11] high landholding rate (around 70–80 percent of all rural households), and high degree

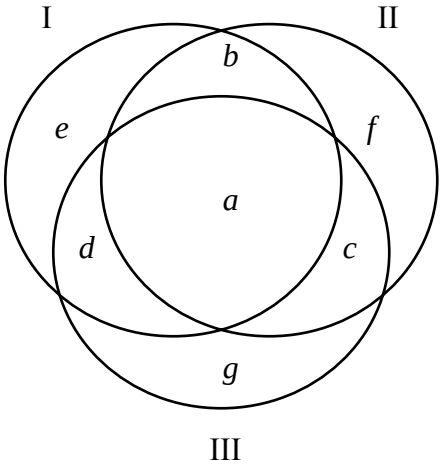
[10] The breakdown is as follows: Han (206 B.C.–220 A.D.), Wei (220–265), Southern and Northern (386–589), Late Tang (624–907), Song (960–1279), Ming (1368–1644), and early Qing (1644 – *c.* 1735).

[11] Statistics show that during the 1920s and 30s after the Qing Empire collapsed the marriage rate remained a high rate of 99.9 percent (see Barclay *et al*. 1976). Even under the strict state control in the 1980s and 90s still as many as 99 percent Chinese

of overlap between the total population and the total households (66–76 percent of the total population), Section *a* alone was able to capture some 70 percent of China's population, counting marriages and landholders. This system functioned for over 1,300 years or 64 percent of the entire lifespan of the Chinese Empire.

The triplex taxation system was the dominant form during the Jin (265–420), Sui (581–618), Early Tang (618–623) and Yuan (1271–1368) for a total of some 300 years (Figure 3). It covered the population more thoroughly than its predecessor.

Figure 3. China's Triplex Tax System



Source: (1) Jin Period, see Fang 646 A.D.: vol. 3 'Wudi Ji' ('Biography of Emperor Wu'), and vol. 26 'Shihuo Zhi' ('Economy'). (2) Sui Period, see Wei 656 A.D.: vol. 24 'Shihuo Zhi' ('Economy'). (3) Early Tang, see Du 801 A.D.: vol. 6 'Fushui' ('Taxes'), also, Liu 945 A.D.: vol. 46 'Shihuo Zhi' ('Economy'). (4) Yuan Period, see Li 1370 A.D.: vol. 93 'Shihuo Zhi' ('Economy').
Note: I – Poll Tax; II – Household Tax; III – Land Tax; *a* – *g*: taxpayer groups.

The triple system was undoubtedly derived from the dual system. Together, the two systems occupied over 78 percent of the lifespan of the empire. With the interlocking mechanisms of the poll/household tax and the land tax, the chance to leave a large proportion of the population undetected and was thin.

During the Qing Period, a simplified tax system gradually took over by 1736 to tax the rural population with a single 'poll tax and land tax-weighed rural tax' (called *tanding rudi* or *tanding rumu*) (Figure 4).[12]

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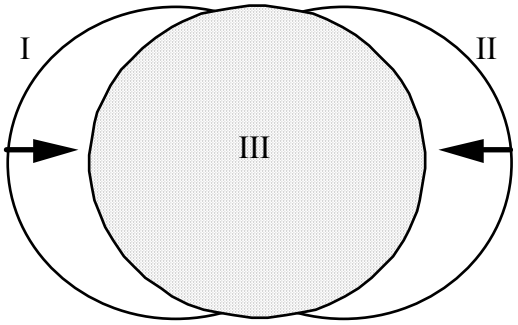
women got married before their thirtieth birthday (Duan 1999: 177, 265; Tong 2000: 302). In terms of landholding, in the 1910s and 30s, at least 70 per cent of rural households were freeholders (Tawney 1964: 34, Chao 1986: ch. 8), although the acreage of landholding varied (Fei 1939: 191–4; Tawney 1964: 34–5, 38, 71; Buck 1937/64: 194–7; Myers 1970; Chao 1986: 107).

[12] It is worth noting that this *tanding rumu* regime was originated also during the Northern Song. But it did not have the chance to replace the old multiple taxes of that time (see Ge 1988).

Figure 4. China's Single-Track System



Source: Anon. 1735: vol. 24; Kun 1899: vol. 133 'Hubu Dingyin Tanzheng' ('Conversion of the Poll Tax, Ministry of Revenue'); Zhao 1927: vol. 121 'Shihuo Er' ('Economy • Two').
Note: I – Poll Tax; II – Land Tax; III – Poll–Land weighed Single Tax; *a*–*b*: taxpayer groups.

One reason for the Qing reform was the decline in poll tax revenue: prior to the reform the revenue ratio between the land tax and the poll tax dropped to 30:1 (He 1826: vol. 30 'Huzheng Wu' ['Taxes and Taxation Policies'], Entry 'Peidingtian Faban' ['Attaching the Poll Tax to the Land Tax']). A deeper reason though was the massive internal migration to marginal lands in Sichuan, Yunnan, Mongolia and Manchuria (Tian and Chen 1986: chs 2 and 5).[13] The traditional demographic strongholds along the Yellow River and East Coast experienced weak or negative growth,[14] while the Yangzi hinterland Sichuan became a main tax contributor by an extra-ordinary growth of 80 times of its original taxpaying share of the empire (Liang F. 1980: 391–410). The increased population mobility made taxing land more cost-effective than taxing people. The new system successfully financed the Qing state for over one century (from 1713/36 to *c*. 1850). This owed much to the empire-wide 'Neighbourhood Collective Responsibility Network' (*baojiazhi*).[15] Hence, the singe-track alone does not undermine the credibility of the data.

In addition to those taxation systems, China's meritocracy created incentives for agents to monitor population fluctuations: the quality of censuses was always a key criterion to judge official performance under the regime of 'individual performance appraisal' (see Pu 1990: 208, 377, 424; Zhang 1992b: 375, 417, 489, 513–4; Wei 1989: 195, 282).

From the above analysis, two preliminary points can be made. First, it is hard to justify how and why Chinese officials always under-reported the population (see Figures 1a and 1b), as it

[13] In the 1920s, as the momentum continued, the rural population mobility of the north was 145% of that of the south (Chi 1998: 73).

