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Nutritional Status in China during the Maoist Period (1949-76)

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NUTRITIONAL STATUS IN CHINA DURING THE MAOIST PERIOD (1949-76)

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Dedication

To the victims and survivors of the Great Flood of 1975

in Henan Province, China

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List of Acronyms

BFDP	Barefoot Doctors Program
CCP	Chinese Communist Party
CDC	Communicable Disease Control
CMS	
CPPCC	National Committee of the Chinese People's Political Consulter Conference
CR	Cultural Revolution
CV	Coefficient of Variation
GDP	Gross Domestic Product
GII	Gender Inequality Index
GLF	Great Leap Forward
EPS	Epidemic Prevention Station
FOH	Fetal Origin Hypothesis
IMR	Infant Mortality Rate
IPC	International Global Partners
MOH	Ministry of Health
NAPSS	National Administration for the Protection of State Secrets
PRC	People's Republic of China
PLA	People's Liberation Army

Chapter 1. Introduction

1. Motivation and aim of this study

In recent years China has become the world's largest economy on a purchasing power parity basis and has lifted over 800 million people out of poverty (World Bank in China 2018; Morrison 2018). A great range of publications attribute this success to the opening up of the country to foreign trade and investment and the implementation of free market-oriented economic policies since the reforms of 1978. Economic historians emphasize that modern economic growth in China started during the Maoist period (1950-76), with great achievements in human development, but high costs in terms of lives lost, social stratification, and lost opportunities to narrow the gap in standards of living and technological innovation with Western countries and Japan (Brandt, Ma, and Rawski 2014; J. C. H. Chai 2011; Chow 1993; Lardy 1983; G. G. Liu 1984; Rawski 2007; Riskin 1987a, 1987b; Harding 1987; Hengyun Ma and Sun 1987).

Maoist economic policies therefore resulted in mixed outcomes. On the one hand, their achievements in respect of economic growth and industrialization are praised as impressive. On the other hand, the period is also seen of one that was full of setbacks, with shortcomings in nutritional standards, significant regional disparities, and inequalities between rural and urban populations. Based on the most recent estimates, between 1952 and 1978 China's GDP grew at 4.4 per cent a year (Maddison 2007; D. H. Perkins and Rawski 2008).[1] While this rate is considered remarkable in comparison to earlier periods, previous studies estimate that China could have reached a 7.6 percent growth rate had it not been for the economic setbacks during the Great Leap Forward (GLF) and the Cultural Revolution (CR) (Chow 1993). The rapid progress with industrialization explains most of the increase in GDP growth rate during this period: between 1952 and 1978, Chinese industry grew at 10.1 percent a year (Maddison

[1] China's Official Statistics indicate that the country's economic growth during the Maoist period was 6.1 per cent. (J. C. H. Chai 2011; D. H. Perkins and Rawski 2008) claim that the problem with official estimates is that "they tend to overestimate the real rate of growth due to the distorted relative prices between the industrial and agricultural products".

2007).[2] But did economic gains during this period translated to an improvement of the livelihoods of the Chinese population? And, if so, were these achievements equally endure nationwide?

Mao Zedong established an egalitarian education and health system that resulted in a remarkable increase of the human development index (HDI). In the late 1970s, China, a low-income economy, surpassed the level of HDI of most middle-income economies in the world and approached those of developed countries (UNDP 1990). From 1950 to 1978, life expectancy increased from 36 years to 68 years, and the birth rate and mortality rates declined from 37 per thousand to 13 per thousand and 18 per thousand to 6 per thousand respectively (World Bank 1983). By the early 1980s, international development agencies were claiming that China was undergoing an epidemiological transition by reducing infectious diseases nationally to a remarkable extent.

However, the Maoist period failed to increase people's standards of living in some other ways. For instance, the consumption and GDP per capita growth rates (2.2 percent) remained lower than that most East Asian countries (Maddison 2007). While public consumption nationally grew slowly, private consumption actually deteriorated due to declines in workers' wages and farmers' incomes (Lardy 1983; G. G. Liu 1984).[3] Chai (2011) attributes the failure to increase standards of living in what was a growing modern economy to the inefficient use of resources at the expense of consumer welfare (J. C. H. Chai 2011). Inequality among urban and rural households separately remained low for the whole period (the Gini coefficients were 0.16 and 0.26 respectively). However, the inequality gap between the rural and the urban populations increased (Ash 2006a; Walker 1984b; Lardy 1983): urban-rural wage gap widened from 2.4 to 1 in 1952 to 3.1 to 1 in 1978 (Parish 1981; Riskin 1987b, 1987a). Moreover, urban-rural gap increased five to six times when adding welfare subsidies and benefits on top of wages. (Dillon 2015).

The hybrid outcomes in development and the economy during the Maoist period make it hard to assess the real gains in human wellbeing. The central motivation of this dissertation is to contribute to the discussion of living standards in China between 1949

[2] China's Official Statistics indicate that Chinese industry grew at a rate of 11.5 percent, but this figure has been considered overestimated since the mid-1990s (Field 1996)

[3] Between 1957 and 1978 total consumption in China increased at a rate of 1.3 percent a year (Lardy 1983)

and 1976 from both the national and regional perspectives. A great array of scholars has studied the wellbeing in China using education, economic, and demographic indicators. However, anthropometric measurements have been analyzed in a minor proportion (please see Chapter 2 for a discussion on the nutritional status in China from a historical perspective). As discussed later in this chapter, studying the levels and trends of the mean height of a population provides us with valuable information of the economic and health conditions in a particular time and location. This is relevant, considering that, despite extended research focusing in the living standards in Maoist China, many experts still put into question the reliability of the official records. Indeed, some of these issues are discussed in Chapter 3 and Chapter 4, where I find irregularities in the data provided by the national and local governments. In addition, to this day, many of the historical archives concerning the Maoist era remain closed to the public or with significant restrictions to their accessibility. This is true especially for historical records concerning the well-being of the population, especially for years of exceptional crisis such as the GLF famine or the Great Flood of 1975, which are also analyzed in this dissertation (see Chapter 4 and Chapter 5). Because the collection of anthropometric measurements in most instances does not have a political connotation, the analysis of human stature overcomes this problematic and provides valuable insights that are contrasted with the official records throughout this research.

Another interesting area of study, attained in this dissertation, is the level of inequality depicted in Maoist China. As previously mentioned, national development in some aspects of wellbeing were impressive, also from an international perspective. However, the level of improvement was subject to gender, residential location, and occupation. Such disparities happened to be a paradox to the political context of the early 1950s, where the Chinese Communist Party (CCP) rushed to develop an egalitarian welfare to overcome the pre-existing inequalities of the Republican era (1912-49) (Dillon 2015).

Campbell (1997) estimates that, in the early 1930s, males living in the urban area were expected to live 14 years longer than their counterparts in the countryside. For females, the year-gap in life expectancy between the urban and rural populations was 10 years. Therefore, some of the health improvements that characterized the Republican era favored the urban male population. Indeed, the excess of female mortality increased during the 1930s and 1940s, while the mortality among the male population declined (Campbell 1997; Jiang et al. 2012). In this context, one of the central subjects portrayed

in the political speech of the time, included the need to ameliorate the livelihoods of women by providing universal education and health, increase the resources for maternal needs, and accelerate their full inclusion into the labor force. Recent publications conclude that the increase of female education was significantly correlated to the reduction in IMR and the improvement of the biological standards of living during the Maoist period (Babiarz et al. 2015; Eng and Sohn 2020; Chae and Hatton 2021). However, to what extent the welfare system successfully reduced gender inequality is less clear. For this, in Chapter 2, I investigate not only the development of the nutritional status for the male and female populations, but to what extent the state's claim in favor of women's equity actually portrayed in reducing the gender gap in the biological standards of living.

Inequality between the rural and the urban populations is evident throughout the 20th century in China. As previously mentioned, the gap between both populations was present during the Republican era and has persisted as a problem until present times. Again, reducing the urban-rural gap prevailed as a political aim through out most of the Maoist period. However, as previously mentioned, the wage-gap widened from the early 1950s to the late 1970s. Also availability of grain and the access to certain welfare benefits and subsidies prevailed favorable in the urban areas. Because rural population and the economic activity had different weight nationwide, another objective in Chapter 2 is to investigate to what extent the nutritional status improved in the different provinces and depict the dynamic of rural and urban inequality. The findings suggest that the welfare policies implemented in Maoist China did not succeed in narrowing the gap between western and eastern regions, nor the levels of inequality between the urban and the rural populations. However, we do find a general reduction of inequality nationwide, where intra-inequality increased only among the urban populations.

Previous publications reveal that the transition towards a market-economy and the implementation of the One Child Policy, increased gender and regional inequality in the 1980s and 1990s. But the paradox remains to why an egalitarian welfare system did not succeed in reducing the regional inequality in the biological standards of living. Given that nutritional intake, the epidemiological environment, and energy consumption determine the nutritional status of a population, a third aim of this thesis is to investigate the distribution of health resources nationwide in order to arrive at an assessment of regional inequality and find the levels of association between health endowments and

the improvement of the biological standards of living. To this regard, the analysis in Chapter 3 reveals that, in general terms, the allocation of the health inputs were less significant in western regions, where the nutritional status remained at its lowest levels relative to the national average throughout the period. At a national level, we also find significant association between health and economic determinants and the gains in the nutritional status. However, the level of correlation is more significant to explain the reduction in IMR.

The political instability during the Maoist era produced significant setbacks during the GLF and the CR that resulted in humanitarian crisis. Because the wellbeing of populations deteriorates during crisis years, the fourth objective of this dissertation is to study the consequences of the most emblematic hydrological failure in world history registered in Henan Province by the end of the Maoist period. The region, mostly agrarian and with significantly high rates in population density, has been subject to recurrent natural hazards and years of famine throughout its history (see Table 5 in Appendix 1). [4] While the great famines of 1879, 1942-43, and 1959-61, have been greatly investigated, little has been published about the famine of 1975-77. In Chapter 4, I investigate the consequences of the great flood in terms of agricultural production and instability, populations' loss, and morbidity. Because the Chinese government has officially undermined the effects of the disaster, I also investigate the level of the crisis through the use of magnitude and intensity scales that are applied by international agencies in the present to evaluate the severity of famine. The findings reveal a more negative outcome than the accepted by the official sources.

Finally, the research in Chapter 5 has two main objectives. First, I investigate the levels of the nutritional status in Henan Province throughout the Maoist period. The study gives us a better understanding of the wellbeing in Henan relative to the national level. The findings reveal higher level in the biological standards of living than the rest of the country, with the exception of the years corresponding to the CR, where a significant

[4] During Imperial times, many dynasties fixed their capitals in Henan province due to its flourishing agriculture. This ceased at the end of the eighteenth century, which may be partially explained by the increase in the recurrence of natural disasters recurrence and the decline in state investment in agriculture and grain storage due to war with foreign states. Today, floods and droughts remain a constant issue in the province, together with other environmental problems, including a scarcity of water. Nonetheless, in recent decades, Henan has been one of the main agricultural provinces in China, providing great proportion of total national food stocks, being especially one of the main grain-producing provinces in the country.

setback in terms of health endowments took place in the region. The deterioration of the nutritional status during the CR has been revealing for most of the regions under study. Indeed the setbacks were more significant than during the GLF, when the most emblematic famine in world history took place. This leads me to conclude that, while the use of human stature to depict wellbeing is a valuable measure, the indicator should be taken with caution for years of severe crisis where the levels of mortality reach to extreme values. Throughout Chapter 2 and Chapter 5, I will discuss my concerns about the findings to explain nutritional status based on the cohorts born during the GLF. The second objective in Chapter 5 is to depict the effects of the Qiwu-ba famine in the nutritional status. We find a reduction of the mean height of the cohorts born during 1975-76, which corroborates the deterioration of the living standards in Henan Province as a consequence of the Great Flood of 1975.

The study focuses on the different political stages of the Maoist period. This is important, because previous studies using mean heights as a measurement of health for the same period, do not take this factor into consideration, hiding the effects of the continuous policy change that characterized Maoist China. These stages, which are explained throughout this thesis, compound the Initial Stage (1950-57), the GLF (1958-61), the Adjustment or Recovery Stage (1962-69), and the CR (1966-76). Therefore, while we find general improvements in well-being, provision of health inputs, and food production throughout the Maoist period, we also perceive great variations between the different political stages.

This dissertation contributes to the existing literature on the living standards and inequality in Maoist China. Also, the case study of Henan Province provides new findings on the consequences of the Great Flood of 1975, indicating that the last famine registered in China was not during the GLF, but at the end of the CR.

In the following sections, I will discuss the sources, the different indicators to evaluate well-being, and finally, present an overview of the economic growth and well-being in China and Henan Province between the early 1950s to the mid-1970s.

2. Sources

For the anthropometric analysis, this thesis uses the dataset from the China Health and Nutrition Survey (CHNS).[5] Data collection was conducted by the Carolina Population Center at the University of North Carolina at Chapel Hill and the National Institute for Nutrition and Health (NINH, former National Institute of Nutrition and Food Safety) at the Chinese Center for Disease Control and Prevention (CCDC). The survey was designed to examine the effects of the health, nutrition, and family- planning policies and programs implemented by national and local governments and to determine how the social and economic transformation of Chinese society is affecting the health and nutritional status of its population. The survey has been periodically conducted from 1989 until today, the last survey occurring in 2015. However, in this dissertation we use the available datasets for the years up to 2011.[6] The survey includes data for nine provinces: Jiangsu, Henan, Hubei, Hunan, Guangxi, Guizhou, Shandong, Liaoning (missing from the 1997 survey), and Heilongjiang (added in 1997), and thee major cities: Beijing, Shanghai, and Chongqing (all three cities included in 2011). All these locations vary geographically, and in their economic and demographic conditions. This variety makes this sample representative of China as a whole, even though it only covers half the provinces in the country (see Figure 1).[7]

The survey, which includes records on health and nutrition, as well as economic, and education indicators, is based on a sample of approximately 7,200 households and 30,000 individuals. Most of these individuals have been surveyed periodically in each of the years when the study was conducted. However, not all survey years record the same individuals. There are two reasons for this. First, some individuals are omitted from the sample because of either migration or death. A second reason is the late incorporation of an individual into the sample due to improvements in the survey, the incorporation of new members of a household, or the inclusion and withdrawal of provinces and cities in

[5] This research uses data from China Health and Nutrition Survey (CHNS). We thank the National Institute of Nutrition and Food Safety, China Center for Disease Control and Prevention, Carolina Population Center, the University of North Carolina at Chapel Hill, the NIH (R01-HD30880, DK056350, and R01-HD38700) and the Fogarty International Center, NIH for financial support for the CHNS data collection and analysis files from 1989 to 2006 and both parties plus the China-Japan Friendship Hospital, Ministry of Health for support for CHNS 2009 and future surveys

[6] The survey of 2015 has been recently opened to the public (May 2018), and I intend to include this new data in the near future

[7] Despite western provinces are under-represented in our dataset, the available data still allows us to analyze the nutritional status of Guizhou and Chongqing, which, as we will reveal in our findings, gives us evidence of the underdeveloped conditions of the western regions.

the sample for the past 25 years. The survey includes both children and adults. Since the aim of this dissertation is to examine the Maoist period, we only use the mean height of adults, which gives us valuable information about the cohorts born during this period.

