The Welfare Consequences of the Great Leap Forward Famine in China, 1959-61: The Stature of the Survivor

OUTLINE PAPER AND SELECTED TABLES AND FIGURES

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Past studies of the Great Leap Forward (GLF) famine in China of 1959-61 focus on the causality or the economic consequences of the famine, but few examine the welfare of the survivors. Between 15 and 30 million people are estimated to have died, the worst famine in world history, which stemmed from the GLF program of rapid industrialization. Human height, an indicator of nutrition, is used to examine the impact on the survivors of the famine who were born from the late 1950s to the early 1960s. Data are drawn from a survey of 112,000 industrial workers born between the 1940s and 1970s that was conducted in 1994, and anthropometric surveys of children conducted between 1950s and the 1990s. Trends in average stature are analyzed in conjunction with data on food availability, mortality, and economic output. These data for the first time enable us to quantify the impact on the welfare of the GLF survivors.

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Forty-five years ago China was emerging from the worst famine in human history that claimed between 15 and 30 million lives. Uncertainty still surrounds the estimates of how many died as a consequence of Great Leap Forward (1958-60) famine, and the causality and explanations for the famine are much debated. Besides the "excess" deaths, many millions of children who ought to have been born during the period were not, which produced an unusual narrowing in the age-specific profile of the country's population, followed by a post-famine bulge as birth rates rapidly rose in a compensatory reaction, which continues to influence China's demography. A particular gap in the economics literature is the near absence of any assessment of the welfare consequences for those who were born or lived through the famine as children. Nearly anyone who has done field work in China's countryside has anecdotal stories about the obvious stunting of those who were infants at the time, and the mid-to-late-40s contract workers on urban construction sites are similarly shorter than either older or younger works. The aim of this paper is to present anthropometric evidence that indicates the welfare consequences of the collapse in food nutrients.

My interest in the post-1949 famines or near-famines is two fold. Firstly, can we apply an entitlements approach to the analysis of famines in 'socialist' societies in which the state determines a person's entitlements to food, even for the primary producer of food? Until the entitlements approach of Amartya Sen (1981, 1990; Osmani 1995), famines were explained as a product of the decline in the availability of food that may have been brought on by war, weather failures or other impacts on the supply of food, which results in hunger, starvation and large-scale death from the diseases associated with hunger. This a simple story of supply-side failure – a food availability deficit (FAD). However, famines often occur without any decline in food availability. Sen argued that famine was the result of a change in the entitlements regime that lessened a person's ability to be able to acquire food. People starved because of a failure in direct entitlements or in the mapping of exchange entitlements. A direct entitlement failure is when a farmer cannot produce enough food because of a change in their endowments, such as appropriation of land or illness that prevents them tilling it. The more common failure is that of exchange entitlements where a person is unable to trade something to obtain sufficient income to exchange for food. A change in exchange entitlements could arise from an inability to trade cattle or labour power for money with which to buy food, for example, or a change in the relative prices of commodity bundles that make the exchange of one type of bundle insufficient to buy the required bundle of food nutrients. The entitlements approach "views famines as economic disasters, not just food crises" (Sen 1981, 162). Understanding the different types of entitlement failures becomes the key to understanding the causality of any particular famine. Sen's framework, though, is predicated on a market environment. For more than three decades until the 1980s markets were barely relevant to the working of the Chinese economy. Grain production, procurement and distribution – that is, the net availability of the staple food to any group of Chinese – was determined by State policy. Therefore, I would argue, an explication of the state-directed entitlements regime is at the centre of any understanding of the origin and severity of any famine or near-famine occurrence in China between 1949 and the mid-1980s.

Secondly, my interest arises from a current project to use anthropometric data (stature and weight) to estimate changes in the relative well being of the Chinese over

the past two centuries which is not captured by conventional economic measures for the standard of living, either because the data do not exist or because they are unreliable (Morgan, 1998, 2000, 2004, 2005, 2006; Morgan and Liu, 2003, forthcoming). Stature is an indicator of the history of net nutrition of a person, especially the net nutrition during sensitive growth phases, while weight is a measure of current nutrition. Combined in the form of the body mass index (BMI: weight in kilograms divided by the square of the stature in metres, kg/m^2) we have a powerful indicator of the capacity of a person to engage in productive physical and mental activity, which is nothing less than a biological indicator of the potential productivity of a person (Fogel 1993, 2004). When we possess sufficient data we are able to calculate average stature and other measures for the population that enables us, in conjunction with whatever other data may be available, to say something about the a biological well being of the population.

This paper will begin with a brief historical remark about famines in China and the early economic development of the PRC. Next it will set out some of the recent literature, focusing on the data, interpretations and models for explaining the Great Leap Forward famine in particular, drawing mostly on a special issue of the *China Economic Review* (Fall 1998). Thirdly, the paper will introduce the anthropometric data for selected provinces affected by famines or near famines in China's recent historical past, and conclude with some preliminary results. **The revised version of the paper should be available for the conference panel session.**