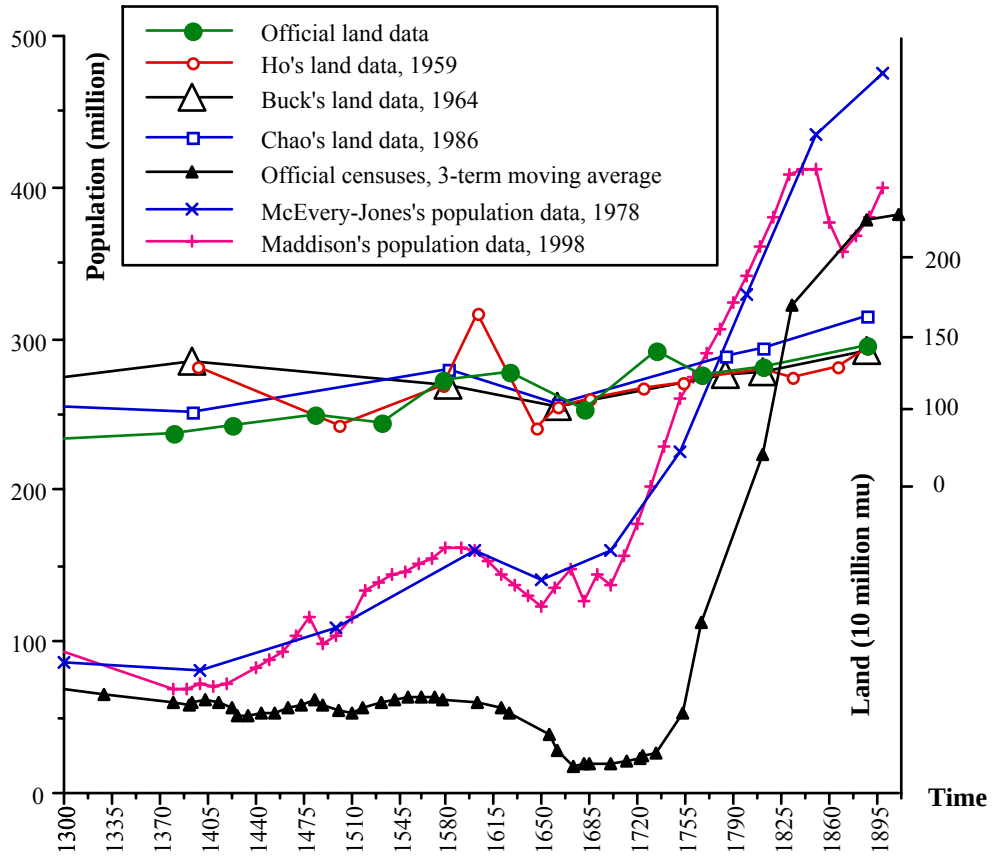
[14] So much so, in some core regions, population appeared to be stagnant in local gazetteers, which has confused modern readers (see Zheng 2000: 592–3).

[15] For a general history, see Zhao 2002.

would not enhance one's career in officialdom. Indeed, given the state preference, over-reporting was most likely to be the norm.[16] Second, considering the prolonged institutions and incentives, it is unbelievable that the Chinese got their figures right only on four occasions (100 A.D., 750, 1400 and 1825), as suggested by modern estimates (see Figures 1a and 1b).

In comparison, there has been much less dispute on the credibility of China's land registration (see Figure 5).[17] This immediately raises another question of why and how the Chinese authorities could tolerate such a double standard within the same administration.

Figure 5. Datum Disparity, Population versus Land



Source: Official land data based on Liang 1980: 4–10. Estimates, see Ho 1959: 102; Buck 1937/1964: 164; Chao 1986: 87, 89. Population data, the same as Figures 1a and 1b.

[16] This tendency had its modern reincarnation during Mao's notorious 'Great Leap Forward' in the late 1950s.

[17] Despite the fact that from China's own record of the late Ming there was an error margin of some 20 percent in the form of under-reporting (Zheng 2000: 557–8).

C. Data Inconsistency and Adjustment

Given that China had the technical capability, institutional framework and individual incentives to produce regular and reasonably accurate census data, the numbers of households and the numbers of individuals do not always tally. This is the paradox. For example, the average family under the Song was made of merely 2.10 people (see Table 4). This is less than half of China's long term average (see Appendix 1) and even lower than the value of contemporary China under the one child policy. Such a small size is not enough to sustain the population. Here, the relevant question is *not* why the Chinese were incapable of registering their population. Rather, it is why they decided not to register everybody at all times.

Table 4. Nominal Family Size according to the Official Data, 1066–1110

Year (A.D.)	Population figure (A)	Household number (B)	A:B
1006	16,280,254	7,417,570	2.20
1021	19,930,320	8,677,677	2.23
1053	22,292,861	10,792,705	2.07
1066	29,092,185	12,917,221	2.25
1083	24,969,300	17,211,713	1.45
1100	44,914,991	19,960,812	2.25
1110	46,734,784	20,882,258	2.24
Average	–	–	*2.10*

Source: Information based on Liang 1980: 4–10.

From Figures 3–5, it is certain that the main concern for the Chinese state was to tax the landowners from whom the lion's share of the tax revenue came. After taxing the landowners, the state had an option either to tax households or to tax individuals. To tax individuals, the state had to group people by age and sex, as women and children were normally exempted from labour and military services. In comparison, to tax households was considerably cheaper and still to get the more or less same revenue. It was this option that created the choice of not counting all the citizens at all times.

The Song system was a good example: it targeted adult males (aged 20–59) for the poll tax (called *ding*) (see Ma 1307: vol. 11 'Lidai Huko Dingzhong Fuyi' [Households and Taxable Adults]; Tuo 1345: vol. 174 'Shihuo Zhi Shang' ['Economy']; Xu 1809: ch. 'Shihuo' [Economy]; Yan *c*. 1843: vol. 64, Entry 'Yongxi Yuannian' [Edict of 984]). Therefore, only about a half of the Songs were captured by the census registration.

In essence, China's datum inconsistency was caused by 'proportional registration', not by bureaucratic incompetence or distortion. Given the afore-mentioned technical capability, institutional framework and individual incentives, China's datum fragments are by and large accurate in their own right. Similar to holography, the present task is to restore the whole picture from fragments. This can be achieved by adjusting fragments with China's own empirical weights.

In principle, as long as we know China's long-term norm, the statistical inconsistency caused by proportional registration can be adjusted to consistency. On such a weight is associated with the long-term stability of the Chinese family structure with the perpetual lineage tradition;[18] and the other, China's ever-lasting private landholding system. The first step is to establish the average size of the Chinese family in the very long run. To exclude the seven Song censuses, the long-term average is 5.77 people per household, derived from China's long-term dual registrations of population and households (for the database, see Appendix 1). This 5.77 average figure falls well within the generally observed and agreed range of China's average family size (i.e. ≥5 persons per household). More importantly, this average emerges from China's own real time primary sources. It thus can be used as a benchmark to adjust the Song household data. The result is shown in Table 5.

Table 5. Nominal Population Figures Adjusted, 1006–1110

Year (A.D.)	Registered households (A)	Adjusted population figure (5.77 • A)
1006	7,417,570	42,799,379
1021	8,677,677	50,070,196
1053	10,792,705	62,273,908
1066	12,917,221	74,532,365
1083	17,211,713	99,311,584
1100	19,960,812	115,173,885
1110	20,882,258	120,490,629

Source: For household figures, see Liang 1980: 8.

The other fifteen periods when the population figures are missing can be adjusted with the same method (see Table 6).

Table 6. Population Numbers derived from Household Figures, Various Years

Year (A.D.)	Registered households (A)	Adjusted population figure (5.77 • A)
520	5,000,000	28,850,000
530	3,375,368	19,475,873
626	2,000,000	11,540,000
649	3,000,000	17,310,000
650	3,800,000	21,926,000
780	3,805,076	21,955,289
839	4,996,752	28,831,259
845	4,955,151	28,591,221
959	2,309,812	13,327,615
976	3,090,504	17,832,208

[18] China's private landholding constantly generated a centrifugal force for the extended family while the Chinese lineage provided a centripetal force. In the long run, they reached an equilibrium and hence stability.

Table 6, continued

Year (A.D.)	Registered households (A)	Adjusted population figure (5.77 • A)
996	4,574,257	26,393,463
1187*	19,166,001	110,587,826
1190*	19,294,800	111,330,996
1195*	19,526,273	112,666,595
1330	13,400,699	77,322,033

Source: Household figures based on Liang 1980: 4–8.
Note: *Southern Song and Jin combined. These two regimes had different poll taxes and hence different population registrations. So, the only common ground was the household registration.