Figure 1. Map of the CHNS regions

Source:*http://www.cpc.unc.edu/projects/china/about/proj_desc/chinamap_600.jpg/view*

Note: provinces included here but not mentioned in the text correspond to the 2015 survey, which is not used in this study.

In addition, I use official and primary sources to study the allocation of health resources, the agricultural production, and the levels on mortality at a national, provincial, and prefectural level.

The Comprehensive Statistical Data and Materials on 50 years of New China (1950-1998) (Xin Zhongguo Wushi Nian Tongji Ziliao Huibian; 新中国五十年统计资料汇编), offers extensive statistical data on

economic and social development indicators compiled by the National Bureau of Statistics. This records, allowed me to study the allocation of health resources at a national and at a provincial level. Another valuable source to study the allocation of health inputs and the levels IMR is a new dataset that include health and economic records obtained from the Provincial Archive of Public Health Records (Weishengzi), the China Statistical Data Compilation (1949-2003), and the 1988 National Survey of Fertility and Contraception.[8] This new dataset was developed by the Stanford University and Central University of Finance and Economics. Only recently has this dataset been available to the public. In this thesis, I cite the publication of Babiartz et al. (2015) to refer to this dataset.

The Statistical Yearbook of Henan Province (1985) (*Henan Tongji Nianjian*; 河南统计年鉴), contains quantitative data for the years between 1949 and 1985 concerning population and agricultural output. The Henan gazetteers (1985) (*Henan Sheng Zhi*; 河南省志), offers detailed information about natural disasters and population between 1950 and 1985. The Henan chronicles (1949-1985) (*Henan Tong Jian*; 河南通鉴), offers specific historical events on a monthly basis from 1949 to 1985. The qualitative data recorded in this chronicles provides with better understanding of the political situation and the political campaigns developed during the Maoist period.

Finally, to study the Qiwu-ba flood, I rely very much on the Zhumadian prefecture gazetteers (1950-1985) (*Zhumadian Diqu Zhi*; 驻马店地区志), which offers both quantitative and qualitative data for the region and specific information on the disaster of 1975.

3. How to measure well-being?

3.1. Measurements of well-being

[8] This new dataset developed by the Stanford University and Central University of Finance and Economics has recently been available to the public. The dataset includes health records at a provincial level from 1950 to 1988. Find additional information at (Babiarz et al. 2015). I kindly thank the authors for giving me direct access to the dataset Mao Mortality Analysis.

Well-being is a multidimensional concept that tries to depict the level of satisfaction of an individual or a society. Because different components may determine life-satisfaction, the OECD's Better Life Initiative set three factors to understand and measure people's well-being (OECD 2020). First, an economic approach that entails the material living conditions and that allows a society to consume the available resources (for example, GDP per capita, wages, or housing). Second, a non-monetary approach that relies on measuring the quality of life, by having individual conditions such as health status, education and skills, or personal security, among others. Such conditions shape the opportunities of an individual in life and therefore have a direct relationship with the levels of satisfaction. Finally, the third component of this framework entails sustainability of the socio-economic and the environment where an individual or societies live. This approach assures the well-being overtime.

In the past, well-being was most commonly studied based on GDP per capita. However, while this indicator is important to understand the monetary dimension and material of welfare within a country or a society, history has shown that economic growth is not always associated to the improvements on the quality of life (Zalm et al. 2014; Gallardo-Albarrán 2019; Prados de la Escosura 2019). For that, other indicators have been appropriately analyzed to understand the dynamics of the well-being. Education, for example, has proven to be an important component to increase the level of satisfaction of individuals and societies. That is, because the advance in education allows to access to better jobs, but more importantly, gives the pertinent knowledge to make choices that have positive association to the increase of satisfaction levels. In this regards, several studies have proven that the increase in the levels of education are strongly correlated to variables such as income or the decline in the mortality rates, especially for infants (Rijpma 2014). In more recent years, the quality of political institutions and the environment have also gained weight to determine the levels of life-satisfaction.

Several indicators are used to measure the key dimension of health. Life expectancy, for example, provides information on the extents of the quality of life. Several studies indicate that, overtime, life expectancy is strongly and negatively correlated to the IMR and mortality rate. That is, because mortality rates reflect the health conditions within a region. As we will discuss in Subsection 3.2, human stature is another indicator of health, which, as previously mentioned, it will be used in this research (Chapter 2 and

Chapter 5), together with figures of IMR (Chapter 3) and the estimates of population loss (Chapter 4).

Because well-being is a multidimensional concept, in recent years there has been an attempt to measure well-being based on composite indexes that consider more than one variable. Such indexes allow comparing different countries from a historical perspective, and depict the relevance of each of the components of well-being throughout time (Prados de la Escosura 2013; Rijpma 2014; Gallardo-Albarrán 2019; Prados de la Escosura 2019). For example, Prados de la Escosura (2019), by applying the Augmented Human Development Index (composed by income, schooling, life expectancy, and level of democracy), concludes that, despite the gains in health during the first half of the 20th century in China, the major improvements were made during the Maoist period. This is also true for the expansion in education, despite the setbacks during the CR, the lack of democracy, and lower gains in income. Such gains in health and education not representative after the new economic reforms, where well-being was more likely explained by the gains in income. The human stature of different birth cohorts, allows us not only to depict the trends in the long run, but also to measure inequality between the distinct populations in China.[9]

In the following subsection I discuss the relevance of using human stature as an indicator of well-being.

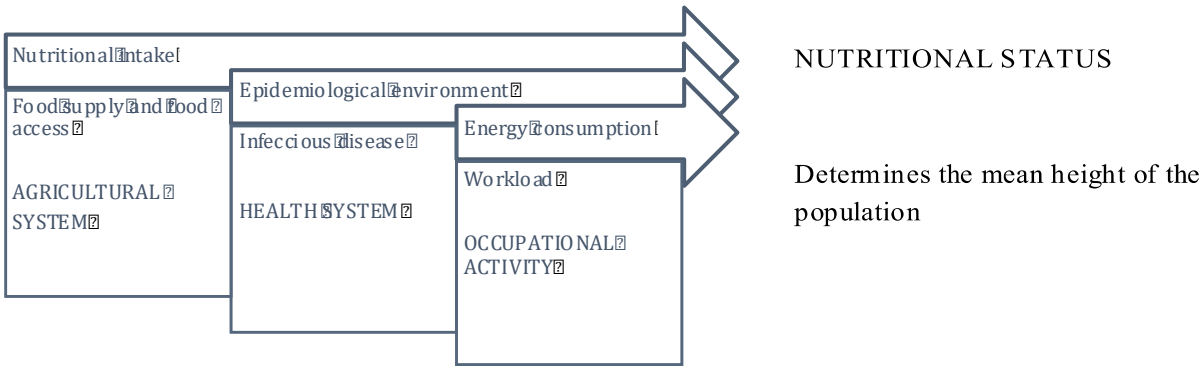
3.2.Human stature

Assessing the average height of a population allows net nutrition to be measured, taking into account both the inputs to health, such as nutrition and health care, and the demands placed on an individual's biological system, such as exposure to disease or the intensity of the workload during the years of the growth of a population (see the determinants of nutritional status in Figure 2). Previous studies pointed out that "nutritional status is a net measure; it represents the energy which has been used for growth once the demand of body maintenance, resistance to disease, play and work

[9] Please notice that new composite indexes consider inequality (see (Gallardo-Albarrán 2019)) and this opens a new window to explore in the near future the case of China.

have been satisfied" (Floud et al. 2011). Therefore, the mean height of a population can be used as an additional indicator to measure the standard of living at a specific location and time, supplementing other evidence such as indexes of real wages, measures of food consumption, and estimates of per capita income.

Figure 2. Determinants of nutritional status



Note: While in open market economies food supply will depend also on international trade, for the case of China I mostly concentrate on the agricultural system, since the major source of grain during this period was based on national production. For further discussion about food imports during the 1950s to the 1970s, see Section 5.1 of this chapter.

Source: Author's own elaboration

Adult height is primarily determined in the first years of life and during gestation (Cole 2000; Waterlow 1994; Karlberg 1989; Floud et al. 2011). Specific illnesses incurred during the growing stage will most likely slow growth. Only representative improvements in the caloric and nutritional intake make it possible to catch one's height up in adolescence. The "catch-up" stage lasts through the years of adolescence to which an individual is, once again, exposed to potential physical growth. The growth stage is different in girls and boys, starting at an earlier age in the case of the former (Hermanussen, Burmeister, and Burkhardt 1995; Eveleth and Tanner 1990). While some studies show that there is significant genetic differentiation among the world's populations regarding when one reaches one's final height, most studies show that it is environmental conditions that best explain height variations between different populations (Gunnel et al. 2004, 2003; Steckel 1995; Harris 1993; Tanner et al. 1982; Schmitt and Harrison 1988; Habicht et al. 1974; Eveleth and Tanner 1990). This allows for long-term analysis of height across different spatial locations. In sum, human height,

as an indicator of well-being, takes account for the fact that some economic activity is non-monetized and therefore is left unmeasured by conventional indicators of living standards (Brainerd 2010; Fogel et al. 1983; J. Komlos 1985, 1989, 1993).

The use of heights as an indicator of well-being has been criticized by some economists who claim that this indicator is not an argument in a utility function (Engerman 1997). However, not only could this argument be applied to other health indicators such as life expectancy, this indicator has also been widely accepted by other economists who claim that the mean height of a population can indeed be seen as one aspect of the accumulation of human capital. This is because, as (Floud et al. 2011) point out, "parents certainly do desire health and growth for their children and are prepared to make sacrifices of income to attain this". In addition, the determinants of height (health, nutritional intake, and workload) contribute strongly to the welfare of a population (Hobsbawm 1963). Therefore, "standard of living, quality of life, and nutritional status are all different but intimately related concepts which are useful in measuring human welfare" (Floud et al. 2011).

Despite the validity of this indicator to measure well-being, there are several studies that indicate that periods of sever demographic crisis, human stature may indicate misleading information about the environmental conditions. In other words, extreme levels of mortality may have a selection effect on the final height average for the birth cohorts born during famine years (see Chapter 5 for a discussion on the topic).

4. Previous assessments of economic growth and wellbeing during the Maoist period

4.1. China

After the establishment of the PRC in October 1949, the government adopted a command economy. From 1953 to 1957 China implemented policies based on the Soviet model of rapid industrialization and collectivization in agriculture. Following the Feldman model, the objective was to develop heavy industry by maximizing investment

and accelerating the growth of industries producing consumer goods (Chai, 2011).[10] Annual investment rates during the Maoist period ranged from 24 per cent to 33 per cent, except for the ensuing years of the GLF (1962-65), when the rate of increase fell to between 10 and 20 per cent (Department of Comprehensive Statistics of National Bureau of Statistics 1999).[11] The great investment in the secondary sector led to a remarkable increase of the industry's share of GDP, which rose from 11.6 percent in 1952 to 33.7 percent in 1978 (Maddison 1998). As a turn out, agriculture's share of GDP declined from 51 per cent to 28 per cent in the same period.

The spectacular increase in investment in heavy industry during this period revealed that this Asian country was even more eager to follow the Feldman model than the USSR, with greater governmental decentralization (J. Chai 2011). Table 1 shows that during the whole period there was significant investment in heavy industry, showing also a different model of industrialization than Hong Kong and Taiwan, which successfully developed their economy by investing on the light industry (Naughton 2018). As a result, the government aimed to generate a maximum push for consumption to grow at a fast pace to maximize the long-term growth rate of the national economy. As Mao pointed out in 1957 at a meeting of socialist nations in Moscow, China aimed to overtake Great Britain as an industrialized power within fifteen years (Chang and Halliday 2005; Y. Yang 2009). Later on, this target was reduced to a three-year period, while an additional aim was announced to overtake American industrialization within seven years (J. Chai 2011; Y. Yang 2009).

Table 1. Share of investment in industry and agriculture from total government expenditure (%)

	Heavy industry	Light industry	Industry	Agriculture
1953-57	47	6	53	6
1958-62	56	5	61	15
1963-65	50	4	54	19
1966-70	61	4	65	9

[10] The concept of investment rate in China refers to the ratio between capital accumulation and national income (rate of capital accumulation)

[11] During the Republican period (1931-36) the annual investment rate was 5 per cent (Chai 2011)

1971-75	55	5	60	12
1976-78	55	7	62	14

Note: The remaining share of investment includes social spending (education, health, pensions, and other), as well as defense expenditure, and relief for areas affected by natural disasters

Source: Author's own elaboration from (Hengyun Ma and Sun 1987; Department of Comprehensive Statistics of National Bureau of Statistics 1999)

One other objective of industrialization was to build heavy machinery for the first sector. For that, it was necessary to have an initial stage in which agricultural producer co-operatives would gradually be created. The post-1949 campaign was based on a radical land reform that destroyed the previous political and economic system based on the landlord-gentry class, where at least 200 million acres of land were expropriated and distributed to at least 75 million peasant families (Gray 1990). This policy was an initial institutional change that would later lead to a system of full collectivization in the countryside. According to Chai, the ultimate determinant of agricultural policy throughout the Maoist period, especially since the implementation of the GLF policies, was to empower industrialization in urban areas by providing them with the agricultural surplus produced by rural population, that is, transferring food and raw materials from the latter to the former (J. C. H. Chai 2011). However, the process led false reporting of grain deficiencies in the rural areas and destroyed peasant's incentives, leading to humanitarian crisis such as the Great Famine (Kueh 1995; Gray 1990). This institutionalized ideology to push the secondary sector lasted until the beginning of the 1970s, when Maoist policies began to focus on an open market, including imports of raw materials and grain from other countries to support industrialization in China (Teiwes, F. ; Sun 2015). Only during the recovery stage (1962-65), government's investment shifted towards agriculture. Nonetheless, the major share of governmental expenditure still exceeded significantly the share of investment towards the primary sector (see Table1).