Famines in China

China in the western imagination was a "land of famines" (Mallory 1926), teaming with peasants who lived, in the description of Tawney (1932), on the threshold of survival like a man with his head barely above the water who would drown were the water to rise another inch. There is a large literature on famines, food supply and nutrition in China. There are various historical studies (Nathan 1965, Will 1990), accounts of famines by missionaries (Richard c.1916) and of missionaries (Soothill 1926, Bohr 1972), numerous reports of famine and disaster relief committees (Central China Famine Relief Committee 1912 and National Flood Relief Commission 1933 cited in Bohr 1972, the UN Disaster Relief Office Report on Drought and Floods in Hebei/Hubei 1982 cited in Kane 1988), accounts of the demographic impact of the Great Leap Forward (Aird 1982, Ashton et al 1984, Bannister 1987, Peng 1987, Kane 1988), discussion of nutrition and well being (Piazza 1986, Kueh 1993, Riskin 1990, 1991, Morgan 1998, 2000), and a raft of recent analyses of mostly post-1949 famine and rural situations (Becker 1996, Bramall 1993, Chang and Wen 1998, Kueh 1995, Lin and Yang 1998, Riskin 1998, Yang 1996, Yang and Su 1998; PLUS several recent pieces). Brief as this list is, Chinese famines and food issues have been the subject of many studies over the past century. Famine and food have also been central to traditional economic policy making in China. The modern Chinese word for economics, *jingji*, is but a 19th century Japanese contraction of the classical Chinese phase *jing she ji min* (regulate the affairs of world to succour the people) that was the basis of imperial Chinese administrators' intervention in economic matters. Central to that intervention was the need to maintain food supply through the maintenance of the water-control systems that would enable crops to be grown and transported, and the proper regulation of markets and employment that would enable the populace to

acquire adequate food. Were it not, as was so often the case in the closing years of many dynasties, uprising and rebellions would progressively proliferate.

At the start of the sixth decade of the People's Republic of China the majority of Chinese are better off than they have ever been. Most are richer, with better nutrition and housing than in the past. The transformation of the past 25 years is phenomenal, despite evidence of widening disparities in income distribution. When economic reform began there was ample evidence that most Chinese were living in a state of endemic hunger, with per capita nutrient availability sufficient only for moderate work intensity (Piazza 1986: 11, 71-80, 195). Although there were significant improvements in nutrient availability from the 1950s, for most years the Chinese average level was on or below the accepted international safe level (Piazza 1986: 77, 195). Per capita grain output, a rather crude measure of potential nutrient availability, was below the 1957/58 peak for every year other than 1974 from the Great Leap Forward until the start of economic reforms in l979 (see Fig 1). Our knowledge, though, of how poorly China was doing between the late 1950s and late 1970s only became apparent with the release of data in the early 1980s. Many scholars who had once seen China as having achieved considerable balance in its development program radically reversed their judgements (compare Nicholas Lardy's writings of 1978 and 1980 with those of 1983 and 1984). China's post-1949 development strategy, far from being balanced or "rural biased", was much like any other country's industrialisation strategy: the peasants paid for it through various and harsh extractive means orchestrated by a communist party, rather than an indigenous capitalist class. It was not simply "urban biased", but "state biased". The foundation policy of the PRC for several decades was an urban-oriented state-biased economic development strategy.

One of the consequences of the strategy was that following the economic recovery and consolidation of communist power in the early 1950s, the party needed to ensure delivery of rural produce to the state. The peasant farmers' propensity to consume the greater output during the relative peace and stability of the 1950s got in the way of the party's modernisation strategy. Rapid expansion of agricultural output was not reflected in greater delivery of that output to the state, principally for the development of industry (to supply the new factories, feed the industrial workforce, and barter for capital goods from the Soviet Union). The difficulties were the impetus for the increasing pace of "socialisation" of industry and commerce, and of "collectivisation" of agriculture from the mid-1950s (these developments are nicely surveyed in Riskin 1987). It culminated in the Great Leap Forward, which saw the implementation of a rapid industrialisation program in the countryside (best characterised by the backyard furnaces) and the creation of the people's communes, the major institutional change of the period. The horrendous demographic outcome, which saw China actually loose population (Fig 2), was only revealed in the early 1980s when China released data on the 1964 census in preparation for the UN-supported 1982 national census. The data, though, are still subject to debate. There is surprisingly little analysis of this major catastrophe, especially from scholars resident in the PRC. "The Great Leap Famine is the least studied and understood of the major famines that have occurred in the world" largely for reason that the Chinese government does not encourage discussion of the period (Johnson 1998).

Insert Fig 1 and Fig 2 about here

Data problems. There is agreement among scholars that the scale of the deaths was enormous. The exact number of excess deaths, the magnitude and timing of the rise in mortality, and the nature of the morbidity associated with the famine remains uncertain. This is due largely to the collapse of the statistical reporting system. Official statistics were compiled from retrospective surveys (Kane 1988).

The problem is we cannot simply answer the question 'how many people died?' Estimates range widely, from 15 million implied by official statistics, to 23-30 million among academic demographers such as Aird (1982), Peng (1987) and Bannister (1987), to a recent former official's estimate of 43 million (Riskin 1998). These uncertainties complicate not only the assessment of the severity of the famine, but also attempts to refine the dating of its onset and end, which have implications for determining the role of government policy or other factors in the famine. There is also inadequate information on the distribution of relief, the provision of medical care for different populations groups, and specific causes of death (most people do not starve to death but die from illness caused by severe nutritional deficit).