The Qing official figures are peculiar. There is no data for households (with exception of 1911). Therefore, our household-based benchmark becomes less useful. However, it is also known that the Qing census only registered adults (*dingkou*). Till *c*. 1735, only males aged 19–59 were eligible for the poll tax (E-er *c*. 1637: vol. 24 'Tianming Liunian Qiyue Shisiri' ['The Fourteenth Day of the Seventh Month of the Sixth Year of the Tianming Reign']). This is undoubtedly a reincarnation of the Song system. To adjust the Qing data, the average number of male adults per household (2.10) under the Song becomes useful. Here, one may argue that the Qing male adults figure could differ from the Song. But this is speculation. To use the Song figure to adjust the Qing data is justifiable as long as the Chinese family structure remained stable over time.

We can work out the Qing population from 1644 to 1735 with the following formula:

$$Q_{(i)} = T_{qi} \bullet \frac{F_1}{F_2}$$

Where $Q_{(i)}$ is the total population of the Qing at Period i; T_{qi} is the captured population at Period i; F_1 is the first benchmark of the long-term average household size (5.77); F_2 is the second benchmark derived from the Song average males per household (2.10). The results are listed in Table 7. The results are integrated in Appendix 2 for a complete set.

Table 7. Population Figures Adjusted, 1655–1734

Year (A.D.)	Taxable population (A)	Adjusted population figure (5.77/2.10 • A)
1655	14,033,900	38,559,811
1661	19,137,652	52,582,977
1673	19,393,587	53,286,189
1680	17,094,637	46,969,550
1685	20,341,738	55,891,347
1701	20,411,163	56,082,100
1711	24,621,324	67,650,019
1721	25,616,209	70,383,584

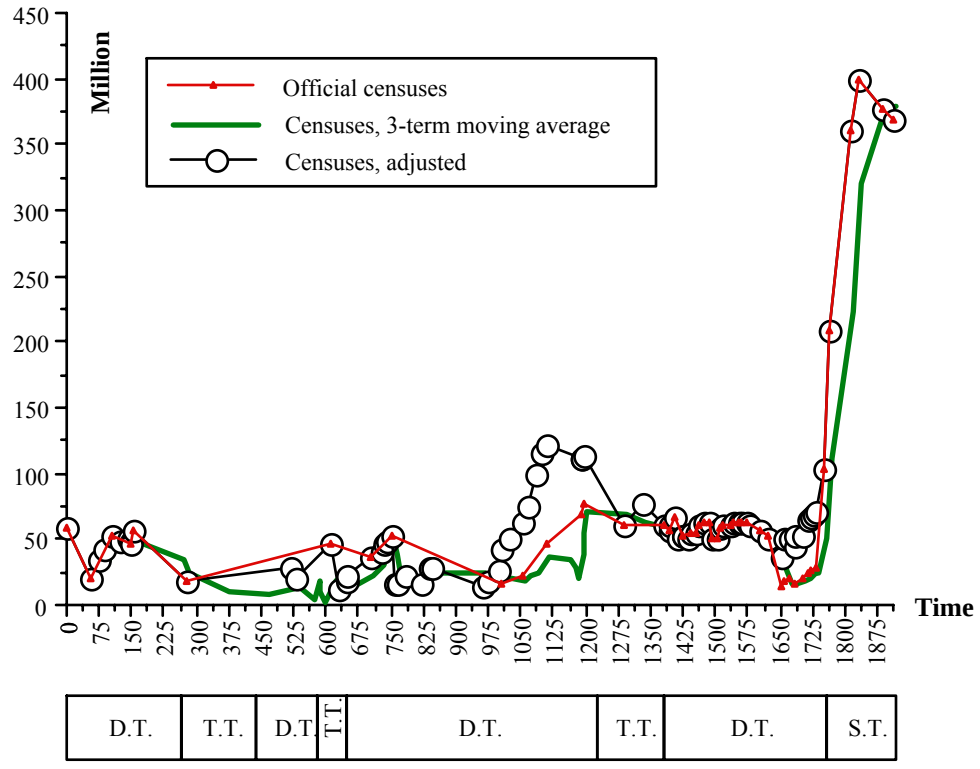
Table 7, continued

Year (A.D.)	Taxable population (A)	Adjusted population figure (5.77/2.10 • A)
1724	26,111,953	71,745,699
1734	27,355,462	75,162,388

Source: Household figures based on Liang 1980: 4–8.

These institution-cum-adjustments differ fundamentally from any previous reconstruction of data by estimation and guesstimation (see Figure 6). They remove the myth of the inconsistency in China's census data.

Figure 6. Official Population Data, Nominal and Adjusted



Source: (1) Official censuses (excluding household numbers), based on Liang 1980; (2) 3-term moving average, based one Liang 1980; (3) adjusted data, based on Appendix 2.
Note: Tax regimes: T.T. – Period of the triplex tax regime; D.T. – Dual tax regime; S.T. – Single-track tax regime.

D. Substantial Tests

The adjustments need to be tested. The new tests are more substantial than the early ones with three directions: (1) a 'feasibility test' to see whether population booms are feasible; (2) a 'dependent test' to see whether a population-depending factor reflects the population fluctuations; and (3) a 'determinant test' to see whether population fluctuations respond to a population-dictating factor. The first test is partly factual and partly hypothetical, while the last two are factual.

The feasibility test is relevant to two spurts. The first one was in 996–1110 when the population increased from 26.39 million to 120.49 million in just over a century. The second spurt occurred from 1734 to 1833 when China's population rose from 75.16 million to 398.94 million in just under a century (see Appendix 2). During the first spurt, the annual growth rate was 1.34 percent; and during the second spurt, 1.70 percent. Three factors are scrutinised: (1) marriage pattern, (2) children-bearing pattern, and (3) life expectancies.

First, the marriage pattern and life expectancies. Persistently, the Chinese got married very early with the average age of 12.8 for the female and 16 for the male (see Table 8).[19] But, counting the legal age can be misleading, as a recent study shows that from 1174 to 1912 as high as 37–38 percent of all the marriages were under the legal age (Jiang 1998: 256, 279). Therefore, the socially acceptable age for marriages in pre-modern China was lower than the biological age of sexual maturity (Duan 1999: 187). As a result, from 1174 to 1912, the married proportion occupied 60.0–62.8 percent of China's total population (*ibid*.).

Table 8. Legal Ages for Marriage during China's Pre-Modern Era

Period	Female	Male
Spring & Autumn (770–476 B.C.)	14 (13)	16 (15)*
Northern Wei (420–534)	13 (12)	15 (14)
Northern Qi (550–577)	14 (13)	–
Northern Zhou (566–589)	13 (12)	15 (14)
Tang 1 (618–733)	15 (14)§	20 (19)
Tang 2 (734–907)	13 (12)§	15 (14)
Northern Song (960–1127)	13 (12)	15 (14)
Southern Song (1127–1279)	14 (13)	16 (15)
Ming (1358–1644)	14 (13)	16 (15)
1635–1644 (Manchu)	12 (11)	–
1644–1911 (Qing)	14 (13)	16 (15)
Average	*13.6 (12.8)*	*17 (16)*

Source: Spring and Autumn, see Anon. *c.* 3rd century B.C.: ch. 'Diguan' ('Land Administrators'); Han *c*. 233 B.C.: ch. 'Waichu Shuo'; Mo *c*. 376 B.C.: ch. 'Jie Yong'; Zuoqiu *c*. 454 B.C.: vol. 20 'Yueyu'; Xie 2000: 3; Wang *c*. 265: ch. 'Benming Jie'. Western Jin, see Fang 646 A.D.: vol. 3 'Wudi Ji' ('Biography of Emperor Wu'. Northern Wei, see Xie 1998: 1–3. Northern Qi, see Li 636: vol. 8 'Houdi Ji' ('Biographies of Later Emperors'). Northern Zhou, see

[19] In comparison, the average age for marriages for the English women was 26 (see Wrigley and Schofield 1981: 528–9; Coleman and Salt 1992: 15–19).