The imposed policy of food extraction on Chinese peasants in the 1950s led to low food welfare in rural areas (see Table 2) (L. Li 2007; Ash 2006a; Lardy 1983). The inequality gap in grain consumption decreased by 3.2 per cent in rural areas between 1957 and 1979, while in urban areas it increased by 10.5 per cent (Lardy 1983). (Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)(Lardy

1983)(Lardy 1983)(Lardy 1983)(Lardy 1983)Figures in Table 2 indicate that this process left peasants with low subsistence levels until the beginning of the 1960s.[12] In some provinces, grain availability decreased to 171 kg per capita during the famine caused by the GLF,[13] where the rate of grain extraction reached 49 percent (J. Yang 2012; Walker 1984a; L. Li 2007). Meanwhile, net procurement in urban areas reached 308 kg per capita, after deducing the 3 million tons exported to allied countries (Becker 1996; Dikotter 2010; Walker 1984a). The failure of the GLF policies led to reorient the agricultural system towards a more decentralized model in favor to increase peasant's income benefits, based on the expansion of private plots, rural trade fairs, and sided economic activities (Kueh 1995). However, the so-called *san zi yi bao* system, while still existent during the CR, it disappeared in practice under the anti-right campaign implemented by Mao. In the mid-1960s, the launch of agricultural modernization increased national yields, yet with unstable consequences in some regions, especially in the North-west and North-east (Kueh 1995). Self-sufficiency in grain reached a reasonable level in the adjustment stage (1962-65) and boosted in the first half of the 1970s.

It is extremely important to consider the functioning of the agricultural system in Maoist China to understand well-being, given that grain availability depended mainly from the domestic market. Than is not to say that imports were not relevant. Indeed, during the Initial and GLF stages, China had a grain trade surplus, despite the decline in output production in the late 1950s. This situation aggravated the famine conditions between 1959 and 1961. After that, China changed from a net exporter to a net importer of grain. Still, imports never exceeded 5 per cent of domestic production (Jowett 1985).[14]

Table 2. Output and availability of grain per capita in rural China (1953-75)

Year	Output of grain per capita of	Availability of grain per capita

[12] Based on Walker's benchmark, 200 kg of unhusked grain, after provision for seed and livestock feed, could provide between 1,200 and 1,400 calories per capita. The benchmark for proper levels of self-sufficient grain is 275 kg, which could provide between 1,700 and 1,900 calories per capita (Walker 1984b).

[13] See Figure 6 in Appendix 1.

[14] In the 1980s, China became dependent on the foreign market to provide food at anational level, which may explain the abolishment of famine conditions in China in the past forty decades.

	agricultural population (raw weight in kg)	of agricultural population (raw weight in kg)
1953-1957	337	238
1958-1962	301	238
1963-1965	320	275
1966-1970	337	275
1971-1975	367	316

Source: Author's own elaboration from Ash (2006)

Another important aspect to consider for this study is the development of the welfare system implemented in the early 1950s with the aim to provide egalitarian social requirements (such as healthcare, education, pensions, maternity programs, among others) and improve national well-being. With the eyes towards Western countries, China started to debate deeply in the establishment of a welfare system since the beginning of the 1920s, but the development of the welfare state did not really get into practice until the establishment of the PRC (Dillon 2015).[15] The rapid investment in public goods translated into fast achievements in the decline in the birth rate (from 33 per mil in 1954 to 18 per mil in 1978) and the mortality rate (from 42 per mil in 1954 to 22 per mil in 1978) (see Figure 3).[16] Also, Figure 3 indicates that the infant mortality rate in China declined from 81 per thousand to 25 per thousand between 1953 and 1976. However, sharp fluctuations in infant mortality during the GLF are also evident, and provincial disparities were significant as well.[17] Previous studies conclude that the achievements in reducing IMR was significantly correlated to the spread of education and the allocation of some health resources such as clinics (Babiarz et al. 2015).

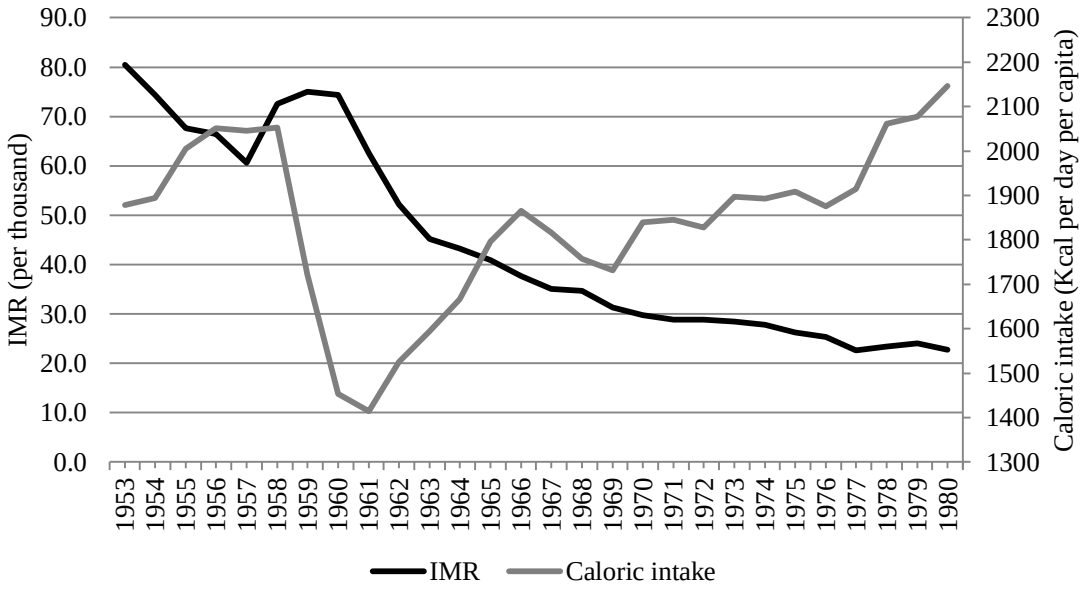
[15] Please notice that investment in public health had already taken place in the beginning of the 20th century. However, in relative terms, the universalization of the welfare system was developed in the mid-20th century.

[16] Some scholars identify the health transition in China at the beginning of the 20th century, where significant improvements in the reduction in prevalence of some infectious diseases were representative in reducing mortality rates (Campbell 1997; Riley 2005).However, to my knowledge, these improvements were mainly in major cities. While during the Maoist period, the pace tin mortality reduction was different for every province, we do find a general decline nationwide, especially foe children under 5 years. That is why there is a general consensus to identify the Chinese demographic transition in the mid-20th century, and not during the Republican Era. (Andrews and Bullok 2014). Therefore, in this dissertation we will identify the demographic transition since the 1950s, even though

[17] See Figure 9 in Appendix 1.

The same pattern is noticeable regarding caloric intake (see Figure 3). Indeed a scissors effect is evident from the mid-1960s, coinciding with the modernization of the primary sector. Note in Figure 3 that the highest figures concerning caloric intake are registered during the initial stage (1949-57), when they reached over 2,000 kcal/per day/capita, before falling to their lowest during the GLF of 1,400 kcal/per day/capita. While there was evidently an increase in caloric intake in China after the Great famine the early period of the CR is represented by a period of stagnation, only exceeding 1,900 kcal/per day/capita after 1973, when a more favorable market, better prices, and production incentives led to an increase in agricultural output. Figures did not reach the levels of the early 1950s until the beginning of the economic reforms in the late 1970s, when price incentives were improved.

Figure 3. IMR and caloric intake in China (1953-80)



Source: Author's own elaboration, for Caloric intake (FAOSTAT, n.d.); For IMR (Babiarz et al. 2015)

From an international perspective, the annual growth in GDP per capita in China between 1950 and 1976 exceeded that of the United States, though it remained lower than economic growth in the OECD countries and the USSR (see Table 3). Comparisons with other Asian countries indicate that annual growth in GDP per capita was higher in China than in India, though significantly lower than Japanese growth rates. China also fell behind neighboring regions that were engaging in the process of industrialization, such as South Korea and Taiwan. Household consumption records

display a more favorable picture for China: annual growth exceeded that of the United States, and the OECD countries between 1950 and 1980 (note that before the economic reforms, the annual growth in household consumption in China was slightly lower; see Table 3). While consumption growth is evident from the records, it should be borne in mind that the initial stage of consumption in China started from lower levels relative to those in the United States and the OECD countries, resulting in a much lower ranking in absolute terms.

Table 3. China's economic performance in comparison to other countries (annual growth %)

	GDP per capita (1950-76)	Household consumption per capita (1950-80)
China	2,4	3,8 (3,1)**
USSR	3,0	3,7
USA	2,1	2,1
OECD (European)	3,3*	3,2
India	1,4	-
Japan	6,9	-

Source: Author's estimates. For GDP per capita, (Groningen Growth and Development Centre 2018), and (Brainerd 2010) for OECD countries. For Household Consumption, (Department of Comprehensive Statistics of National Bureau of Statistics 1999) and (Brainerd 2010) for USSR, USA, and OECD countries. Notes: *annual growth from 1950 to 1980. **from 1952 to 1980; from 1952 to 1976 in parenthesis.

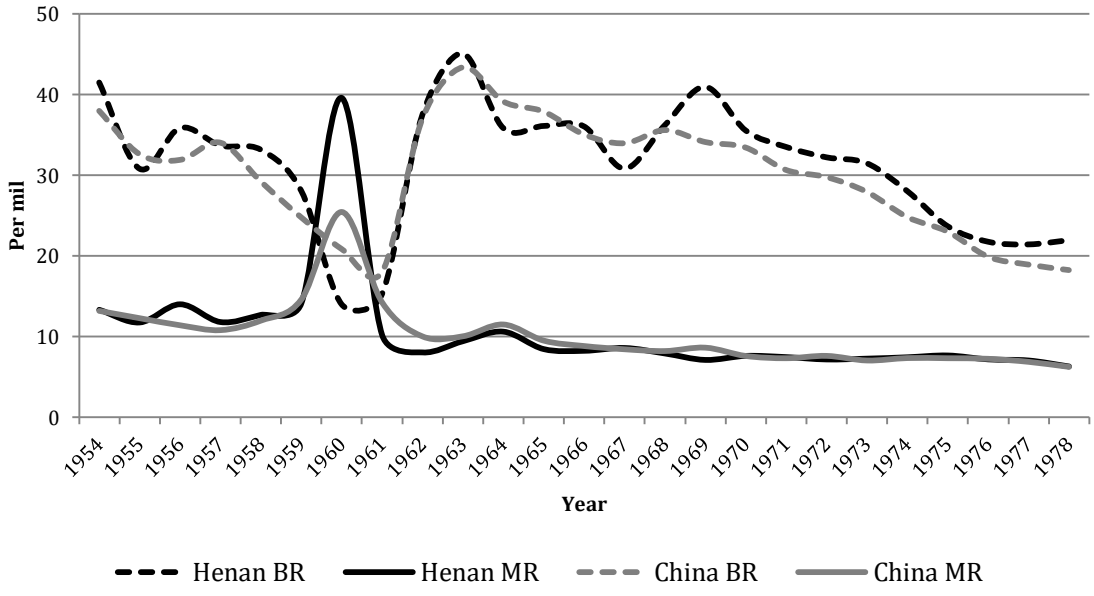
4.2. Henan Province

Between 1952 and 1978 Henan Province remained as the second most populated province in China, after Guangdong Province. In terms of GDP, Henan stood as a middle-income region throughout the Maoist era. However, in terms of GDP per capita, the region remained to the same levels as western provinces such as Yunnan and Sichuan provinces. Despite being one of the provinces with higher agricultural output, Henan persisted under national average in terms of grain availability (see Figure 6 in

Appendix 1). Indeed, during the GLF, Henan was as one of the regions with lower per capita grain availability. Famine conditions in Henan Province were common since the Dynastic times. While some famines were man-made, the recurrence of natural disasters in the region played an important role in the constants agricultural instability (see Table 5 in Appendix 1). The overflow of the Yellow River, the Huai River, and the Hai River was a recurrent problem, which led to the over-construction of dikes and dams that resulted into a greater constrain to avoid the development of famine conditions (see Chapter 4).

Despite the low economic standards of the region, the mortality rate in Henan province decreased by 46 per cent, from 13.3 per thousand in 1954 to 7.2 per thousand in 1976 (see Figure 4). Due especially to the introduction of population policies ("later, longer, fewer"), the birth rate decreased by 48 per cent, from 41.5 per thousand in 1954 to 21.7 in 1976. This, among others, was one of the political decisions taken after the devastating outcome of the GLF, during which the mortality rate in the province reached 40 per thousand and the birth rate reached 14 per thousand.

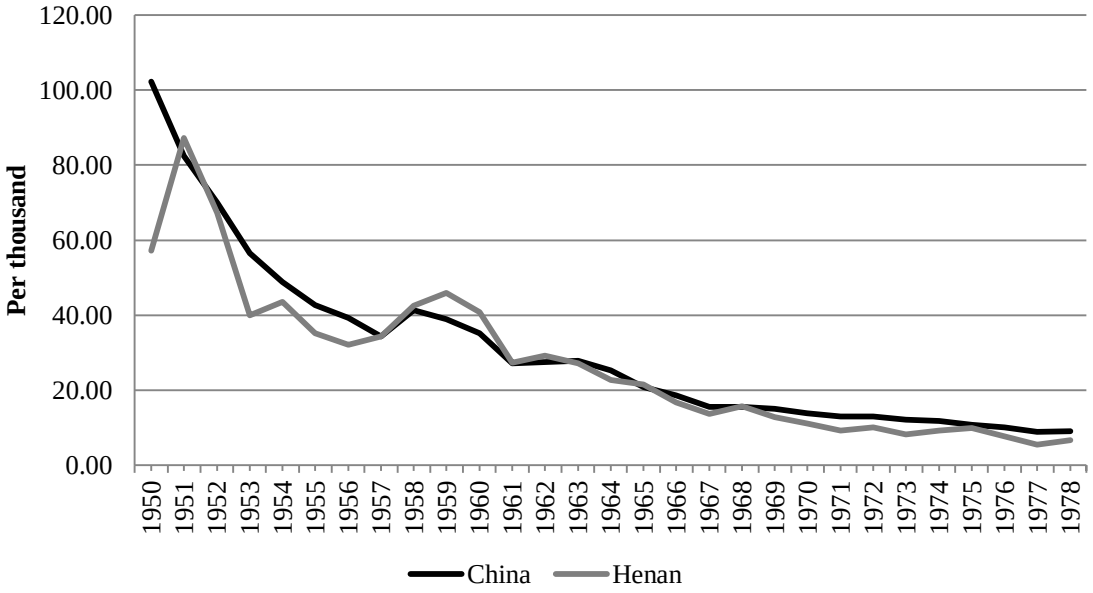
Figure 4. The demographic transition in China and Henan Province (1954-89)



Source: For Henan province, (Henan Tongji Nianjian 1985 [Henan Statistical Yearbook 1985] 1986); For China, (Department of Comprehensive Statistics of National Bureau of Statistics 1999)

Previous studies show that the main explanation for the initial stage of the demographic transition is the reduction in the infant mortality rate (IMR). Figure 5 shows the decreasing pattern in the mortality rate for children under five years of age at both the national and provincial levels. From 1950 to 1978 the rate decreased by 8.3 per cent in China generally and 7.4 per cent in Henan province. Progress in reducing IMR depended on the implementation of health policies focused on the reduction of infectious diseases, the increase in the number of midwives and in women's education, and hygienic improvements. Note that in most of this period the IMR for children under five years of age in Henan province was lower than the national average, with the exception of the GLF period, when Henan's rate was 11 per cent above the national average, reaching a figure of 46 per thousand in 1960. However, for 1975 I estimate a 7.3 per cent increase in the IMR for children under five years of age over the previous year, even though the national average fell by 5.7 per cent. Indeed, the rate in Henan province reached almost the same rate as the national level. This suggests that the anomaly of the 1975 humanitarian crisis in Henan province can be isolated as a particular case in China and deserves academic attention.