As for the accuracy of Chinese official statistics, most scholars accept these as the best we have whatever their biases and inadequacies. Riskin (1990, 23 n6) observed: "Checks of internal consistency and other considerations have convinced most independent scholars that government statistics for most of the post-1949 have been accurate expressions of what the Chinese government believed to be true." Deliberate falsification has rarely occurred. Rather, the problems are missing data, systemic inaccuracies, or reluctance to disclose how statistics were constructed, the weights used and definitions, which require scholars to exercise caution in their use of official data.[1]

Causality and interpretation. There is much disagreement among scholars over the relative weight to give to any particular factor in explaining the onset of the GLF famine and its severity, especially the role of Chinese government policy. It is best to begin this section with a brief summary of what is generally agreed.

The grain harvest is the major determinant of overall food availability in China, and grain was the main source of energy and protein for the Chinese. Food grain output has fluctuated widely. The famine began after the largest grain crop on record and for the most part excess deaths rose before the harvest failures of 1959. From the 1958 yield of 200 million metric tonnes, grain output fell 29% to 1960. The average per capita consumption in the countryside fell from 204 kg in 1957 to 154 kg in 1961, and the national average per capita daily calorie intake in 1960 was about 1500 calories, well below the estimated safe limit for the period of about 2100 (Riskin

[1] Decline in food availability (FAD) in any particular province could have been due to a decline in production, a rise in exports or a peculiar geographic factor (eg, weather failure), or a combination of these. The inadequacy of statistics mean we still do not know enough about grain supply and other economic indicators in any particular province. Some, such as Anhui, one of the worst affected, remain a statistical black hole. Important income and consumption data for Anhui for most years before the late 1970s are missing from even the most recently published SSB historical statistics volumes.

1990, 1998; Piazza 1986). NEED TO ADD NOTE + CHECK whether the average is total or adult equivalent. Check sources used by Riskin and Piazza.

The exaggeration of the 1958 grain yield at the time, reported up to twice the 1957 harvest, gave the impression the country had ample, and was instrumental in government policies to raise procurement, reduce area sown to grain, and promote exports. In 1959 the state procured 39.7% of total output (the net was 28% after distribution to deficit areas) compared with a pre-GLF average around 25% (net about 17.5%), and exported 4.16 million metric tonnes (Riskin 1990: 29, 44). The collapse in output produced a classic FAD-type famine, but most scholars argue that a decline in food availability was only partial explanation of the famine. FAD does not account for the rise in mortality that occurred in 1958, nor does it account for the great variations in the severity of the famine among China's provinces. Similarly an improvement in food availability does not explain the end of the famine in 1962 – per capita availability of grain in 1962 was below that of 1959, and about the same as 1960, the worst year of the famine. Official data estimates national per capita grain consumption in 1960 at 164 kg and at 165 kg in 1962. Other explanations must be sought. The only plausible explanations appear to be policy changes. Communal kitchens were abolished, private plots were again allowed, land was turned over to the household in some places, and the amount of grain procured was reduced, which coincided with significant import of grain from Australia and other suppliers.

The severity of the famine was a product of many variables, of which FAD was a factor, but not necessarily the most important. About other factors and causality there is much disagreement. The arguments are: a game theoretic approach to model the impact on productivity of the lost of exit rights from the collective (Lin 1990); the modification of the exit-rights argument with a Sen-based entitlements analysis of the urban bias of food distribution (Lin and Yang 1998); a "tragedy of the commons" argument that focuses on food waste arising from the communal dining system, resulting in a "failure in consumption efficiency", that along with other radical political policies undermined property rights governing incentive structures (Cheng and Wen 1997, 1998, Yang 1996, Yang and Su 1998).

Lin (1990) uses a game theory hypothesis to explain the collapse of production and ensuing famine. In the fall of 1958 the nature of the collective changed, from voluntary to compulsory participation. This was a change from a repeated to a one-time game. The lost of the right to exit the collective had a significant impact on the incentive structure of the collective, which produced a decline in productivity and the subsequent collapse in grain output. "When the freedom to quit exist, at the end of each production round, members of a collective can decide whether they want to participate in the collective in the next round. Those who find they are better off being members of the collective will retain their membership. Otherwise, they will withdraw from the collective," argues Lin (1990, 1241). Participation in a collective allows members to share the benefits of pooled resources, the economies of scale unavailable to the typical individual Chinese household farmer. Due to the difficulty of adequately supervising agricultural work, the success of the collective depends on "a self-enforcing contract" in which each member promises to put in as much effort as they would on the household farm. If a member shirks, others can decide to leave; the shirker, who has benefited from the collective without due effort, needs to modify her actions to preserve the collective if she wishes to benefit from the scale economies in the second round. "If the discounted present value of future losses is larger than the

one-time gains in this round, the member will honor the agreement. Therefore, it is the threat of a collective's collapse that greatly reduces the incidence of shirking" (Lin 1990, 1242). The assumption here is that the output of a voluntary collective will be at least as good as the sum of the households comprising it working separately.

With the compulsory imposition of collective membership in the commune exit is not permitted. The result is the collective becomes a one-time game, and the self-enforcing contract fails because "It becomes impossible to use withdrawal either as a way to protect oneself or as a means to check the possibility of shirking by the other members. … [Therefore], supervision becomes crucial in establishing work incentives and productivity levels in the collective" (Lin 1990, 1242). Effective supervision of agricultural work is very difficult, and the link between present effort and future reward is weaken in the absence of ownership over output (the reward), which undermines work incentives and consequently affects adversely productivity. Lin argues that the game theory hypothesis explains the success of the collectivisation movement 1952-58 and the sudden collapse of agricultural output 1959-61, which is supported by evidence for the change in total factor productivity for agriculture (see chart following the references).