Linghu 636: vol. 5 'Wudi Ji' ('Biography of Emperor Wu'). Tang, see Zhang 1992b: 436. Northern and Southern Song, see Jiang 1998: 272. Ming, see Li 1509: vol. 69 'Marriage of Among the Ordinary People'. Manchu, see E-er *c*. 1637: vol. 9; Jueluo 1652: vol. 23, Entry 'Tiancong Jiunian Sanyue' ('The Third Month of the Nineth Year of the Tiancong Reign'). Qing, see Wu 1648: 'Hulü Hunyin' ('Family Law, Marriages'); see also Chen 1936: ch. 4; Guo 2000: 180–4.
Note: Figures in parentheses are the biological age. *Recommended by the influential *Yellow Emperor's Medical Classics* (Yang *c*. 618: ch. 'Shuwen' ['Inquiry'], Entry 'Shanggu Tianzhen Lun' ['Archaic and Innocent Issues']) and *Confucius Home Instructions* (Wang *c*. 265). §Confirmed by recent archaeological findings (Jiang 2003: 159).

Such a universal marriage pattern is particularly relevant to women. Statistics for the 1920s throughout 90s show that the marriage rate among all women in China was 99–99.9 percent (Barclay *et al*. 1976; Duan 1999: 177, 265; Tong 2000: 302).[20] Childless young widows were customarily remarried (Wolf and Huang 1980: 133–42, 227–8; 258–9). There is no exaggeration that China was very close to the realisation female human resources to the full in both biological and social terms.

The life expectancies in pre-modern China were around 40 years (as during the eighteenth century, see Liu 1985: 52; Liu and Wu 1991: 278).),[21] suggesting that the population as a whole was very young and hence fertile.

Second, child-bearing. Evidence shows that the male-to-female sex ratio during the Qing was 1.15–1.19:1 (Jiang 1998: 224–6). The married women thus occupied 45.7–46.5 percent of all the married couples. Given that about 60 percent of all Chinese were married, the married female proportion (MFP) in China's total population could be 27.4–27.9 percent. To expect this 27.4–27.9 percent to produce the annual 1.34–1.70 percent net increase for China's total, a maximum 6.20 percent of 'general fertility rate' (GFR) had to be achieved by MFP.[22] Considering the inevitable deduction by infant mortality rate and population loss rate (due to diseases and old age), the GFR value had to be higher than 6.20 percent.

China's infant mortality rates for 1949 and 1960 were 2.00 and 2.54 percents, respectively (Tong 2000: 107). During this period, China had a predominantly poorly-educated rural population (80 percent of China's total). Moreover, both years were harsh because of the twelve-year long wars (1949) and murderous Great Leap Forward (1960).[23] So, these rates can be taken as proxies for pre-modern times. It is known that to maintain the population *status quo*, modern China has to maintain an annual crude birth rate of 2.10–2.20 percent (Tong 2000: 66). This can be used a proxy for China's population loss during peace.

These two loss rates (maximum 4.74 percent) can be translated into anther 17.30 percent GFR, which makes China's overall GER at 23.50 percent (6.20 + 17.30). From China's own record, this rate can be met with spare capacity (see Table 9).

[20] In comparison, during the seventeenth and eighteenth centuries, the marriage rate amongst the English women varied from 75% to 89% (see Wrigley and Schofield 1981: 528–9; Coleman and Salt 1992: 15–19).

[21] In comparison, during Tokugawa Period (1603–1868), the Japanese life expectancy was about 35 years (Yasuba 1986; cf. Hanley and Yamamura 1977: 221–2).

[22] GFR = the total number of births over the number of all the women of the fertile-age cohort times 1000‰.

[23] China suffered heavy losses in human lives during the wars and the Maoist famine, easily 30 million for each case.

Table 9. China's GFR and Spare Child-Bearing Capacity (%), 1928–33

Region	Real GFR (A)	Required GFR (B)*	Spare capacity (A–B)
North China	38.10§	23.50	14.60
South China	39.80	23.50	16.30
Sichuan	44.10	23.50	20.60
Nation-wide	38.90	23.50	15.40

Source: Information based on Jiang 1998: 274; §Chen 1934: 141–5.
Note: *Required growth rate for the Song and Qing growth.

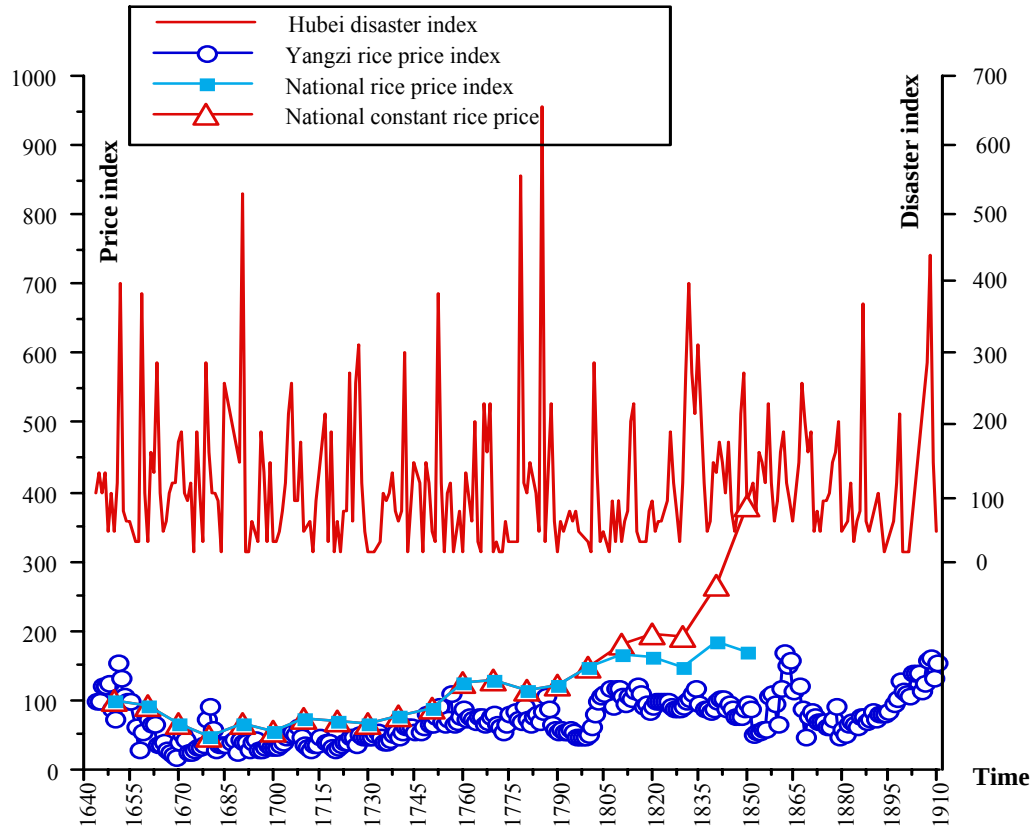
So, China should have had no difficulty to generate the required growth rate for the Song and Qing spurts. However, China's fertility capacity does not explain how the Chinese population fluctuated. One way to confirm China's numerous demographic fluctuations is to find a 'shadowy factor' that accompanied the movement of the population. One such shadowy factor is the food price.