Figure 5. Mortality rate for children under 5 years of age in China and Henan Province (1951-80)



Sources: Author's own elaboration based on the dataset provided by (Babiarz et al. 2015), based on the Provincial Archive of Public Health Records (Weishengzi).

Nutritional intake in the province also improved, yet it was only in the mid-1950s that we may say that the required caloric intake of 2,100 kcal/day/person was reached (see Table 4). The trend from the early 1950s to the mid-1970s was a small increase from 1,764 kcal/day/person to 1,823 kcal/day/person. I lack information for the period of the GLF. However, national data shows that in 1961, by the end of the famine, the caloric intake was only 1,426 kcal/day/person. If taking into account the fact that Henan province was one of those most severely affected by the famine, I can assume that the levels of nutritional intake were even lower in this particular province. Indeed, in 1965, during the recovery period, the caloric intake had still not reached 1,500 kcal/day/person. Also, as indicated in Figure 6 (Appendix 1), the levels of grain availability per capita were lower than 200 kg/person, suggesting that the caloric intake was under 1200 Kcal. In the early 1970s, however, there was a clear recovery in the nutritional intake in the province, which reached the level of the daily-required caloric intake. Yet, by the mid-1970s these improvements had ceased and even gone into reverse. While during this period, such figures were considered sufficient to count as "self-sufficient" grain standards for the Chinese authorities, the extreme physical labor to which the population was exposed suggests that "a total calorie requirement of 2,100 per head of total population might be regarded as conservative standard" (Walker 1997). The implication of this assumption is that any external shock would affect the health conditions of the population to a major degree. This topic and a more extendeded work on the wellbeign in Henan province will elaborated in Chapter 4 and Chapter 5, where the use of new data and new methodology will allow to the depict the conditions of the population in Henan.

Table 4. Caloric intake (Kcal per day per capita) in HenanProvince and China

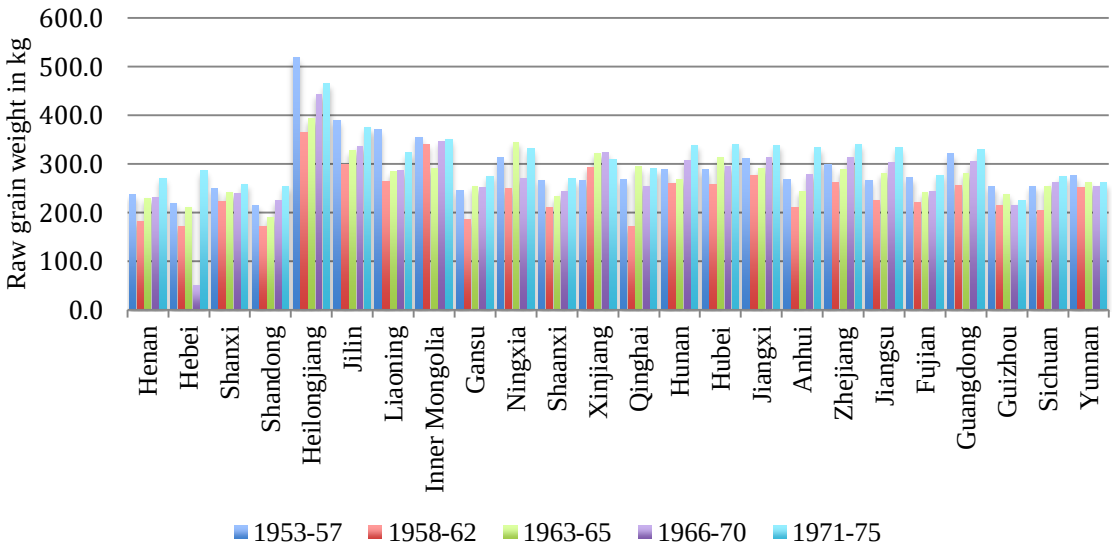
Year	China	Henan Province
1953	1,879	1,764
1954	1,895	1,809
1955	2,005	1,915
1956	2,051	2,088
1957	2,045	1,843
1958	2,053	-
1959	1,722	-

1960	1,453	-
1961	1,415	-
1962	1,526	-
1963	1,594	-
1964	1,666	-
1965	1,797	1,445
1966	1,865	-
1967	1,817	-
1968	1,758	-
1969	1,731	-
1970	1,840	1,858
1971	1,845	1,965
1972	1,828	1,930
1973	1,897	1,939
1974	1,893	1,733
1975	1,909	1,823
1976	1,875	-
1977	1,914	-
1978	2,062	-
1979	2,077	-
1980	2,146	-

Source: For China, data taken from (Food and Agriculture Organization of the United Nations 2017); For Henan province, data taken from (Walker 1997)

Appendix 1

Figure 6. Provincial availability of grain per capita of agricultural population (1953-75)



Source: Author's elaboration based on Ash (2006)

Figure 7. IMR by province (1950-90)

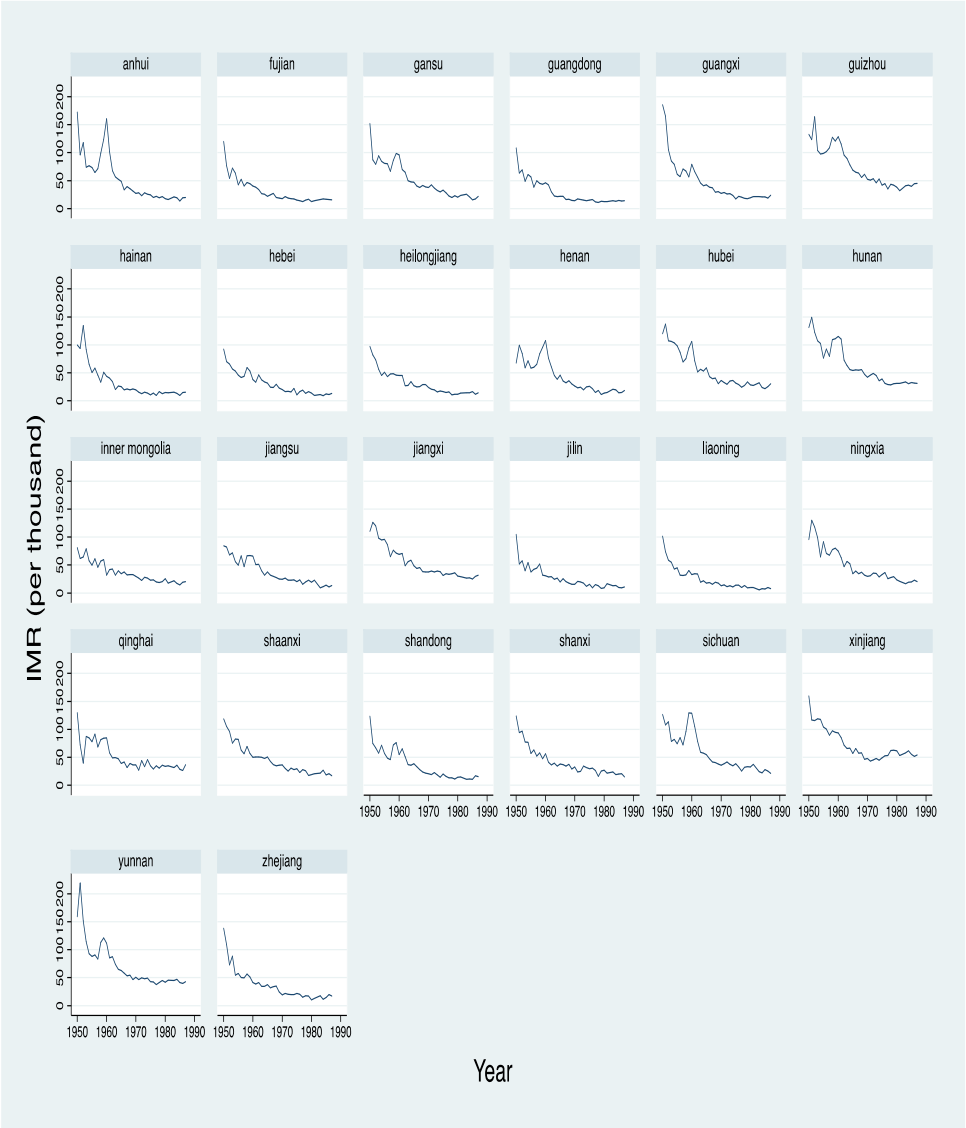


Table 5. Frequancy of natural disasters and famine years in Henan province (620-2014)

Dynasty/State	Total droughts	Recurrence of droughts	Total floods	Recurrence of floods	Total of other natural disasters*	Recurrence of other natural disasters	Total of famines	Total famine years
Tang Dynasty (620-907)	14	1 every 20 to 21 years	12	1 every 24 years	4	-	1	1
Five dynasties and Ten Kingdoms (908-960)	4	1 every 13 years	-	-	-	-	-	1
Song Dynasty (961-1271)	57	1 every 5 to 6 years	9	1 every 34 to 35 years	3	-	-	-
Yuan Dynasty (1272-1368)	27	1 every 3 to 4 years	2	1 every 48 to 49 years	4	1 every 24 years	5	5
Ming Dynasty (1369-1643)	19	1 every 14 to 15 years	12	1 every 23 years	18	1 every 15 years	8	14
Qing Dynasty (1644-1911)	30	1 every 9 years	57	1 every 4 to 5 years	58	1 every 4 to 5 years	8	14
Republic of China (1912-1948)	4	1 every 9 years	7	1 every 5 years	7	1 every 5 years	3	8
People's Republic of China (1949-2014)	44	1 every 1 to 2 years	38	1 every 1 to 2 years	19	1 every 3 to 4 years	2	6
TOTAL	199	1 every 7 years	137	1 every 10 years	113	1 every 12 years	27	49

Source: Data from Hosie, Alex (1878) "Droughts in China, A.D. 620 to 1643". *Journal of the North-China Branch of the Royal Asiatic Society*, New series No. XII. Shanghai: Celestial Empire Office; Zhang Gaochen (2010) *GuangXu chao (1875-1908) zaihuang yanjiu [Research on the Famine of Guangxu Times, 1875-1908]*. Shangdong: Shandong University Doctoral Dissertation; Henan Annals (1949-2012); Zhumadian Chronicles (1949-85). *Notes:* For other natural disasters we refer to hail, earthquakes, locust, high winds, and sand storms

Chapter 2. Biological Living Standards in Maoist China

1. Introduction

The establishment of the People's Republic of China (PRC) in 1949 represented an era of change in the history of the country. After the economic decline since the end of the Qing Dynasty in the nineteenth century and the constant internal wars and conflicts in the first half of the twentieth century, Mao Zedong's primary objectives were to raise living standards and remove inequalities nationwide. To achieve these objectives, the Chinese Communist Party (CCP) followed the USSR model during the first stage of the regime and centralized the economy. As a result, the new Chinese government concentrated on developing of the heavy industry in a bid to overtake the British and Americans in terms of economic growth, introducing a land reform to allegedly improve the agricultural sector so it could feed its people and support the industrial sector, and finally establishing a universal education and health system.

While many of the policies implemented during this period proved to be failures, such as the commune system during the GLF and the education system during the Cultural Revolution (CR), this period showed many other positive outcomes. In this chapter, I use the stature of the Chinese population to measure standards of living during the Maoist period. The mean height of the population allows us to understand its nutritional status. Therefore, as a measure of well-being, human stature gives us information not only about the supply of economic inputs but also their demand (Steckel 1995). This is relevant given that on many occasions the reliability and quality of economic data during the Maoist period has been called into question, leading to puzzling conclusions about the country's economic development. This underscores the importance of using anthropometric indicators as an alternative measure to examine the well-being of the Chinese population during this particular period. This study focuses in three central

questions. First, did biological living standards increase during the Maoist period? Second, was inter and intra-provincial inequality gap narrowed during this period? And finally, did the welfare state achieved reducing the gender gap and urban-rural gap.

To answer these questions, I will use the mean height of adult cohorts born between 1950 and 1976. The data have been gathered from the China Health and Nutrition Survey (CHNS), which have been conducted in twelve different regions of China since 1989.[18] This allows us to overcome specific problems with data reliability during the Maoist period. As Morgan points out, "anthropometric techniques provide a valuable insight into economic growth and change during periods of rapid transitions, and in circumstances where conventional data for measurement of economic well-being is often missing, of poor quality, or difficult to interpret due to price distortions and difficult to capture non-market effects such as subsidies and public transfers" (Morgan 2000). All these features might apply to the case of China during the Maoist period.

Previous publications, discussed in section 2, use stature to understand standards of living in China from a historical perspective, but few studies have concentrated on specific trends in the Maoist period. Even then, these studies do not rely on yearly data for the whole period, but concentrate in specific stages within the Maoist period. Therefore, the motivation to conduct this study is to provide new evidence on the nutritional status in Maoist China, from 1950 to 1976, concerning the four political stages (initial stage, GLF, adjustment stage, and the CR). This chapter contributes to the literature by studying the trend of Chines population's stature yearly. In addition, from my knowledge, the existing studies about the Maoist period have not revealed the existing inequality trends within provinces, gender, and settlement. In conclusion, this chapter offers new findings versus other publications that analyze the Maoist period by using more traditional economic and health indicators.

The records used in this study produce four major findings, some of them confirming past studies concerning wellbeing. First, there was a representative increase in biological living standards during the Maoist period. Indeed, a comparison of our data with those for other countries in the world shows that, while the gap between China and the West widened with respect to biological living standards during the Maoist period, the mean heights of the Chinese population exceeded the mean heights of other Asian

countries such as Japan and India. Second, the gap in nutritional status between the urban and rural populations widened from the initial stage to the end of the Maoist period.