Lin and Yang (1998) restates the exit-right hypothesis, and develop augments drawing on Sen's entitlements approach that recognises FAD alone is an insufficient explanation for famine. The premise is that the causes of a production shortfall should not be confused with the causes of a famine. Sen's focus is on the collapse of endowments that prevent a certain proportion of the population from acquiring food. Lin and Yang is the only study I am aware of which attempts to explain the right food as a determinant of the Chinese famine, and do so econometrically. They use panel data for 28 provinces 1954-66 to explore the relationship between mortality and the urban-biased ration system that guaranteed city residents food, and left farmers with the residual. The effect of this system was excessive export of grain from rural areas to the cities. They concluded that "the Chinese food entitlement system, which was dominated by urban-biased distribution, explains a greater part of the inter-provincial variation in mortality rates than does food availability" (Lin and Yang 1998, 131).

Factors other than FAD and food entitlements inform the conclusions of Yang (1996), Change and Wen (1997, 1998), and Yang and Su (1998). They focus on communal dining and radical policies as an explanation for the famine. Yang (1996) argues that the creation of communal mess halls led to the depletion of grain, leading to hunger and starvation. The argument is based on the tragedy of the commons: when meals were free individuals will over consume because conservation in the present will not ensure access in the future as others may have already consumed what an individual had saved in the past (that is, there are no exclusivity property rights). Yang uses evidence of a significant and negative correlation between participation in communal mess halls and mortality rates. Change and Wen (1997, 1998) similarly argue that famine was a product of "consumption inefficiency", in that communal dinning lead to over consumption and waste of food, rather than FAD or entitlements failure. Yang and Su (1998) is an extension of Yang (1996) and Change and Wen (1997, 1998), but emphasises the politics of the GLF period. Communal dining was the institutional manifestation of the radical policies of the GLF, and much blame for the famine can be sheeted home to the over-enthusiastic implementation of central policies by provincial and lower level leaders.

Anthropometric data

This study draws on surveys conducted since the late 1970s, jointly commissioned by several ministries and conducted under the direction of staff at the Research Institute of Sports Science of the State Physical Culture Commission (*tiyu yundong weiyuanhui*). Most surveys were of school children and youth through to the age of 22, but several surveys have been conducted of other population groups, including mature and middle aged adults workers. This study uses both types of surveys.

Survey of Adult Workers: As part of a study of the health of workers, 112,530 Chinese men and women employed in 17 industries plus Beijing municipal government were measured in 1994 using a variety of indicators, including height and weight. The 62,346 males were aged 18-59 and the 50,184 females were aged 18-54, the age range reflecting the official age of retirement of 60 for men and of 55 for women. The mean sample size per age cohort for men was 1484 (range 1223-1904, SD 154) and for women 1356 (range 111-1666, SD 134). They were employed in 63 large-scale industrial or service work units, and included the railways, petroleum, coal mining, construction, machinery, post and telecommunications, chemical industry, automotive, aeronautics, metallurgy, textiles and government agencies. Any students or trainees were excluded. For every industry there were about 100 subjects for each age cohort, with the minimum size group per age for any industry of 34 subjects.

One of the aims of the study was to analyse the health of the middle-age population to provide data for devising ways to encourage physical activity. There were 45,726 subjects older than 41 years in the study. While there are various problems with the reporting of the data – there is no identified weighting for region and no information is provided about the choice of the enterprises to be included in the sample[2] – the height data is probably representative of urban employed State sector employees. Height was measured to 0.1cm intervals with an error level of ±0.2cm specified. Other anthropometric and physiological indicators recorded included weight, chest and waist measurement, blood pressure, lung capacity, and various measures of physical exertion.

The results are reported in summary tables. Average height, for example, is tabulated for each age cohort, the standard deviation and the sample size. More highly aggregated data are provided by four politico-social classifications: worker (*gongren*), cadre (*ganbu*), scientific-educational (*kejiao*) and other (*qita*). These data might have allowed analysis of the change in height by social background for specific political and economic events in recent Chinese history. Unfortunately, the data are aggregated into five-year age groups, rather than annual means, and the numbers of subjects from each social group in each five-year interval is not specified, only the aggregate total.[3] A difficulty with the data for the subjects older than 40 years of age is that we need to correct the reported height for shrinkage that begins during the fifth decade of life, though correction is not needed for those born during the GLF. The correction method

[2] The sample measurement card included in the field workers' handbook does not even have a field for provincial origin (*jiguan*), which is unusual given Chinese sensitivities to a person's social background.

[3] I considered requesting access to the underlying data, but given that provincial origin is not reported either, further analysis of social background without controlling for region of origin would be pointless.

used for Fig 3-7 is a transposition of the estimated age-related shrinkage equation that Chandler and Block (1991) had obtained from a longitudinal study.