The food price is particularly suited because the per capita demand for food is both price and income inelastic and hence stable in both good and bad times. If the demand is stable, what changes is the price level as the supply kicks in. When population size is relatively small, the aggregate demand for food is weak, the food price stays low, and *vice versa*. The fluctuations in the food price can thus reflect the fluctuations of the population that demands for food. For the current purpose, rice is chosen, because it was by far the most consumed staple food after the Song.

But a common illusion needs to be corrected that in pre-modern China the food price was determined by disasters that created food shortage. This would work only if food supply was highly localised all the time. During the Qing the Yangtze–Han Plain (geographically Han meaning Hubei roughly) was so integrated with other parts of the empire that disasters in Hubei had virtually no bearing on the food price in the greater Yangzi region. Instead, the Yangzi price was consistent with China's national price index (see Figure 7). The alleged impact of disasters on food price was very limited.

Before we start, all the prices need to be converted to a constant price. During the Song, there was a lasting inflation due to the deregulated monetary supply. Bronze coins, iron ingots and paper currency were simultaneously circulated to feed the growing commercial activities. Measured by silver, the Song price level increased by 350 percent in 245 years with an inflation rate of 5.2 percent per decade (Yu 2000: 556–7). During the late Ming, China experience a price revolution due to the intake of large quantities of overseas silver, about 14,300 metric tons a year on average (Deng 1997: 176–8). In 1520–1650, China's nominal price index for rice increased 2.6 times hand in hand with a three-fold rise in the general price level (Yu 2000: 788; Deng 1997: 176–8; for regional changes, see Wang 1992: 40–7 and Marks 1991: 102). This represents an inflation of 3.8 percent per decade. In the late Qing, the tide changed. China's silver reserve began to drain quickly with the opium trade (Deng 1997: 125). This silver drain caused appreciation of the relative price of silver to bronze coins by about 150 percent during 1810–40 (Yu 2000: 860). This makes a rate of 14.5 percent per decade.

Figure 7. Hubei Disasters and the Yangzi Price, 1640–1911

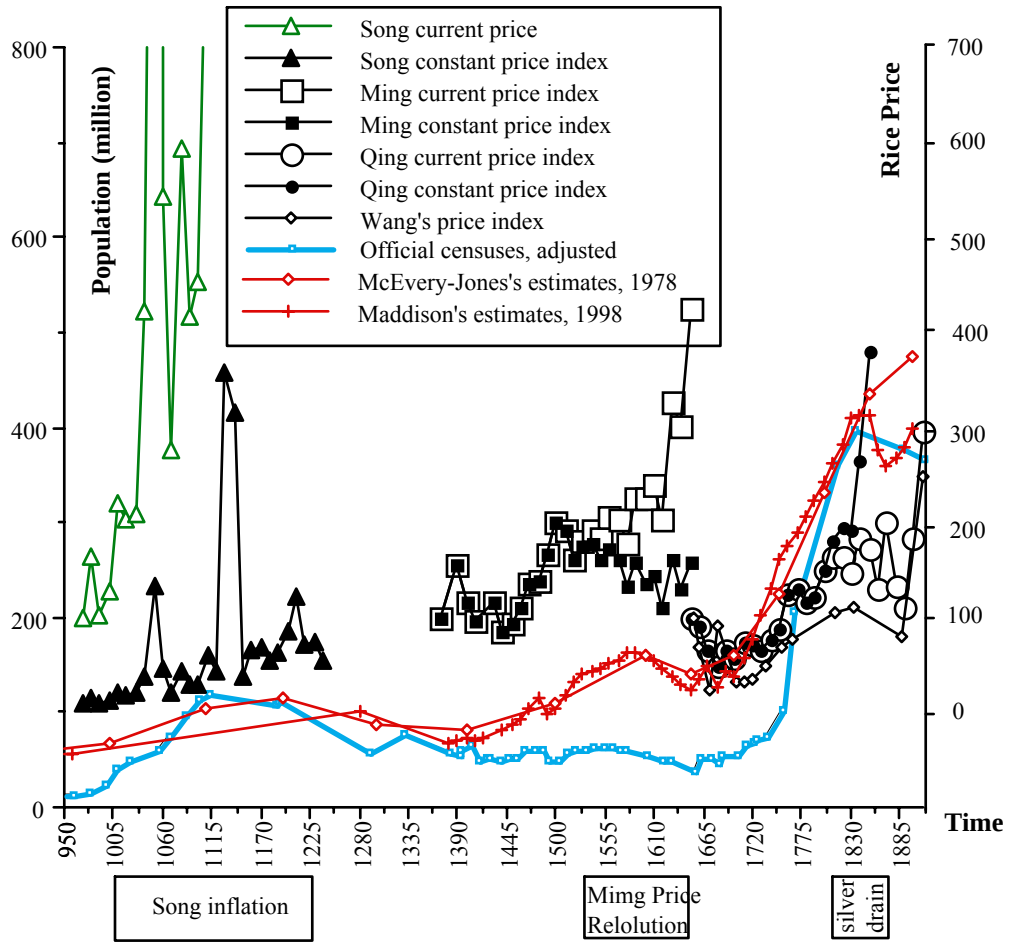


Source: Hubei disaster index based on Ho 1959: Appendix 3; the Yangzi rice price index based on Wang 1992; the national rice price index based on Yu 2000: 903–4; the constant price index based on Yu 2000: 860.

Astonishingly, China's long-term constant price index for rice fluctuates in the same direction as that of the population size (Figure 8). This pattern is highly consistent with the classical and neo-classical model for producers (here rice-growers) as price takers at the mercy of market demand. It thus makes no economic sense that during 1500–1700 a rocketing population should be coupled by a price decline, as modern estimates have portrayed. Here, either the Chinese rice sellers were irrational by selling their produce short or either the estimates are incorrect.

To test population fluctuations with the food price is effective but inconclusive, because the food price was a dependent variable to the population size. A tougher test needs to be conducted with a factor that dictates the population size. Disasters fill the bill. Conceptually, the actual size of population is to a great extent determined by the *force majeure* of disasters.

Figure 8. Population vis-à-vis Rice Price, 950–1911



Source: The price index series based on Yu 2000: 556–7, 602–5, 754, 786–9, 806, 903–4; Wang 1992: 40–7. China's official data, see Appendix 2. Estimates: McEvedy and Jones 1978: 166–74; Maddison 1998: 267.
Note: Boxed periods were those with inflation or deflation.

The most obvious cause of a loss of lives in pre-modern China was the war. It has been suggested that the Mongol and Manchu conquests were responsible for the losses of 25 and 35 million of Chinese lives, respectively (Jones 1988: 109). Taping Rebellion is believed to have cut China's population by one-sixth (see Ge *et al*. 1999: 84–111; Lu and Teng 2000: 790–802). Natural disasters including floods, droughts, insects and epidemics were also effective in reducing population numbers. In the nineteenth century, a major natural disaster could hit a quarter to a half of China's territory (Li 1994), affecting millions of lives.