The findings in this paper also that the improvements in the nutritional status between 1950 and 1976 are not consistent during the whole period and it differs among provinces, gender, and settlement, which leads to the third conclusion in this chapter when calculating the coefficients of variation (CV) and the Gender Inequality Index (GII). First, I estimate a height difference of 8.3 and 7.3 cm between the more prosperous regions of China (Beijing and Shanghai respectively) and the most impoverished (Guizhou and Chongqing province). However, inter-provincial and intra-provincial inequality in the nutritional status decreased during this period. Inequality among male, female, and rural populations also decreased, but abruptly increased among the urban population. Interestingly, the gender gap increased throughout the period. Only during the GLF we depict a significant inequality reduction between male and female populations, as well as between the rural and the urban populations. Finally, the CR is the period with the highest deterioration in biological living standards, in terms of growth and inequality among the different populations. Cosidering the GLF stage as the period with greater mortality rates, our findings suggest that selection effect blurs the

This chapter is divided into eight sections. Section 3 exposes the main ideas concerning biological standards in China within a literature review. Section 4 explains the data selection used in the research. Section 5 describes the methodology applied to estimate inequality of the nutritional status in China. Section 6 describes the trends in the mean heights of the Chinese populations during the Maoist period. Section 7 discusses the findings in respect to the nutritional status inequality. Finally, section 8 offers the chapter's conclusions.

3.Nutritional status in China in the long-run

Records of stature in China date back to the nineteenth century. Most records are those of Chinese immigrants to Australia, the American continent, and other Asian countries

in the mid-nineteenth and early twentieth centuries; prison records and railroad archives in the first half of the twentieth century; and medical and school records in the same century. However, not so many records are available for the Maoist period. As previously mentioned, most studies of biological living standards in China concentrate on the late Qing Dynasty (1800-1911), the Republican era (1912-1949), and the period after the economic reforms of the late 1970s, little having been published for the Maoist period. Moreover, most publications focusing on the Maoist period have studied the health consequences of the GLF famine (1959-61) using human stature as a proxy for health. Therefore, few articles have investigated the trends for this period from a historical perspective.

There is a general consensus that the mean height of the Chinese population fell in the nineteenth century, especially after 1850, due to internal turmoil and foreign interventions that weakened the national economy (Morgan 2009; Carson 2007, 2006; Joerg Baten and Hira 2008; Joerg Baten et al. 2010).[19] In the first three decades of the twentieth century, the mean height of the Chinese population increased with the fall of the dynastic regime and a higher concentration in the industrial sector (Morgan 2004). However, after 1930 the trend decreased once again due to the economic instability, that was a consequence of the Civil War (1927-49) and the Japanese War (1937-45) (Ward 2013; Joerg Baten et al. 2010; Zhen-Wang and Ji 2005; Morgan 2004; Carson 2007).

The main findings for the Maoist period highlight the improvements to biological living standards during the early 1950s, with a rapid deterioration during the GLF (T., X., and Vaithianathan R. 2010; Ji and Chen 2008; Morgan 2007, 1998; H. Li et al. 2011; Zhen-Wang and Ji 2005). Morgan points out that the recovery stage started in the mid-1960s, mainly due to the developments in public health, rather than the improvements in nutritional intake (Morgan 1998). Also, Schwekendiek stresses that the mean height of children in the 1960s in China was similar to the mean heights of children in Japan and South Korea (D. J. Schwekendiek 2016). However, recent studies conclude that such resemblance was only among the female populations, and that the stature of the male

[19] Most of these studies use height records from populations in Southern regions, which migrated to the U.S., Australia, and Indonesia. The destination factor seems to have influenced on the population's height difference when comparing heights, resulting in better biological standards for those who migrated to the U.S. and Australia than those who migrated to Indonesia. The difference is based on two possible explanations. First, better skilled workers tended to migrates to the U.S. and Australia. Second, Chinese who migrated to the U.S. and Australia in their adolescent years and early twenties may have catch up in terms of heights due to better nutritional intake after they had migrated from China.

cohorts was substantially higher in South Korea than in China (a difference of 2 cm to 4 cm) (Daniel Schwekendiek and Baten 2019b). This same study indicates that gender inequality in China was low in the 1960s and 1970s, and suffered a substantial increase after the implementation of the ne new economic reforms in the 1980s. In spite of these findings, by the end of the Maoist period rural-urban inequality was significant: the stunting measure was more than three times greater in rural than in urban areas (International Bank for Reconstruction and Development 1981). Latest studies find social spending (on education and health) and parental education as significant factors to explain the improvements of the biological standards of living in Maoist China (Daniel Schwekendiek and Baten 2019b; Chae, Hatton, and Meng 2021).

The increase in the mean height of the population became more evident after the economic reforms of the late 1970s, when the net nutrition of the Chinese population improved. Indeed, representative increases in biological living standards were evident for most provinces between the mid-1980s and the mid-1990s (C. Chen 2000; Morgan 2000; Daniel Schwekendiek and Baten 2019b; Chae, Hatton, and Meng 2021). However, most studies also demonstrate the permanence of the inequalities between provinces and of the growing gap between the rural and urban populations (Zhai et al. 2004; Shen, Habicht, and Chang 1996; H. Li et al. 2011; Morgan 2000; D. J. Schwekendiek 2016). Also, most recent findings indicate that the One Child Policy implemented in China after the economic reforms resulted to have a significant effect on the deterioration of the nutritional status for the female populations (Chae, Hatton, and Meng 2021).

As shown in the previous paragraphs, not many publications have concentrated on the biological living standards in Maoist China. While most studies analyze the GLF famine, to my knowledge, there are no studies focusing in the Maoist period as whole.[20] In this sense, the present chapter gives a more accurate perspective of the tendencies, improvements, and inequalities in the biological living standards from 1950 to 1976, allowing having a better perspective of the different stages within the Maoist period. Another contribution of this chapter is the use of heights distinguishing between male

[20] The study that gives a more approximate perspective of the biological living standards in Maoist China is partially base on the CHNS data, however instead of using the height indicator, the study uses the mean age at menarche of women. The study concentrates on the period from 1880s to the early 2000s and concludes that the biological living standards started to improve since the beginning of the Maoist period, constantly increasing until present times (Eng and Sohn 2020). The reasons of improvement from 1950 to the 1970s are attributed to the expansion of women's education and the improvement in health policies.

and female populations, and between rural and urban populations for China. While some of the studies previously mentioned also analyzed gender and settlement data, these are rather concentrated only in one geographical area within China or in one stage within the Maoist period. Also, creating birth-cohorts born in the different political stages of this period, allows for a better understanding of the policies that had a greater effect in the nutritional status of the Chinese population.

4. Data selection

Numerous researchers have used the CHNS dataset to conduct a vast range of studies on the nutritional and health status of the Chinese population. However, most of these studies focus on welfare conditions in recent decades. Only some of the literature provides a historical perspective, studying the population born between 1956 and 1964 to investigate the effects of the famine resulting from the GLF (1958-61). Therefore, contrary to previous publications, I use these data to investigate biological living standards during the Maoist period, allowing for a greater perspective of the nutritional status during the whole stage. To collect a great number of observations, I create a new dataset by gathering the data from every survey conducted from 1989 to 2011.

I first select all adult individuals in the sample from 1989 to 2011 age 21 to 50 years old. I use this age range assuming that individuals younger than 21 years may still be in the growing phase and individuals older than 50 years may be in the shrinking phase (Bogin 1999; Eveleth and Tanner 1990). Other studies consider the growth stage of stature to end at age 22 and therefore include only individuals over 23 years in the analysis. However, in addition to the literature that supports age 21 as the benchmark for growth, we should also be aware that not all ethnic groups have the same growth stages. For this reason, I have revised the records of heights and found no variation in stature between individuals at age 21 and age 23, meaning that the growth stage within this dataset ends at age 21. This selection allows creating birth cohorts from 1939 to 1990. However, to focus on the Maoist period, I use mainly those cohorts born between 1949 and 1978.[21]

[21] While a comparative analysis of the Maoist period with the before and after periods is relevant, I have decided to concentrate on the study of the Maoist period in this article and to leave the comparative study for future research. Only when comparing the different provinces have I also

Also, while the CCP came to power in October 1949, I set the starting have fixed 1950 as the year in which my analysis starts so as to leave out of the analysis those individuals who were conceived during the last year of the Republican era (see Figure 18 in Appendix 2 for the distribution of the data sample).

As previously mentioned, my sample includes all nine surveys (1989-2011). This allows including as many observations as possible, comprising those excluded and included in later years. I only include the adult population, and any individual who has no height record is deleted from the dataset. Also, outliers are removed from the sample (heights shorter than 140 cm and taller than 200 cm). Because many of the individuals documented in the sample have been measured in some or all of the surveys, I also delete any repeated observations. If I detect different height records for the same individual over the years, I consider this to be a typographical error, and I use the measure that has been logged the most frequently over the years. If the recorded height measurement has a considerable variation over time, I set aside the possibility that the individual has grown or shrunk over the years based on previous assumptions. Therefore, I take the latest measure recorded in the sample, assuming that the measuring procedure and the recording of the data have improved over the years.

After the data selection process, my sample totals 13,885 observations, including height records for over 6,000 males (46.4 per cent of the sample) and over 7,000 females (53.6 per cent of the sample) (see Table 6). The rural population represents 62 percent of the sample, the urban population 38 per cent. Note the mean height difference of 2.2 cm between the urban and rural populations in the Summary Statistics displayed in Table 1, which suggests an inequality gap between the two populations during the period under study. Except for Beijing, Shanghai, and Chongqing, each province represents about ten

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included the records for the Republican era and the immediate period after the economic reforms. I have two justifications for this decision. First, there are some anomalies in the data recorded in the 1997 and 2000 surveys for cohorts born between 1982 and 1990 (see Appendix, Figure C). Contrary to other birth cohorts and surveys conducted in other years, these birth cohorts consist of individuals who were only measured either in 1997 or 2000. In Figure 19 (Appendix 2) we destinguish a decline of 14 cm and 20 cm respectively from the mid-1980s to the end of this decade. This pattern is not shown in the remaining surveys, where in fact most birth cohorts born between 1980 and 1990 were measured at least twice from 1989 to 2011. The pattern in the remaining surveys shows an upward trend that corresponds with the findings in other studies, which show an increase in the mean height of children measured after the economic reforms in 1978 (Morgan 2000). Therefore, these data deserve further analysis for the future period. However, it is worth highlighting that from 1939 to 1949 the mean height of the Chinese population increased by 2.4 cm, while from 1939 to 1976 it increased by 5 cm.

per cent of the total sample. The fact that the three administrative cities represent the late incorporation of these cohorts explains no more than three per cent of the sample in the CHNS survey. As expected, Beijing and Shanghai both record the highest mean heights in the sample (166.8 cm and 165.6 cm, respectively). Note that data for the administrative cities are available only from 1961, due to the late incorporation of these regions in the conducted surveys.[22]

Table 6. Summary statistics

	Observations	Share from total sample (%)	Mean	Std. Dev.	Min	Max
Settlement						
Urban	5308	38.2	163.5	8.2	140	193.6
Rural	8577	61.8	161.3	8	140	189
Gender						
Male	6440	46.4	168	6.3	142.1	193.6
Female	7445	53.6	157.1	5.7	140	178
Province						
Beijing	470	3.4	166.8	8.1	145	193.6
Liaoning	1410	10.2	164.6	7.5	140	187.4
Heilongjiang	1185	8.5	164.9	7.9	144.7	189
Shanghai	372	2.7	165.6	8	146	185.2
Jiangsu	1406	10.1	162.8	8	140	186
Shandong	1364	9.8	164.4	7.6	140	190
Henan	1448	10.4	162.6	7.8	140	186.5
Hubei	1327	9.6	161.3	7.8	141	186
Hunan	1421	10.2	161.2	7.6	140	185
Guangxi	1449	10.4	159.1	7.5	140	186.5
Guizhou	1625	11.7	157.9	7.8	140	183.2
Chongqing	408	2.9	159.8	7.5	140.1	179.4
Total sample	**13885**	**100**	**162.2**	**8.1**	**140**	**193.6**

[22] For detailed explanation see Chapter 1

5. Methodology

5.1. Measurements to estimate inter and intra-inequality

A great array of scholars has analyzed inequality based on anthropometric measures to have a better understanding distribution of wellbeing (Joerg Baten 2000; Pradham, Sahn, and Younger 2003; Fraunholz and Baten 2004; Moradi and Baten 2005; Deaton 2008; Blum 2011; J. Baten and Blum 2012; Blum 2013; García 2014; Yong Xu and Hang 2017; Ramon-Muñoz and Ramon-Muñoz 2018; Martínez-carrión and Salvatore 2019; Cámara, Martínez-carrión, and Ramon-Muñoz 2019). In past studies, height inequality has been analyzed by different measurements: standard deviations, the Theil entropy index, the Gini coefficient, centimeters differences of specific populations relative to the national mean height (inter-inequality), and the coefficients of variation (intra-inequality)

In this chapter I will use inter and intra-inequality measurements. For the later, coefficients of variation have been proven to be a robust estimator. First, previous findings indicate a strong correlation between the CV and the differences in average height of diverse social and occupational groups (Joerg Baten 2000). This allows studying inequality without having to rely on the economic status classification of the individuals measured in the surveys. Second, previous studies have find a high correlations between CV and the Theil entropy index and the Gini coefficient (Fraunholz and Baten 2004; Moradi and Baten 2005). The former confirms the use of CV as a measurement of health inequality, the latest proves the interaction between economic and height inequality. On this regard, it makes sense that disparities in income within a country would favor the well-off population to have a greater access to food purchase and healthcare, widening the gap relative to the low-income group. While this association may be less significant in communist countries, such assumption is relevant for this study considering that not only income and welfare benefits were inconsistent between the rural and urban populations, but also within the cities major economic and welfares differences existed between the government officials, permanent laborers, and the workers employed in the collective sector (Dillon 2015).

In sum, using the CV allows us to measure the existent inequalities within each of the regions under study, as well as within the different population groups: rural, urban, male, and female (see Section 8). On the other hand, in Section 7 I measure inter-regional inequality by calculating the difference in centimeters between the better-off and worse-off regions, as well as in relation to the national mean height.

5.2. Gender Inequality Index

The measurements of height inequality indicated in the previous sub-section are not suitable to analyze the gender inequality due to sexual dimorphism. The biological component assumes two particular factors. First, males are often taller than females. Second, the size of dimorphisms increases with the growth of stature. Therefore, the widening of the gender gap in terms of height does not necessarily imply an increase in inequality. In recent years scholars have developed different methodologies in order to overcome sexual dimorphism when analyzing gender height inequality. In this study I apply the height GII, which is based on the Gender Development Index (GDI).[23] To my knowledge, this is the most recent and accurate type of measurement to estimate height inequality between the male and the female populations. The formula to estimate GII is as follows:

$$GI_h = H_m - H_f - (-33.75 + 0.276 * H_{mf})$$

Where H_m and H_f are the height values for males and females respectively, H_{mf} is the average height of both genders, and GI_h represents the gender inequality of height.