Surveys of School Children and Youth: Small-scale anthropometrical surveys in single locations have been conducted in China since the 1910s (summarized in Yeh 1959, Piazza 1986, Morgan 2000). A quasi-national study was conducted in 1975 that surveyed 273,735 children from birth to 17 years in urban and suburban rural counties of nine cities (Zhang 1977). Periodic national scale studies have been conducted since 1979, covering 16 provinces and more than 200,000 students in 1979 (Report 1982), 28 provinces and nearly one million students 7-22 years in 1985 (Report 1988), and 30 provinces and about 250,000 students in 1991 (Report 1993), 1995 (Report 1996) and 2000 (Report 2002). Only Han (ethnic Chinese) are discussed here, though data on national minority groups were collected from 1985.[4]

Data was collected using a stratified random sampling method. Three urban and three rural observational districts (including one urban and rural area from the provincial capital region) representative of poor, middle and upper socio-economic areas were selected, and within each observational district three observational places were selected for the 7-18 year group.[5] Each observational place could be a single school or a group of neighbouring schools, from which the observational classes were randomly selected. Finally, the student sample was randomly selected from the observational classes and examined to ensure they met the health criteria for inclusion in the final data set.[6]

Preliminary exploration of the GLF

There is disagreement among scholars over the weight for any particular factor in explaining the onset of the GLF famine and its severity, especially the role of Chinese government policy. State control of grain production, procurement and distribution, along with destruction of the alternative sources of income and food that Chinese had long depended – the rural markets and household garden plot – and destruction of incentives structures within the collectives are at the centre of any explanation of the GLF famine. Yet, few have attempted to quantify the welfare outcomes of the GLF. Below we use height data to measure the impact on welfare.

Final attained adult height is a measure of the cumulative the net nutrition available for human growth from birth to adulthood (or time of measurement for a

[4] Besides height and weight, there are sitting height, chest and physical exertion measures. Each report includes the survey procedures and the sample size, mean and standard deviation for each measure.

[5] Urban places were defined as those in the city area (*shiqu*) or its suburbs (*jiaoqu*), which included the provincial capital and another two urban areas. Household registration (*hukou*) was used to classify residency. Post-secondary students' *hukou* prior to enrolment was used to determine their rural-urban status. Rural populations in the text are referred to as 'rural-classified' population because the author has not verified the degree to which the data are representative of rural areas.

[6] The normality criteria excluded students with any infectious disease, growth abnormality (dwarfism and giantism) or physical disability, as well as menstruating women.

child). The change in the average stature of a population over time indicates how well the human organism has survived its socio-economic and epidemiological environment. From the trend in average height of a population we can infer change in income and income distribution, the access to nutrients as influenced by the relative prices of food, and obtain measures of gender, social and spatial differences in nutritional status (Eleveth and Tanner, 1990; Steckel, 1995). The GLF produced a collapse in grain output and a sharp decline in available food energy. The consequences, for those who were born around this time or were in their infancy, we would expect to be revealed in reduced stature. The degree to which average height is reduced depends on the severity and length of nutrient privation, and whether there was more than adequate nutrition after the effect to allow "catch up" growth to take place (Eleveth and Tanner, 1990).

Fig 3-7 show the average height of men and women based upon the survey of adult workers in the early 1990s. Fig 3 reports the measured height of men ordered by year born and their estimated adjusted height, and Fig 4 shows both series smoothed using a double-centred three-year moving average.[7] Fig 5 and Fig 6 report the same results for women. Fig 7 shows the smoothed series for both men and women. The adjusted stature – which is a better estimate of actual mature adult height of the older subjects – shows a secular downward slope during the Sino-Japanese War for both men and women. Male stature begins to trend upwards from the last year of the Sino-Japanese War, 1944-45, into the early years of the PRC, despite the economic instability, hyper inflation and conflict of the Civil War. Women fared less well. The final attained stature of men and women born during the 1950s rose quickly, with a gain of about 0.75cm for each in six years to 1957-58. The stature of both men and women born during the GLF declined (the GLF period is highlighted by a red rectangle on Fig 3, Fig 5 and Fig 7). The average height for men declined about half a cm and women about the twice the decline of men. For women, the decline began earlier than for men, about 1957, and the fall was greater and more prolonged. For those born from c.1962, the attained height for men and women both rose through to 1971-72, with a slight dip coinciding with the most intense period of the Cultural Revolution, 1966-67. The decline in height after 1972 may be more due to the effect of youth – young adult workers had not attained full height – rather than due to the food crisis in 1972-73 after widespread drought in China's wheat zones.

Figs 3-7 about here

Using the anthropometric surveys of students through to 25 years of age, we are able to derive a series of adult heights covering most years of the GLF. To do this we first needed to run regressions to estimate whether the older students had reached adult height (stopped growing) to avoid any downward biases from immature subjects. Based on the regression analysis of height-for-age, were able to determine

[7] A Double-centred three-year moving average is the three-year moving average of a previously calculated three-year moving average. It has the same span as a five-year moving average but, in my view, more faithfully tracks secular trends than a five-year moving average while reducing stochastic noise.

when adolescent growth had ceased for the various series and thus filter the data set to obtain a time series of mature Chinese adults ordered by year of birth.[8] The sequencing does not allow us to use the children survey data to look at the worst years of the GLF – there is a gap in the constructed series for 1960-62. Nevertheless, the children series is plotted with the 1994 adult survey data in Figs 18-19. Both series track each other quite well up to 1959, but less so during the 1960s and 1970s, though they do indicate severe biological stress was placed on Chinese born in these years. Such a conclusion would fit with what we know about the impact of the GLF and the Cultural Revolution periods on demography, grain output, the collapse in food availability and the agricultural productivity.