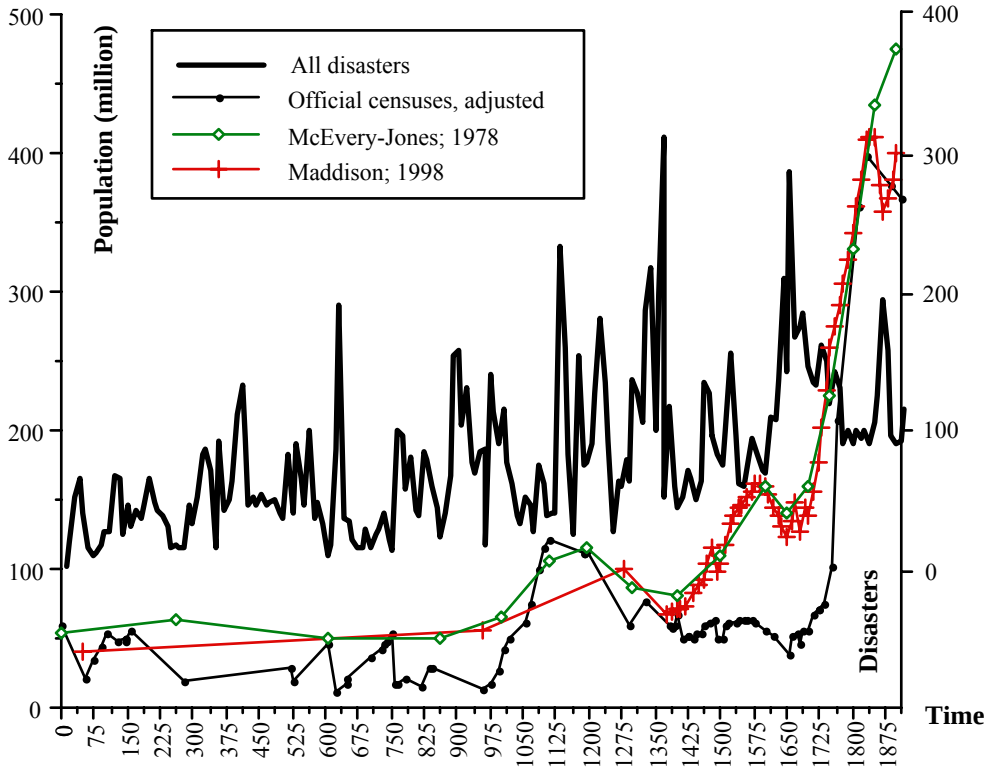
For ideological, political and economic reasons, the Chinese were very sensitive to disasters. Typically, the throne saw disasters as omens against his legitimacy. Local officials had the incentives to report all sizeable disasters for tax and famine relief efforts (Li 1992; Zhang 2004;

also McNeill 1998: 37). The ordinary citizens had incentives to report disasters for tax exemptions (Deng 1998: 372–86). The zeal for reporting disasters was thus perpetuated by the gains for both the officials and the farmers (Mallory 1926: 1–2, 38–42). Such incentives warranted a good coverage of disasters across the empire.

On the other hand, to record disasters was relatively straightforward: (1) the concept was commonly shared by all Chinese; (2) the damage was physical and visible. As a result, to report a disaster requires minimal labour input and caused fewer disputes among different agents. This helped the accuracy in data collection. Not surprisingly, no one has so far questioned the credibility of Chinese data for disasters.

When we put data for disasters and population together, a pattern emerges. In Figure 9, with few exceptions, a rise in disasters is coupled by a dive in population, and *vice versa*.

Figure 9. Disasters versus Population, *c.* 50–1911



Source: Data for disasters based on Chen 1937. Official censuses, see Appendix 2. Estimates: McEvedy and Jones 1978: 166–74; For Maddison 1998: 267.

From the fourteen pairs of data from 1660 to 1911 (see Appendix 3), the resulting correlation coefficient is a highly significant -0.85. Ideally, one should calculate such correlation for the entire Chinese history. However, the Chinese data have only a few year-by-year corresponding observations. The alternative is to compare the rates of change in corresponding periods rather than years. A 'see-saw' pattern firmly confirms the *force majeure* at work (see Table 10).

Table 10. Rates of Change in Disasters and Population

Period (A.D.)	Period breakdown	Disasters/Population	Annual rate (%)
1. 2/4–154/7			
Disaster increase (a)	4–125	3 → 68 (↑ 2,267%)	2.61
Demographic response (a)	2–125	59.6 → 48.7 (↓ 82%)	–0.16
Disaster decrease (b)	125–54	68 → 32 (↓ 47%)	–2.63
Demographic response (b)	125–57	48.7 → 56.5 (↑ 116%)	0.46
2. 157–519 (insufficient data)			
3. 519–627			
Disaster decrease (a)	519–609	43 → 20 (↓ 47%)	–0.85
Demographic response (a)	519–609	28.9 → 46.0 (↑ 159%)	0.52
Disaster increase (b)	609–27	20 → 193 (↑ 965%)	13.42
Demographic response (b)	609–27	46.0 → 11.5 (↓ 25%)	–8.01
4. 627–758/60			
Disaster decrease (a)	627–738	193 → 24 (↓ 12%)	–1.90
Demographic response (a)	627–742	11.5 → 48.9 (↑ 425%)	1.27
Disaster increase (b)	738–58	24 → 102 (↑ 425%)	6.80
Demographic response (b)	742–60	48.9 → 17.0 (↓ 35%)	–6.04
5. 758–956/9			
Disaster decrease (a)	758–839	102 → 62 (↓ 61%)	–0.62
Demographic response (a)	760–839	17.0 → 28.6 (↑ 168%)	0.66
Disaster increase (b)	839–956	62 → 89 (↑ 144%)	0.31
Demographic response (b)	845–959	28.6 → 13.3 (↓ 47%)	–0.67
6. 969–1190			
Disaster decrease (a)	969–1110	142 → 42 (↓ 30%)	–0.87
Demographic response (a)	976–1110	17.8 → 120.5 (↑ 677%)	1.44
Disaster increase (b)	1110–90	42 → 79 (↑ 188%)	0.79
Demographic response (b)	1110–90	120.5 → 111.3 (↓ 92%)	–0.10
7. 1190–1397/1403			
Disaster increase (a)	1190–1365	79 → 314 (↑ 397%)	0.79
Demographic response (a)	1193–1381	112.7 → 60.0 (↓ 53%)	–0.34
Disaster decrease (b)	1365–97	314 → 47 (↓ 17%)	–6.11
Demographic response (b)	1381–1403	60.0 → 66.6 (↑ 111%)	0.48

Table 10, continued

Period (A.D.)	Period breakdown	Disasters/Population	Annual rate (%)
8. 1397–1477/84			
Disaster increase (a)	1397–1457	47 → 136 (↑ 289%)	1.78
Demographic response (a)	1403–64	66.6 → 60.5 (↓ 91%)	–0.02
Disaster decrease (b)	1457–77	136 → 99 (↓ 73%)	–1.60
Demographic response (b)	1464–84	60.5 → 62.9 (↑ 104%)	0.19
9. 1477–1547/52			
Disaster increase (a)	1477–1517	99 → 157 (↑ 159%)	1.16
Demographic response (a)	1484–1519	62.9 → 60.6 (↓ 96%)	–0.11
Disaster decrease (b)	1517–47	157 → 61 (↓ 39%)	–3.20
Demographic response (b)	1519–52	60.6 → 63.3 (↑ 104%)	0.13
10. 1547–1873/87			
Disaster increase (a)	1547–1653	61 → 289 (↑ 474%)	1.48
Demographic response (a)	1552–1655	63.3 → 38.6 (↓ 61%)	–0.48
Disaster decrease (b)	1653–1833	289 → 92 (↓ 32%)	–0.64
Demographic response (b)	1655–1833	38.6 → 398.9 (↑ 1,033%)	1.32
Disaster increase (c)	1833–73	92 → 159 (↑ 173%)	1.38
Demographic response (c)	1833–87	398.9 → 377.6 (↓ 96%)	–0.10

Source: Data for disasters based on Chen 1937. Official censuses, see Appendix 2.
Note: Comparable pairs: (a), (b), and (c). Arrows: directions of changes.