6. Trends in adult heights (birth cohorts 1949-76)

6.1. Chinese mean heights in an international comparison (1930-80)

[23] For more information on the elaboration of the GII, refer to (Daniel Schwekendiek and Baten 2019a)

Before analyzing the data for the Maoist period, I conducted a comparative analysis of my data with other sources used in previous publications. Note that in Table 7 that data for mean heights for China in the Clio Infra database are much higher in comparison to the new data used in this chapter. Based on the information given by Clio Infra, the figures in this database are taken from different sources and correspond only to the male population.[24] In this chapter, I have compared the figures with my data considering the total population (China**) and the male-only population (China***). In both cases, the mean heights shown in my database are much lower.[25]

However, the growth rate in human stature during this period is considerably higher in my sample. The Clio Infra database shows that the increase to the mean height in China between 1940 and 1980 is 4.1 cm. Based on the CHNS data, the increase during the four decades is also 4.1 cm when looking at the total population and 5.7 cm when considering only the male population. For the Maoist period, the comparison with the figures in the Clio Infra dataset suggests a variation of between 2.7 cm and 7.6 cm in the 1950s, 2.7 cm and 7.7 cm in the 1960s, and 1.5 cm and 8 cm in the 1970s. While the tendency seems to be the same, the difference between the two databases suggests new interpretations, which will be discussed in the following paragraphs.

Table 7. Mean height of the male population in different countries (1930-1980)

Country/Year	1930	1940	1950	1960	1970	1980
Netherlands	174.1	177.5	178.7	182.2	182.3	182.7
Kingdom	173.9	174.9	176	176.9	177.1	176.8
Italy	168.1	169.3	171.3	173	174.1	174.5
Japan	161.4	162.6	163.6	165.7	166.8	171.7
Spain	165.2	166.3	170.8	174.2	175.2	175.6
India	163.7	164.1	163.5	163.9	164.3	164.4
Russia	167.9	169	172	173.6	177	177
China*	166.5	167.4	169.2	170	170	171.5
China**	-	158.0	161.6	162.3	162	162.4
China***	-	163.7	166.5	167.5	168.5	169.4

[24] Unfortunately, and for the specific case of China, sources are not always specified. See references and sources cited at (Clio Infra 2013).

[25] It would be good to compare both sources, however, as mentioned in footnote 9, I found no specific reference on this specific source.

Sources and Notes: Clio Infra for all countries, including China* (there are no specifics about this data, but we assume it refers only to the male population). **Author's own calculation of total population based on CHNS data; ***Author's own calculation of male population based on CHNS data; [(a)] To have sufficient observations, the calculation is based on the height of individuals born in 1939 and 1940.

Next, I compare the mean heights in different countries in order to understand the position of China internationally in terms of nutritional status.[26] Previous studies indicate that the improvements in health in Europe begun in the second half of the nineteenth and the beginning of the twentieth centuries and the epidemiological transition spread after World War II (Deaton 2015; Hatton 2011). The figures displayed in Table 7 show a clear inequality gap in terms of nutritional status between the European and Asian continents throughout the twentieth century. While both regions improved their nutritional status, this was higher in Europe than in Asia: from 1940, when I have data for all countries, to 1980 the mean height of the male population in Europe increased by 7.5 cm, while in Asia it increased by 5.7 cm.[27] Therefore, the inequality gap between the two continents was higher in the 1980s (7.4 cm) than the 1940s (5.6 cm), although the decade with the greatest inequality gap in terms of nutritional status is the 1970s, when it reached 10.2 cm.

Within Asia, the records in both datasets (Clio Infra and my own) displayed in Table 7 show that during the Maoist period the mean height of the male population in China was always higher than in India or Japan. In the case of India, the inequality gap in nutritional status increased throughout the second half of the twentieth century. Indeed, the height difference between the two countries in the 1950s was 3 cm, while in 1980 it reached 5 cm. The variance between China and Japan is the inverse, meaning that the gap was reduced between 1950 (2.9 cm) and 1970 (1.7 cm). However, according to my dataset, in 1980 the mean height of the male population in Japan was 2.3 cm higher than in China, widening the inequality gap once again. The increase in height on Japan

[26] For simplification, we only gathered the information for five European countries and three Asian countries. Also notice that, because there are no specifics about the sources for China in the Clio Infra dataset, the comparative analysis will be based on the data for male population from the CHNS dataset (which is representative nationwide, as previously mentioned) and the data of male population from the Clio Infra dataset for the remaining countries.

[27] It is worth noticing that some studies attribute the difference between some Asian and European countries to the change in nutritional patterns and the "milk hypothesis." For further explanations see (Bogin 1999) p. 277-81

between 1970 and 1980 (4.9 cm) explains the great inequality gap between the two countries.

6.2. China

The trend in the mean height of the total population in China during the Maoist period shows a positive slope (see Figure 8).[28] However, the increase is of only 1.20 cm (*P= 0,000*); the mean height of the cohort born in 1950 is 161.4 cm, and that of the cohort born in 1976 is 162.6 cm.[29] While these findings corroborate the evidence of health improvements during the period, along with the other health indicators described in in Chapter 1, it is clear that the Maoist period experienced phases of fluctuation and stagnation. The minimum values were recorded in 1951 (160.3 cm) and 1954 (160.4 cm), both years hit by great floods nationwide. On the other hand, the maximum value is in 1963 (163.0 cm), when there was a representative increase in the fertility rate, reflecting the social and economic recovery that came after the failure of the GLF. Indeed, all mean heights of cohorts born within the adjustment stage from1962 to 1965 are above 162.0 cm.

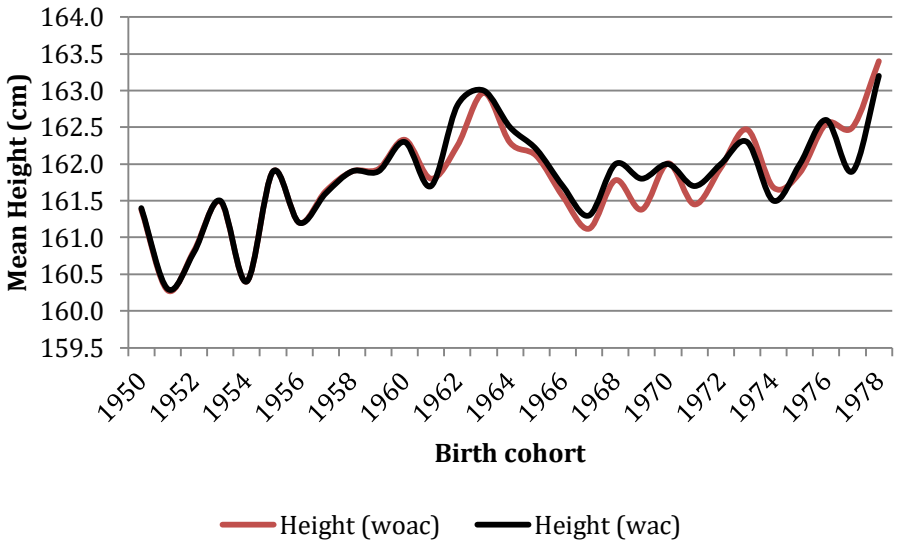
Figure 8 shows that the period of the CR is characterized by total stagnation and even a significant decrease at the beginning of the period, which was also one of severe political repression (*P= 0,001*). This finding is relevant because the previous literature has stressed that, while political turmoil and backwardness characterized the CR when it came to education, within the health system the introduction of the barefoot doctors was described as a success story (Shi 1993; Smith 2000). The evidence of this article proves otherwise. The mean height of the total population would not exceed 163.0 cm until the introduction of the new economic reforms in 1978. Plausible explanations to why these results are different to previous studies will be discussed in Chapter 3, which concentrates on health inputs and distribution in Maoist China. Yet, I should highlight

[28] The graph includes the mean height in China with and without the administrative cities to show the effect of the introduction of the administrative cities in 1961, as explained in Section 3.

[29] While the Communist Party was finally victorious on October 1st, 1949, I do not consider this year representative of the Maoist period. On the other hand, while the new economic reforms were not implemented until 1978, I chose 1976 as the end of the Maoist period after the death of Mao Zedong on September 9th of that year.

the difficulty to interpret the trend of the mean height during the whole Maoist period, considering that high infant mortality rate during the GLF have a positive effect in height due to a selection effect (for further discussion on this point, please see Chapter 5).

Figure 8. Trend of average height in China, birth cohorts of 1950-78



Source: Author's elaboration based on CHNS records (1989-2011)

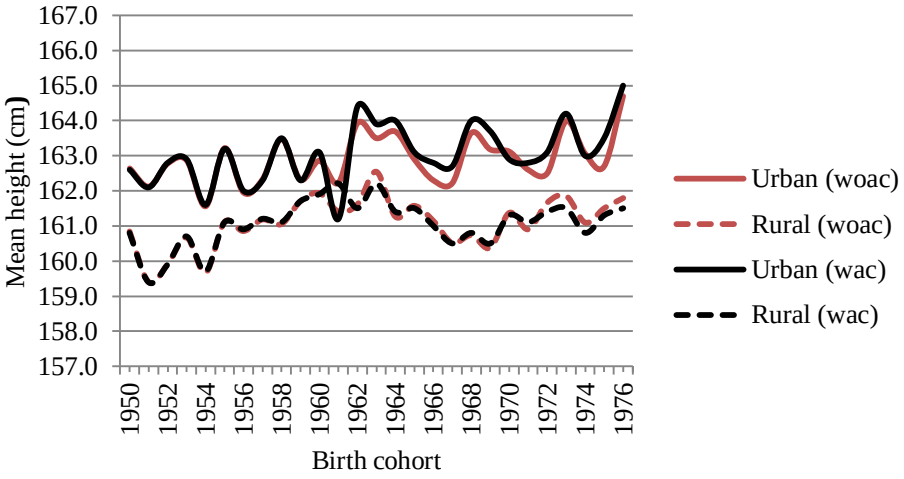
6.3. Urban and Rural

One of Mao's great objectives concerning health and education was to narrow the inequality gaps between the urban and rural populations (Huang 2013; D. Perkins and Yusuf 1984). However, previous publications have shown an inverse tendency, that is, that the gap between the urban and rural populations in fact widened during some stages of the Maoist period (Ash 2006b; Huang 2013; Lardy 1983; Walker 1984b). The evidence in my dataset confirms this conclusion. Figure 9 (a) shows how the mean height of the urban population during the Maoist period was always higher than the mean height of the rural population. Based on the dataset without administrative cities, we can also see the gap between the urban and rural populations widening in terms of

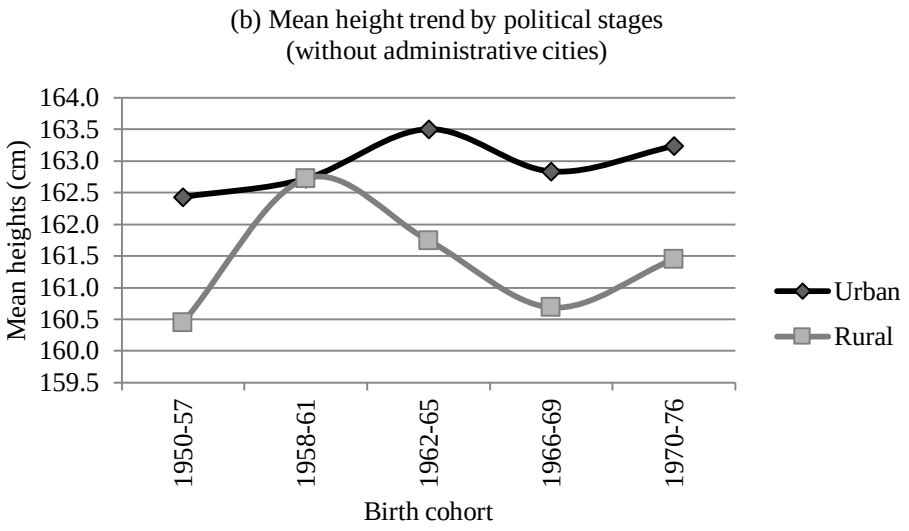
nutritional status from 1.8 cm in 1950 to 2.9 cm in 1976.[30] That is because, while the mean height of the urban population increased by 2.1 cm (P = 0.00) during the Maoist period and the mean height of the rural population increased by only 0.9 cm (P = 0.01).

Figure 9. Trend of heights of the urban and rural populations (1950-76)

(a) Yearly trend (with and without administrative cities)



[30] I choose to use the dataset without the administrative for this analysis to avoid the effects of the administrative cities in the data set after 1961. When I compare the mean height of the rural and urban cohorts with the administrative cities, data indicates that in 1961 the mean height of the rural population is 1.0 cm higher than the mean height of the urban population. By the end of the Maoist period, the mean height of the urban population is 3.5 cm higher than the rural population. In this case I also perceive and increase of the gap between the rural and the urban population in terms of the nutritional status. From this figures I conclude that in 1961 the deterioration of the biological standards of living was greater in the administrative cities than at a provincial level. This interpretation deserves further research, which is not treated in this Doctoral thesis due to lack of data regarding other health variables for the urban and rural populations.



Source: Author's elaboration based on CHNS surveys (1989-2011)

During the GLF (1958-61), the gap in terms of mean height between rural and urban areas overlapped (see Figure 9 (b)). Note that the mean height of the urban population remained stagnant in comparison to the previous stage, while the mean height of the rural population increased by 1.8 cm. It has been well documented that the great famine of the late 1950s and early 1960s had a greater effect on the rural population than the urban population. How can we then explain the opposite effect concerning nutritional status? A whole range of studies shows that the urban population also suffered from the famine. However, the mortality rate in the urban areas (14 per thousand) resulted significantly lower than in the rural areas (29 per thousand) (Peng 1987b; Ashton et al. 1984; J. C. H. Chai 2011; J. Yang 2012). I therefore assume that the survivors in the rural areas during the GLF famine were physically stronger and had better health than the survivors in the urban areas. Indeed, when considering the administrative cities, in 1961 the mean height of the rural population was 1.1 cm higher than that of the urban population (see Figure 9 (a)).[31]

The mean heights of the urban and rural cohorts declined during the first stage of the CR, between 1966 and 1969 (see Figure 9 (b)). Because the nutritional status in the

[31] New evidence shows that the scarring effect is significantly lower in heavily famine-affected areas than regions where the same famine did not result in a great excess of mortality (Blum, Colvin, and Mclaughlin 2017). See Chapter 5 for greater insight on this topic.

rural areas deteriorated more rapidly than in the urban areas, we can still detect significant differences between both cohorts (2.1 cm), despite the aims of Mao's agricultural and health policies discussed in Chapters 1 and 3. In the second stage of the CR (1970-76), both cohorts gained in human stature yet, in either case, remained lower than during the adjustment stage.