Figs 8-9 about here

Conclusion

Famine in China after 1949 cannot be explained singularly by simple appeal to the failure of weather or FAD or government policy, but by a complex interaction of all of these elements. It is not plausible to argue, as Becker (1996) does, that Mao and the CCP leadership sought to kill the population, say in the manner analogous to that of Stalin in the 1920-30s. Mao's "crimes" may be judged severely by history, perhaps as the delusions of a visionary (for the "vision thing" was certainly a powerful driver of the policy of the period), but it does not seem reasonable to argue that his actions were, in a premeditated sense, deliberately murderous.

Reflecting on the great variety of evidence – despite the big holes in the statistical data, and uncertainties about how those data were compiled – we need an analysis that focuses on the institutional dynamics that set off events which created the famine of 1959-61. It seems to me that we need to map the nature of the entitlements that the communist state permitted its people, which denied the Chinese the ability to acquire food. These state-determined entitlements constrained the opportunities of the population so much more than would seem to be the case for people living in a market or quasi-market environment, and certainly in a democratic political environment that would have allowed the dissemination of news of such tragedies that may have prompted a change in policy or more speedy relief measures.[9] State control of grain production, procurement and distribution, along with destruction of the alternative sources of income and food that Chinese peasants had so long depended — the rural markets and food production on the household garden plot — and destruction of

[8] For the the 1979 survey, males and females > 19 years of aged (20-25); the 1985 survey, males 19-22 and females 17-22; the 1991 survey, males 18-22 and females 17-22; the 1995 and 2000 surveys, males 17-22 and females 16-22.

[9] Drèze and Sen (1995, 76) observed that "no substantial famine has ever occurred in a democratic where the government tolerates opposition, accepts the electoral process, and can be publically criticized. A government which has to deal with opposition parties, to answer unfriendly questions in parliament, to face condemnation from the public media, and to go to polls on a regular basis, simply cannot afford *not* to take prompt action to avert a threatening famine. But a non-democratic country has no such guarantee against famine." Cited in Riskin (1998, 122 n.14).

incentives structures within the collectives, are at the centre of any explanation of the GLF famine. They also explain in varying degrees the endemic hunger that characterised China until the early 1980s. The institutional change of the late 1970s and early 1980s that saw the re-introduction of household farming, in its success is an indictment of the folly of the previous two decades of policy making. The tragedy of China from the late 1950s to the early 1980s was the tragedy of state failure, no better exposed than in the perverse mapping of the entitlements regime that denied so many Chinese access to adequate food and nutrition for more than a generation.

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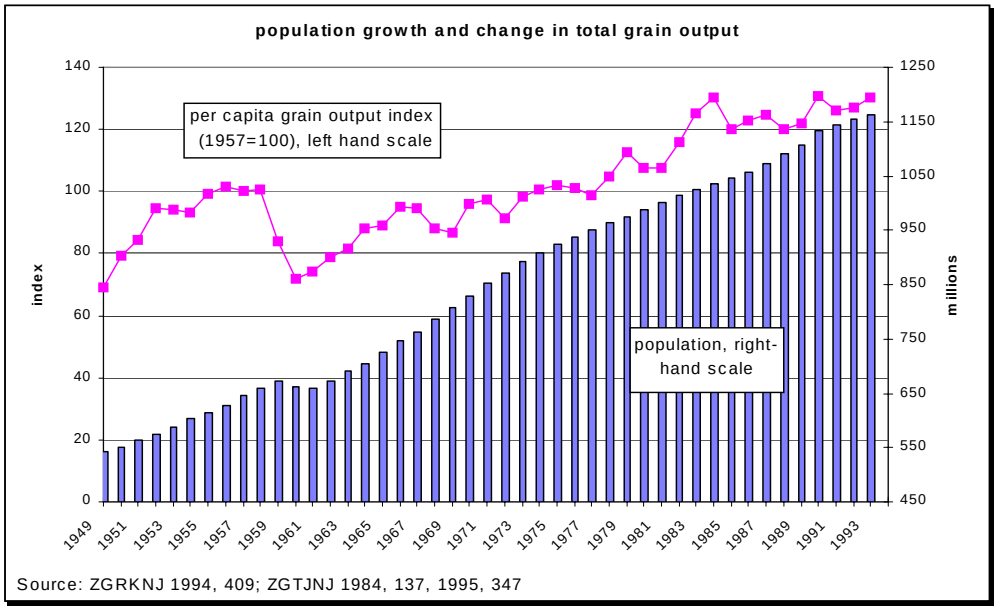