In contrast, McEvedy-Jones and Maddison's numbers for 1 A.D. to 1300 are made immune from the impact of disasters. They then move in the same direction as the disasters for the period of 1400–1600. The early Qing of 1640–1700 is the only time when disasters play a part (see Figure 9). Unless there is no such thing as the *force majeure* over population, these modern estimates are implausible.

E. Conclusion

This study provides a straightforward and logical solution to myth and mess associated with the demographic pattern in traditional China. The key is the understanding of the Chinese fiscal institutions and their functions which dictated census registrations. The results being all convergent, the robust testing of the accuracy of China's pre-modern official censuses strongly indicates that the census-based series are fundamentally sound: institutionally, economically, sociologically and biologically (i.e., in terms of human reproductive parameters). In comparison, the modern-day estimates *cannot* and *do not* stand the same tests. Therefore, the Chinese official census figures are by and large very accurate as long as one knows how and where to adjust them. In contrast, the modern-day estimates are deeply flawed and intrinsically unreliable.

Several important implications emerge from the findings of the present research. First of all, it becomes only obvious that the modern-day estimates greatly exaggerate, and hence severely distort, the stance and dynamics of the Chinese population for a total of 1,150 years (1) from *c*.

200 A.D. to *c*. 700, (2) from *c*. 800 to *c*. 1000, and (3) from *c*. 1450 to *c*. 1910 (see Figures 10a and 10b). This stands for over 60 percent of the time when China was under censuses.

Figure 10a. Official Data vs. Modern-day Over-estimates, *c*. 200 A.D. to *c*. 1000

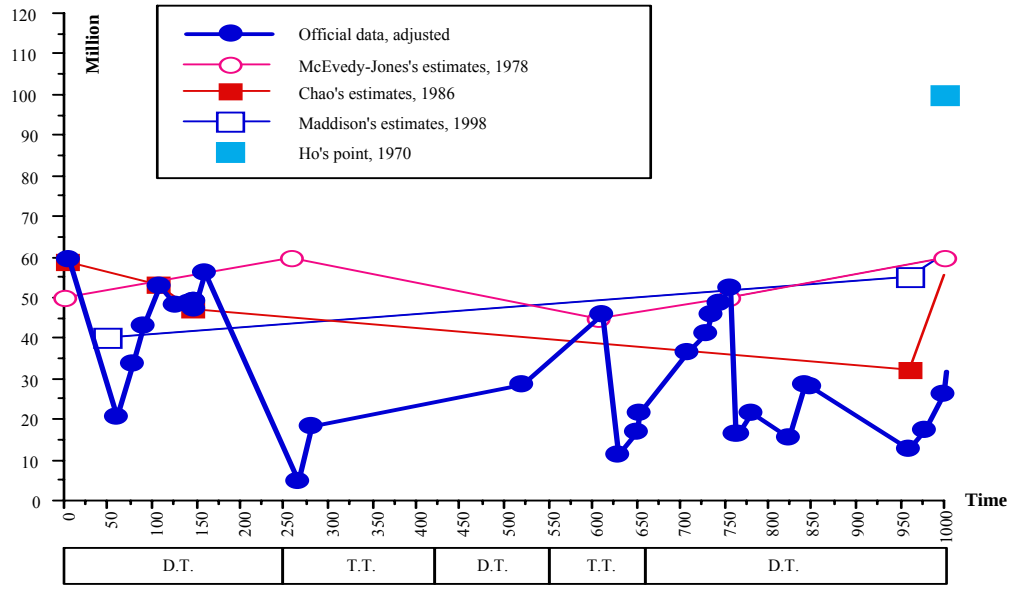
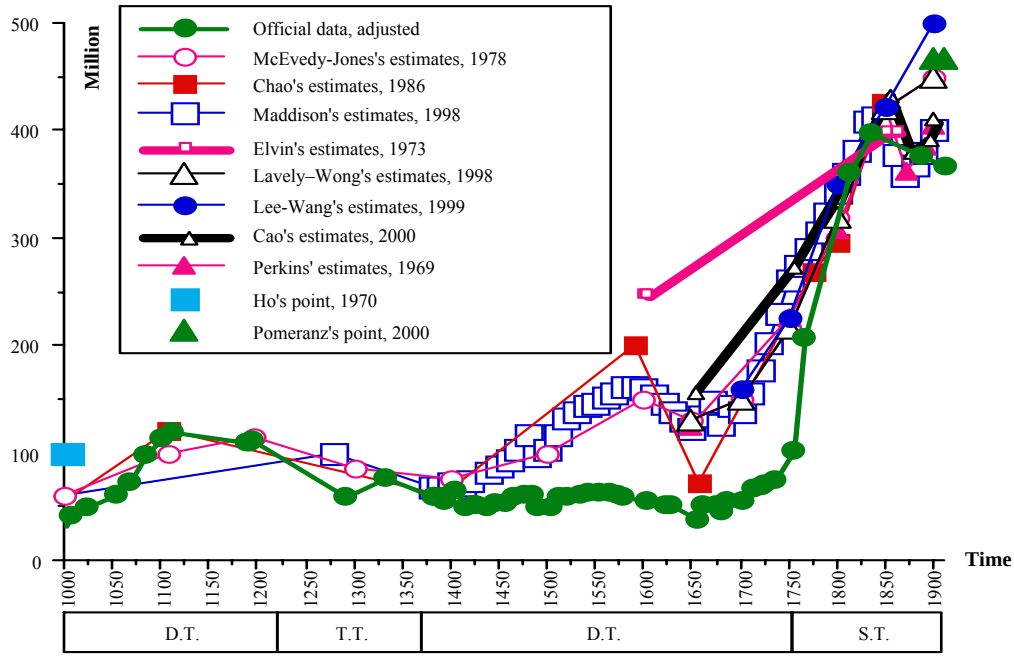


Figure 10b. Official Data vs. Modern-day Over-estimates, *c*. 1500 to *c*. 1910



Second, the more accurate demographic pattern of premodern China sheds new light on the understanding of how pre-modern Chinese society functioned, and how their economy performed over time. Now, a great many population-estimates-based 'secondary estimates' of China's total output, surpluses, market size and so forth need to be re-examined, and probably, overhauled.

Third, given the fact that China's population growth was at the mercy of disasters, the economy had to reach its upper limits many times, not just once in the second half of the Qing. If so, the notion of a 'high level equilibrium trap' under the Qing needs rethinking. Also, China's 'food security' may have been very limited in the long run. This may lead to re-assessment of the standards of living in premodern China.