6.4. Gender

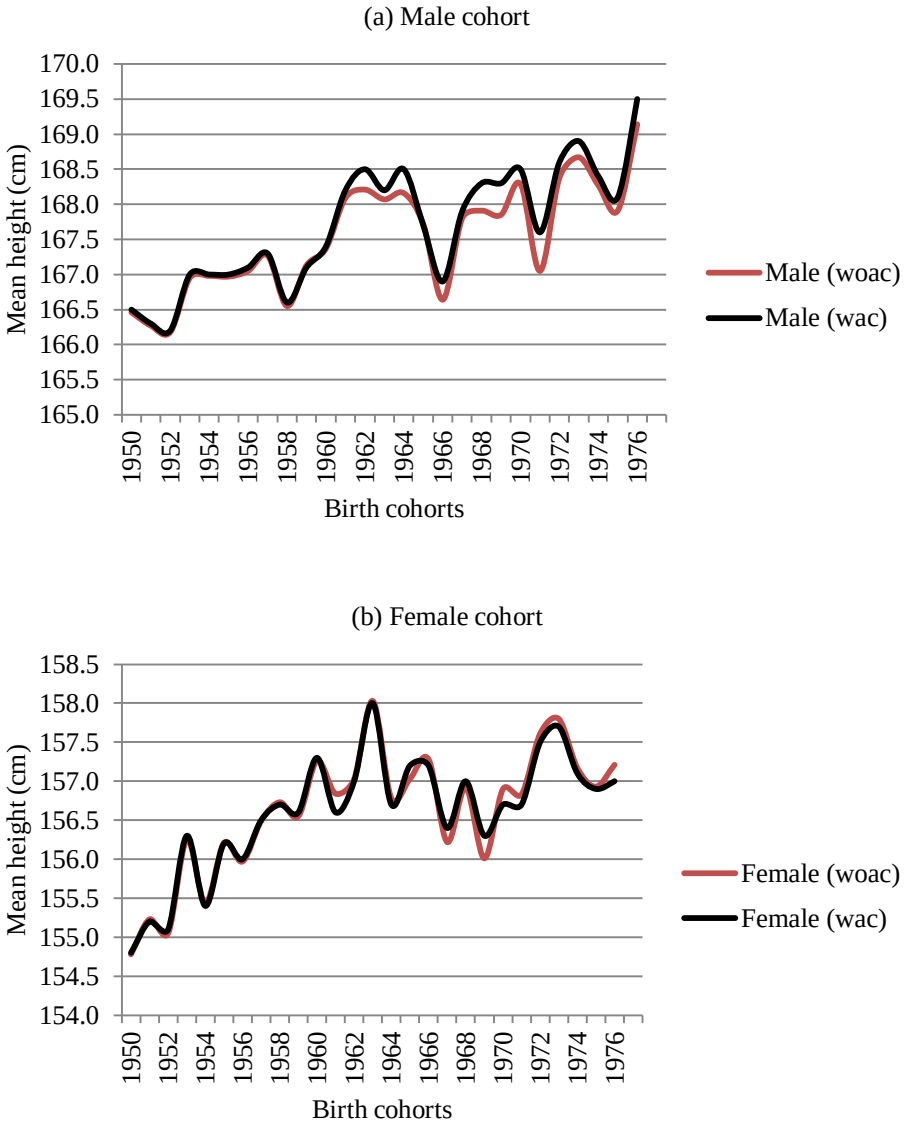
Based on the anthropometric measures used in this study, there is evidence of improvements in the nutritional status for both the male and female populations during the Maoist period. From 1950 to 1976, the mean height of the male cohorts increased by 2.7 cm, that of the female cohorts by 2.4 cm (*P= 0,00*) (see Figure 10 (a) and (b)).[32] Therefore, the gender gap in terms of mean height remained static, increasing only from 11.7 cm in 1950 to 11.9 cm in 1976. However, when comparing the cohorts born during the first stage (1950-57) of the Maoist period and the final stage (1970-76), estimates indicate that the gap in the biological standards of living between male and female cohorts declined by 1.1 cm (see Figure 10 (c)).

Estimates indicate that the biological standards of living increased consistently during the first three stages of the Maoist period (see Figure 10 (c)). Again, we should take these results with caution and consider that the increase of 1.1 cm during the GLF for both cohorts is indorsed not to the improvements in nutritional status, but the high increase in mortality during this period. Therefore, I attribute such increase to the selection effect. It is also during this period where we find a more narrow gender difference in terms of height in respect to the other stages during the Maoist period due to a higher increase of the female populations versus the male populations. What is evident in **Error! Reference source not found.**Figure 10 (c) is that the first phase of the CR is defined as the period where the biological standards of living had a greater decline for the whole period. When compared to the adjustment stage, the decline

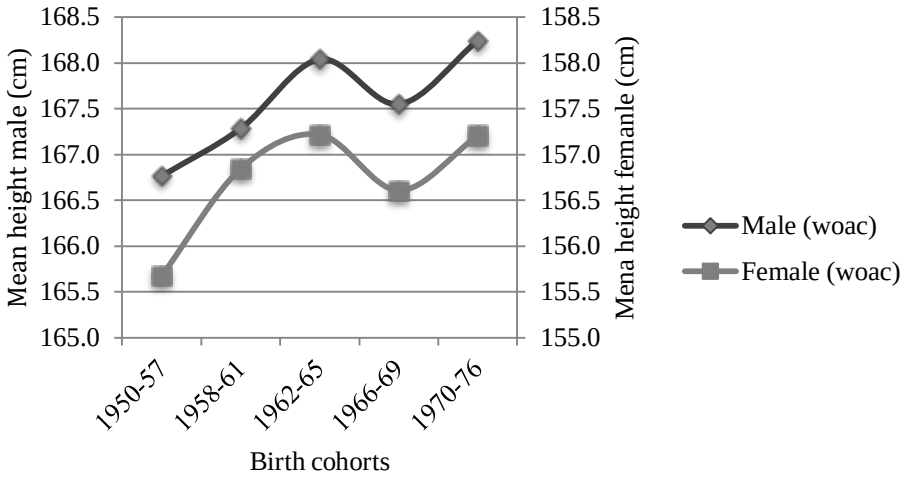
[32] The estimates given in the main text are base on the trend of the mean heights without the administrative cities. The estimates for the trend including the administrative cities (from 1961 to 1976) the increase of mean height of the male of cohort is 1.3 cm and for the female cohort id 0.4 cm.

among male cohorts is 0.6 cm and the decline among female cohorts is 0.5 cm and recovered once again in the second phase of the CR.

Figure 10. Trends in heights of the male and female populations (1949-78)



(c) Mean height by political stage (without administrative cities)

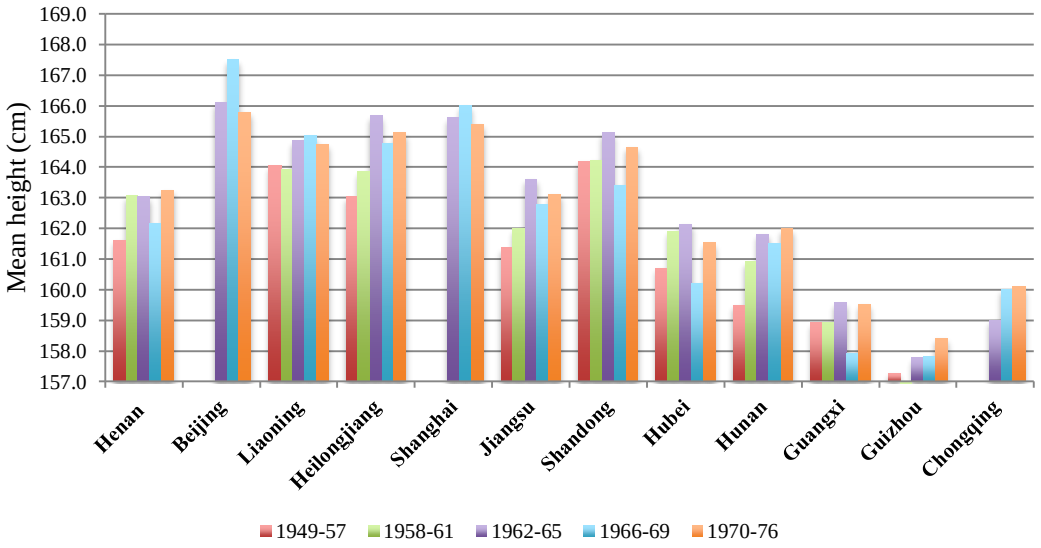


Source: Author's elaboration based on CHNS surveys (1989-2011)

7. Provincial trends and disparities

During the Maoist period, all provinces improved their biological living standards (see Figure 11). However the increase of the mean height varies by province. The greatest increase was evident in Heilongjiang and Hunan provinces, where human stature grew from 163,0 cm and 159,5 cm in the initial stage to 165,1 cm and 162,0 cm by the end of the CR (2,1cm and 2,6cm respectively). On the other hand, Shandong and Guangxi province increase in human stature was only of 0,5 cm and 0,6 cm for the whole period. The remaining province grew in human stature between 0,7 cm and 1,7 cm.

Figure 11. Mean heights by province (1939-84)



Source: Author's elaboration based on CHNS surveys (1989-2011)

I can discern a pattern regarding low and high biological living standards in the different regions. In general, Guizhou province and Chongqing administrative city have the lowest rates in terms of mean heights. Note that during the whole Maoist period human stature in this province was never higher than 158.4 cm. Also Hubei, Guizhou, and Guangxi provinces did not exceed the national mean height during the whole period under study.[33]

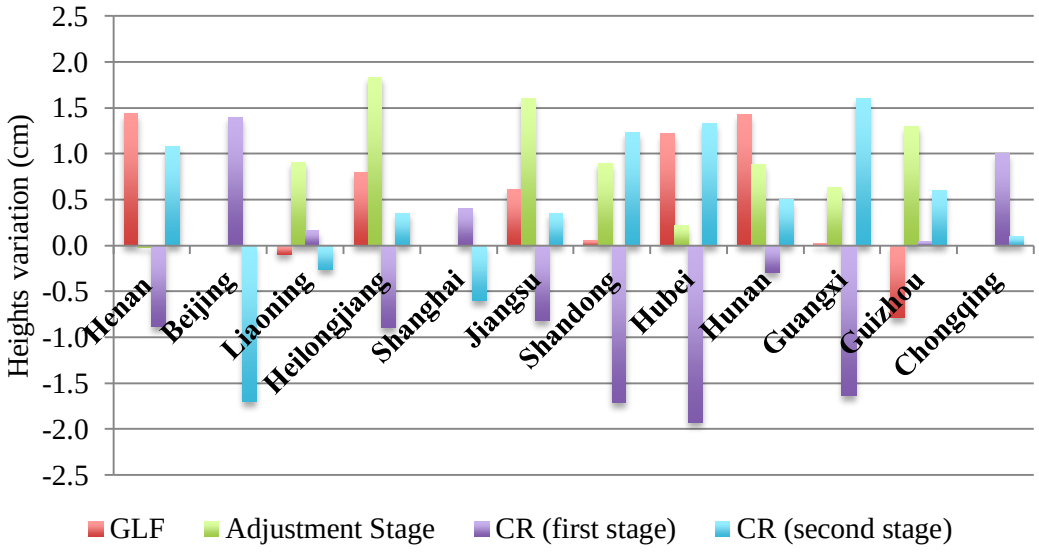
On the other hand, as expected, Beijing and Shanghai have higher biological standards, the mean height of their populations exceeding 165.5 cm for most of the period. Therefore, I discern a gap in terms of biological living standards between the worse off and the better off regions of 8.3 cm (*P= 0,00*). Also, note that in Heilongjiang, Liaoning, and Shandong provinces, while they do not reach levels as high as Beijing and Shanghai, the mean heights of the population are above the national mean height during the whole period. In conclusion, we find inter-provincial inequality of the nutritional status, where the western regions are in a worse-off position relative to the national levels.

In making comparisons between provinces and periods, we should draw two conclusions based on the records in Graph 8. First, during the GLF only Liaoning and

[33] The national mean height in this case refers only to provincial mean heights to avoid the effect of the later incorporation of the administrative cities in later years.

Guizhou provinces show falls in human stature, which are not statistically significant (*P= 0.955*). Secondly, I find a general deterioration in biological living standards during the CR (see **Error! Reference source not found.**Figure 12). Most provinces declined in their human stature measures during the first stage of the CR (1966-69) (*P= 0,001*). The most severely affected provinces were Shandong, Hubei, and Guangxi, where the mean heights of their populations decreased by 1.7 cm, 1.9 cm, and 1.6 cm respectively. Also, the measures for Henan, Heilongjiang, Jiangsu, and Hunan provinces deteriorated in terms of nutritional status, while Liaoning and Guizhou suffered a period of stagnation. On the other hand, Beijing and Shanghai were mostly affected in the second stage of the CR (1970-76), where the mean height of the population decreased by 1.7 cm and 0.6 cm respectively. However, in the first half of the 1970s, I find an opposite effect to in the remaining provinces, where the biological standards of the population improved, yet with no statistical significance (*P= 0,365*).