Fig 1. Per capita grain output index and China population growth

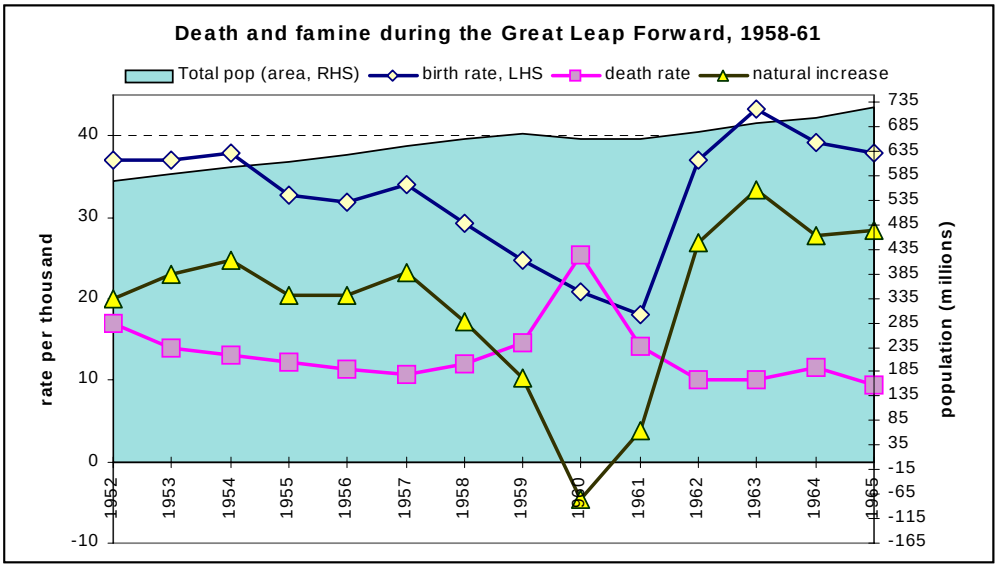

Fig 2. China GLF demographic disaster

Fig 3 Height of Chinese men born 1935-76 (annual means)

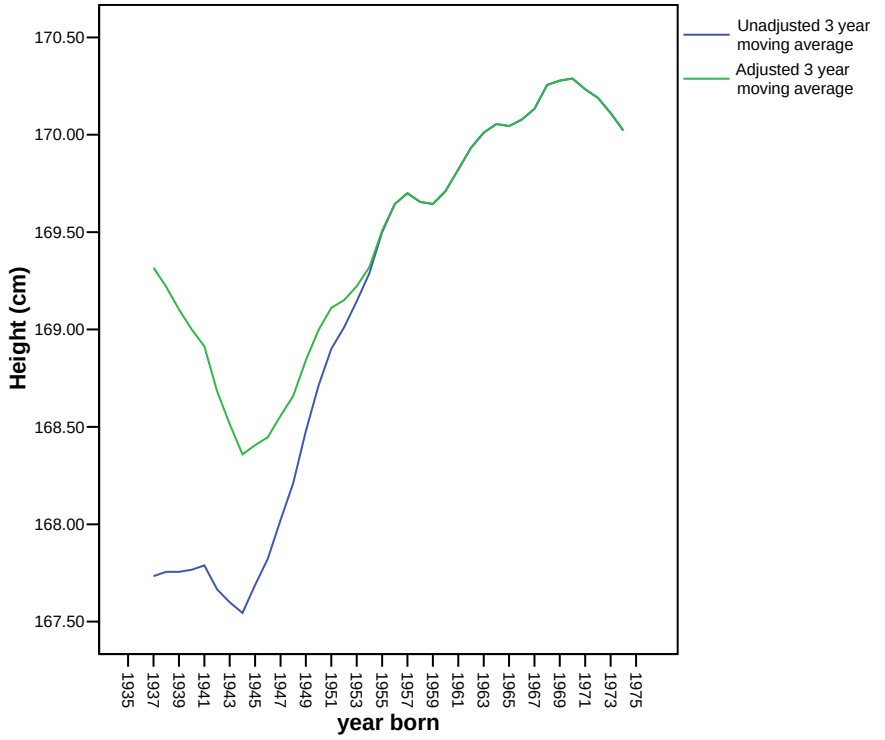

Fig 4 Height of Chinese men born 1935-76 (double-centred moving average)

Fig 5 Height of Chinese women born 1935-76 (annual means)

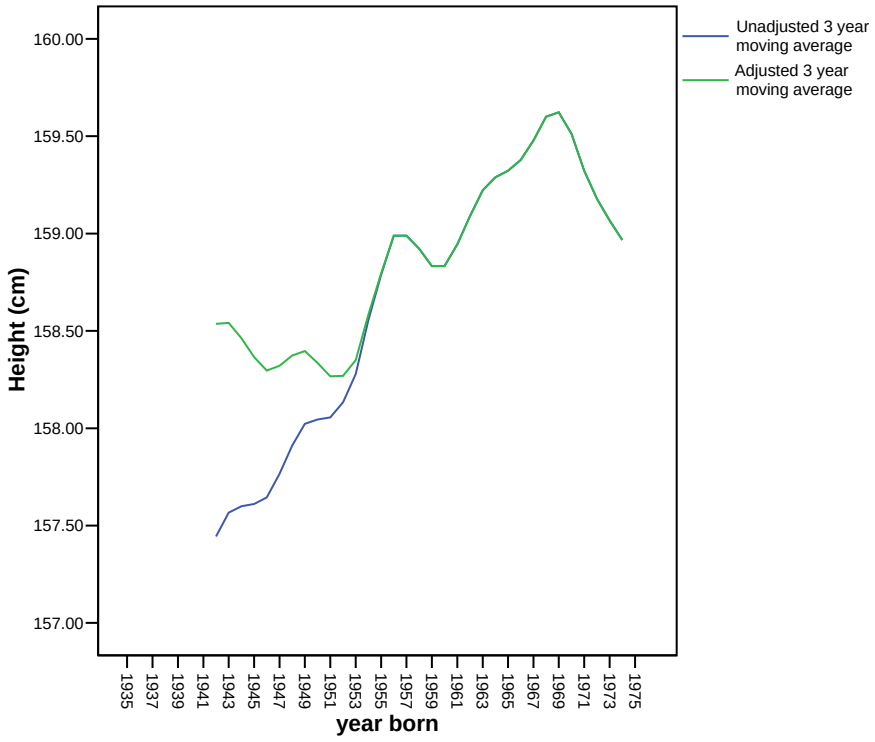

Fig 6 Height of Chinese women born 1935-76 (three-year double-centred moving average)