Fourth, as the Chinese population fluctuated frequently, and violently at times, the population was never an ever-growing quantity. Thus, China's man-to-land ratio did not deteriorate all the time. Rather, it was able to adjust itself in both the short run and long run.[24] The notion of a Malthusian crisis during the Ming–Qing Period evaporates, especially for the period prior to 1750.[25] Likewise, the view that China's rural economy was constantly on the edge of 'involution' in Ming–Qing times becomes really questionable.[26] In addition, the hypothesis that China's per capita income stagnated from 1500 A.D. onwards has to be groundless.[27]

Last but not the least, the correlation between disasters and population size suggests that in China a Smithian growth was the dominant type which at best generated numerous incremental improvements but not a significant breakthrough. China was thus just one of the many 'traditional societies'. This puts one more nail in the coffin of 'Chinese exceptionalism'. In this context, it becomes inappropriate to ask why and how China did not succeed in its indigenous scientific and industrial revolutions.[28] Also, the clock for the 'great divergence' between China and the West will have to be re-set to a point in history much earlier than the alleged eighteenth and nineteenth centuries.[29]

Acknowlegements

I would like to thank Professors Eric L. Jones (Reading University, UK) and Osamu Saito (Hitotsubashi University, Japan) for their valuable comments. My LSE colleagues Professor Nick Crafts and Dr. Peter Howlett have made an irreplaceable contribution regarding the presentation and testing technique.

[24] For the man-to-land ratio approach, see Chao 1986.

[25] A reliable sign of such crises was mass starvation.

[26] For the involution, see Huang 1985 and 1990.

[27] For the hypothesis, see Maddison 2001: 90.

[28] For the scientific question, see Lin 1995.

[29] For the divergence, see Pomeranz 2000 and 2002.

Appendices

Appendix 1. China's Long-term dual registrations of population and households (excluding ten entries of the Song)

Year (A.D.)	Population figure (A)	Household number (B)	A:B
2*	59,594,978	12,233,062	4.87
57*	21,007,820	4,279,634	4.91
75*	34,125,021	5,860,573	5.82
88*	43,356,367	7,456,784	5.81
105*	53,256,229	9,237,112	5.77
125*	48,690,789	9,647,838	5.05
144*	49,730,550	9,946,919	5.00
145*	49,524,183	9,937,680	4.98
146*	47,566,772	9,348,227	5.09
157*	56,486,856	10,677,960	5.29
280†	18,463,863	2,989,840	6.18
609†	46,019,956	8,907,546	5.17
705*	37,140,000	6,156,141	6.03
726*	41,419,712	7,069,565	5.86
734*	46,285,161	8,018,710	5.77
742*	48,909,800	8,525,763	5.74
755*	52,919,309	8,914,709	5.94
760*	16,990,386	1,933,174	8.79
764*	16,920,386	2,933,125	5.80
820*	15,760,000	2,375,400	6.64
1291†	59,848,960	13,430,322	4.47
1381*	59,973,305	10,654,362	5.63
1391*	56,774,561	10,684,435	5.31
1393*	60,545,812	10,652,870	5.68
1403*	66,598,337	11,415,829	5.83
1413*	50,950,244	9,684,916	5.26
1423*	52,763,178	9,972,125	5.29
1426*	51,960,119	9,918,649	5.24
1435*	50,627,569	9,702,495	5.22
1445*	53,772,934	9,537,454	5.64
1455*	53,807,470	9,405,390	5.72
1464*	60,499,330	9,107,205	6.64
1474*	61,852,810	9,120,195	6.78
1484*	62,885,829	9,205,711	6.83
1490*	50,307,843	9,503,890	5.29
1502*	50,908,672	10,409,788	4.89
1510*	59,499,759	9,144,095	6.51
1519*	60,606,220	9,399,979	6.45
1532*	61,712,993	9,443,229	6.54
1542*	63,401,252	9,599,258	6.61

Year (A.D.)	Population figure (A)	Household number (B)	A:B
1552*	63,344,107	9,609,305	6.59
1562*	63,654,248	9,683,396	6.57
1571*	62,537,419	10,008,805	6.25
1578*	60,692,856	10,621,436	5.71
1602*	56,305,050	10,030,241	5.61
1620*	51,655,459	9,835,426	5.25
1911§	368,146,520	71,268,651	5.17
Average	–	–	*5.77*

Source: Information based on Liang 1980: 4–10.
Note: *Under the dual tax regime; †under the triplex tax regime; §under the single-track tax regime.

Appendix 2. China's official population data adjusted

Year (A.D.)	Number of people
2*	59,594,978
57*	21,007,820
75*	34,125,021
88*	43,356,367
105*	53,256,229
125*	48,690,789
144*	49,730,550
145*	49,524,183
146*	47,566,772
157*	56,486,856
280†	18,463,863
520*	28,850,000
530*	19,475,873
609†	46,019,956
626†	11,540,000
649†	17,310,000
650†	21,926,000
705*	37,140,000
726*	41,419,712
734*	46,285,161
742*	48,909,800
755*	52,919,309
760*	16,990,386
764*	16,920,386
780*	21,955,289
820*	15,760,000
839*	28,831,259
845*	28,591,221
959*	13,327,615
976*	17,832,208
996*	26,393,463

Year (A.D.)	Number of people
1006§	42,799,379
1021§	50,070,196
1053§	62,273,908
1066§	74,532,365
1083§	99,311,584
1100§	115,173,885
1110§	120,490,629
1187§	110,587,826
1190§	111,330,996
1195§	112,666,595
1291†	59,848,960
1330†	77,322,033
1381*	59,973,305
1391*	56,774,561
1393*	60,545,812
1403*	66,598,337
1413*	50,950,244
1423*	52,763,178
1426*	51,960,119
1435*	50,627,569
1445*	53,772,934
1455*	53,807,470
1464*	60,499,330
1474*	61,852,810
1484*	62,885,829
1490*	50,307,843
1502*	50,908,672
1510*	59,499,759
1519*	60,606,220
1532*	61,712,993
1542*	63,401,252
1552*	63,344,107
1562*	63,654,248
1571*	62,537,419
1578*	60,692,856
1602*	56,305,050
1620*	51,655,459
1655§	38,559,811
1661§	52,582,977
1673§	53,286,189
1680§	46,969,550
1685§	55,891,347
1701§	56,082,100
1711§	67,650,019
1721§	70,383,584

Year (A.D.)	Number of people
1724§	71,745,699
1734§	75,162,388
1753Δ	102,750,000
1766Δ	208,095,796
1812Δ	361,693,379
1833Δ	398,942,036
1887Δ	377,636,000
1911Δ	368,146,520

Source: Information based on Liang 1980: 4–10.
Note: *Under the dual tax regime; †under the triplex tax regime; §under the dual tax regime with special discount on population numbers; Δunder the single-track tax regime.

Appendix 3. Population Fluctuation versus Disasters, 1661–1911

Year	Population (million)	No. of Disasters
1661	52.6	169
1673	53.3	176
1685	55.9	187
1701	56.1	148
1711	67.7	137
1721	70.4	135
1724	71.7	163
1734	75.2	152
1753	102.8	144
1766	208.1	133
1812	361.7	97
1833	398.9	92
1887	377.6	99
1911	368.1	94

Source: For population, see Appendix 2; for disasters, see Chen 1937.

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