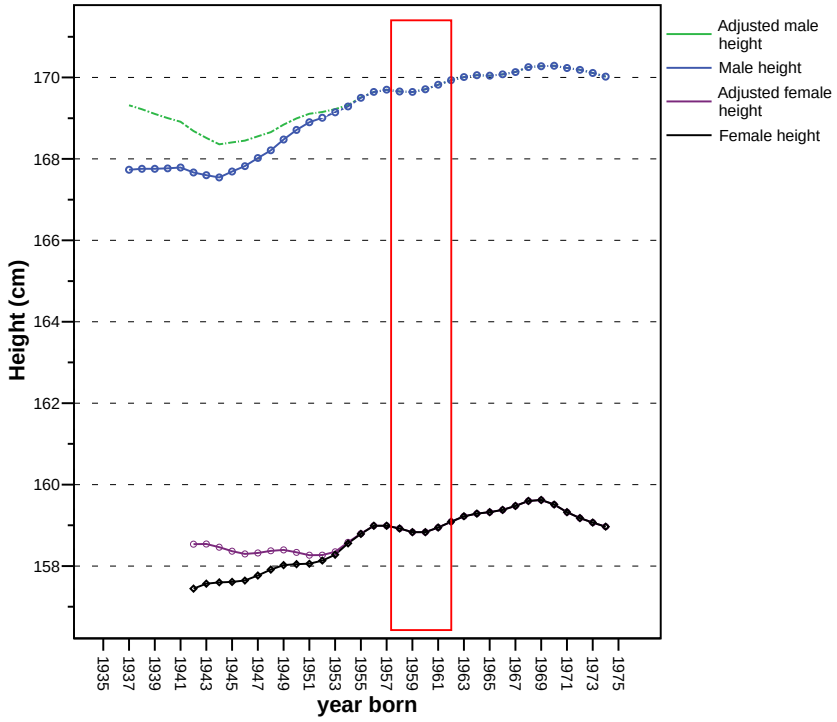

Fig 7 Average height of adult Chinese men and women ordered by year of birth (three-year doubled-centred moving average)

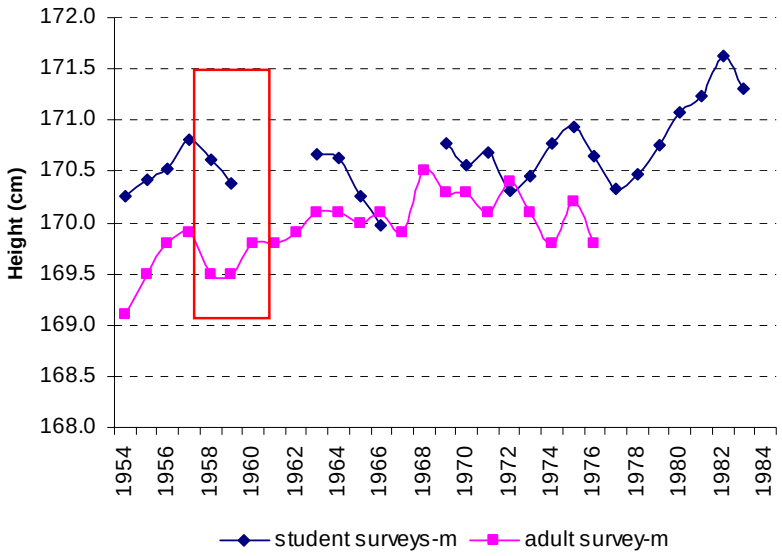

Fig 8 Change in average height of adult men 1954-84

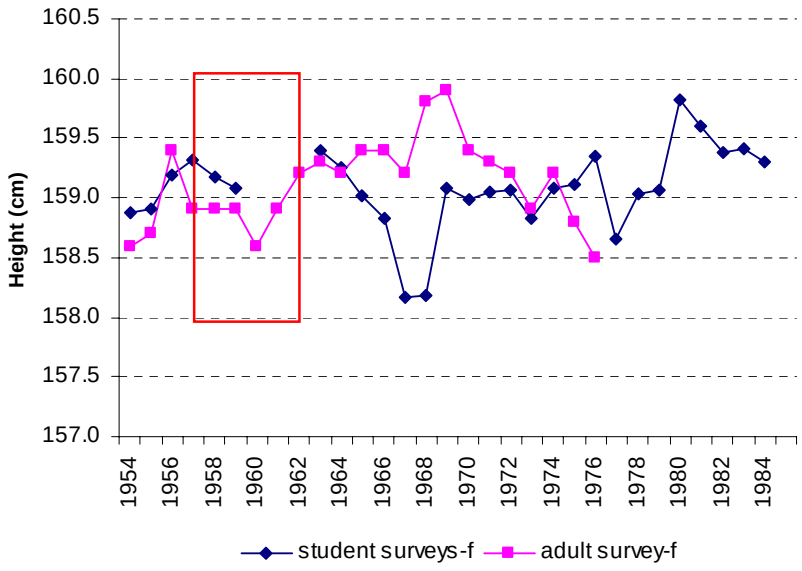

Fig 9 Change in average height of adult women 1954-84