Figure 12. Provincial height variation beween political stages



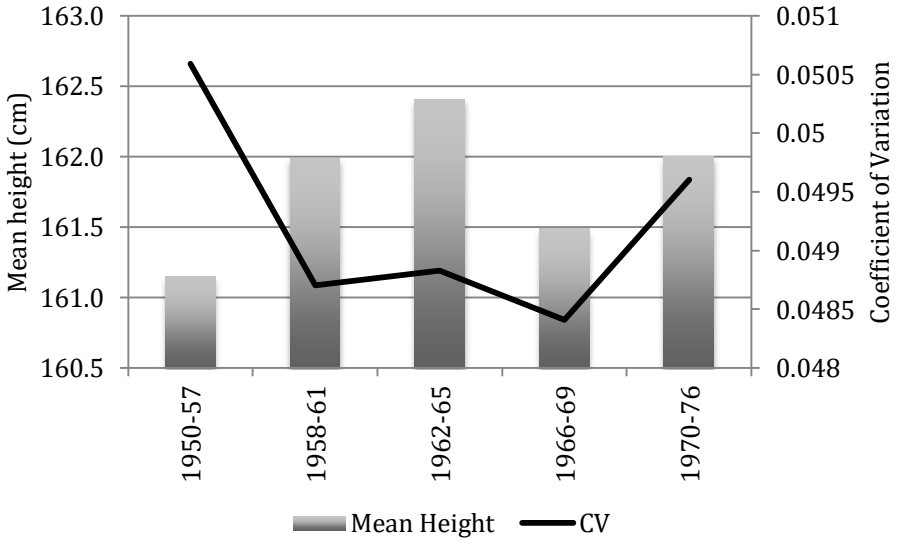
Source: Author's elaboration based on CHNS surveys (1989-2011)

8. Measuring inequality of the biological standards of living

In this section I measure inequality based on the coefficients of variation (CV) of the mean heights. Previous studies highlight that the use of CV represent inequality better than other measures of dispersion (J. Baten and Blum 2012; Blum 2013). A great array of publications indicates that there is a close relationship between the first stages of industrialization and the growth in inequality, following by its fall afterwards. Considering the pronounced industrialization during period under study, we would expect the Kuznets' inverted U hypothesis to be shown in our data. To very this assumption, I estimate the CV by the different stages during the Maoist period. I have used only provincial data to estimate the CV in order to control for the effects represented by the incorporation of the administrative cities after 1961.

Results indicate two major findings for the Chinese case. First, contrary to the increase of the biological standards of living, we find a decline in inequality during the Maoist period (see Figure 13). Second, we reject the Kuznets' hypothesis, finding a U-shape trend of the inequality trend between the early 1950s and the mid-1970s, identifying the greatest reduction in inequality between the late 1950s and the late 1960s.

Figure 13. China: Coefficient of Variation by political stages

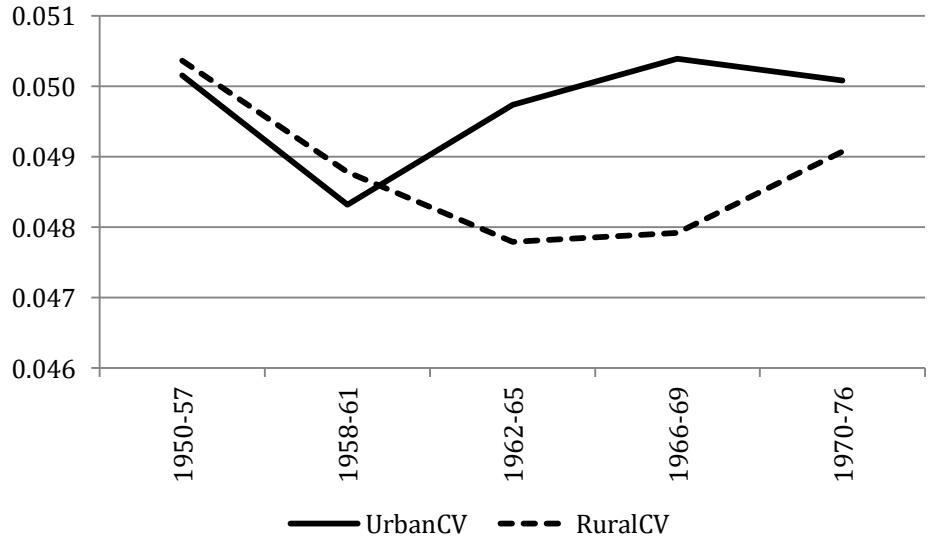


Source: Author's elaboration based on CHNS surveys (1989-2011)

In order to understand the trend of inequality in China, we analyze the dynamics within the urban and rural populations, as well as within the male and female populations.

Estimates of the CV for the rural and urban population show an opposite trend between both cohorts during the Maoist period. Results indicate that while inequality among the rural population declined significantly during this period, inequality among the urban population, inversely, increased significantly (see **Error! Reference source not found.**Figure 14). Until the GLF, the degree of inequality among the rural and urban population was very similar. The decline of inequality among the rural population is representative from 1958 to 1969, with a significant increase in the second stage of the CR. This trend is very similar to the case of China as whole, shown in Figure 13, indicating that, most likely, the national tendency of inequality is determined by the dynamics within the rural population. This makes sense, considering that rural population has greater weight within our sample. On the other hand, the estimates of the CV for the urban cohort indicate that inequality abruptly increased after the GLF, reaching its highest point during the first stage of the CR and having a slight decrease during the second stage of the CR. Though, despite the different trends within the urban and rural populations, it is apparent that the Kuznets' hypothesis does not apply to either case. In addition, Figure 14 suggests that since the adjustment stage, the levels of inequality remained lower among the rural population than the urban population. However, by the end of the Maoist period, the gap narrowed down.

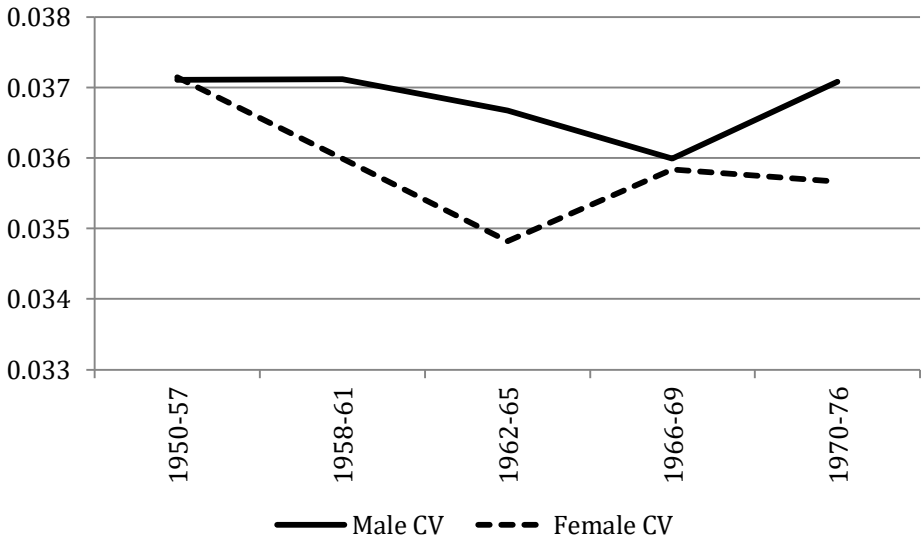
Figure 14. Intra- inequality in rural and urban China



Source: Author's elaboration based on CHNS surveys (1989-2011)

Estimates of CV by gender indicate that the trend of inequality declined among both male and female cohorts (see **Error! Reference source not found.**Figure 15). The female cohort had a significant decline of inequality until the adjustment stage and suffered an increase of inequality during the CR. While male inequality remained stagnant during the first two stages of the Maoist period, the decline was significant after the GLF until the first stage of the CR. During this stage, the levels of inequality in terms of nutritional status shrunk among both male and female cohorts. By the end of the Maoist period, this gap widened once again, mainly due to the abrupt increase of inequality among the male cohorts.

Figure 15. Intra-inequality: Male and female populations in China

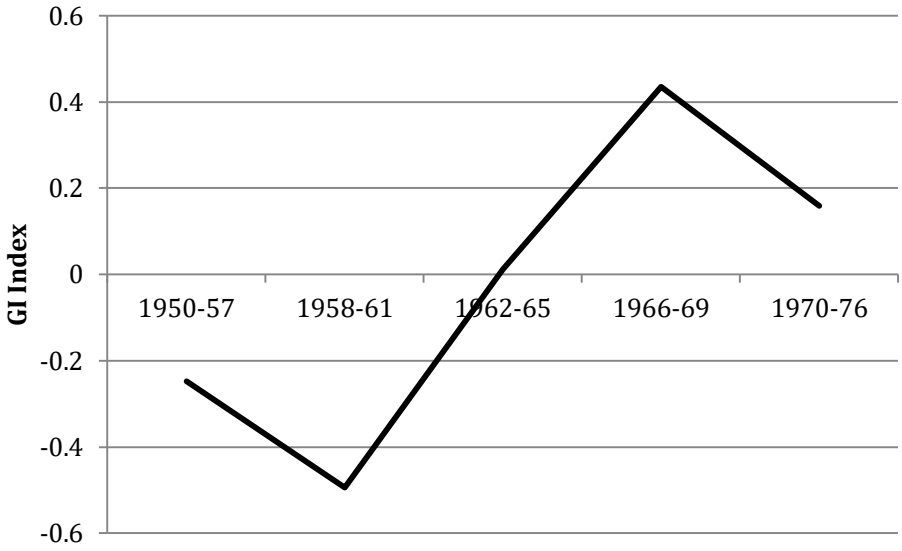


Source: Author's elaboration based on CHNS surveys (1989-2011)

Figure 16 indicates that contrary to the political agenda, the gender inequality increase during the Maoist period. The highest levels of inequality are targeted in the first stage of the CR. Interestingly, the gender gap suffered an abrupt decline during the GLF. Considering that the mortality rate of females was higher during this period and that the share of missing women increased (Jiang et al. 2012), it should be considered that the decline in inequality is based on the assumption of the selection effect. As shown in

Figure 10 (c), the stature of the female population raised at a faster pace than the stature of the male population (refer to Chapter 5 for a more extended discussion this topic).

Figure 16. Gender inequality in Maoist China



Source: Author's elaboration based on CHNS surveys (1989-2011)

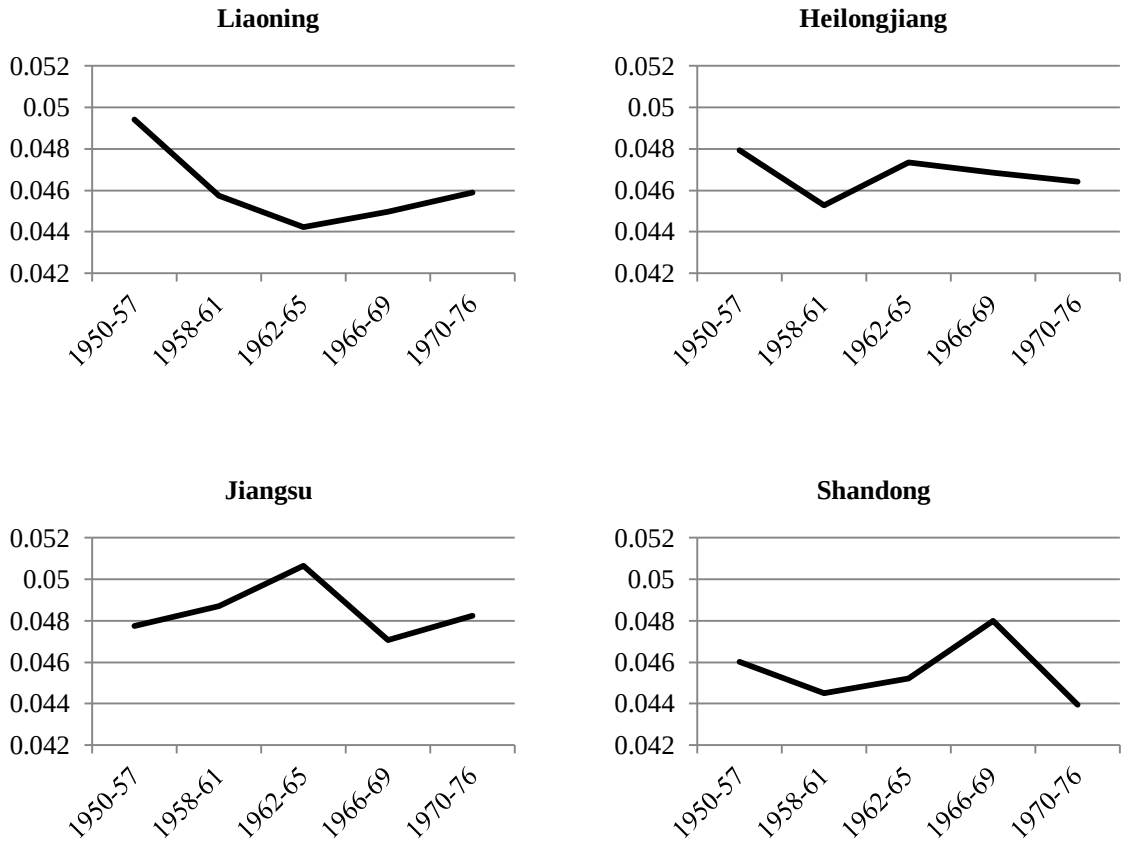
What seems to be consistent for all the analyzed populations is that there is a general decline of inequality during the GLF and, only in some cases, also in the first stage of the CR. Therefore, it could be argued that the reason why the inverse U-shape hypothesis does no apply to the Chinese case is closely related to the negative effects of the GLF policies, which led the country not only to famine but also a significant decline in terms of GDP and industrial output. Also, as an effect of the famine, population density decreased significantly by the end of the GLF, presumably leading to a better distribution of resources among the population.

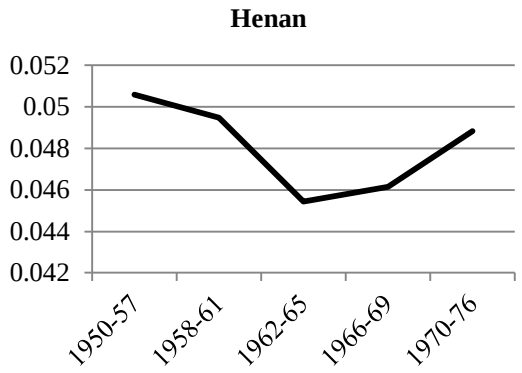
Finally, we analyze whether the national inequality tendency is portrayed at a provincial level. Results indicate that intra-provincial inequality is represented differently by each province and administrative city (see Figure 17). Results indicate that fifty per cent of the regions under study in this chapter suffered a decline of intra-provincial inequality between 1950 and 1976; that is the case for Liaoning, Heilonjiang, Henan, Hunan, and Guangxi provinces and Shanghai administrative city. In contrast, Hubei province and Beijing and Chongqing administrative cities suffered a significant increase of the

inequality trend during this period. Meanwhile, Jiangsu and Shandong provinces remained stagnant in terms of inequality. Figures also indicate that Jiangsu, Henan, Hubei, and Guizhou provinces remain with the highest rates of intra-provincial inequality all along the Maoist period.

Interestingly, contrary to the pattern shown at a national level, the figures in Figure 13 that the Kuznets' hypothesis does apply in those provinces and administrative cities that were more industrialized such as Heilonjiang, Jiangsu, and Chongqing. However, this may not be considered as a general pattern taking into account that two major industrialized regions, Liaoning and Shanghai, reject the hypothesis. While understanding the different factors that contribute to the distinct inequality trends between provinces disserves academic attention, this analysis drives beyond the aims of this chapter.

Figure 17. Intra-regional inequality in Maoist China




Henan
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1950-57
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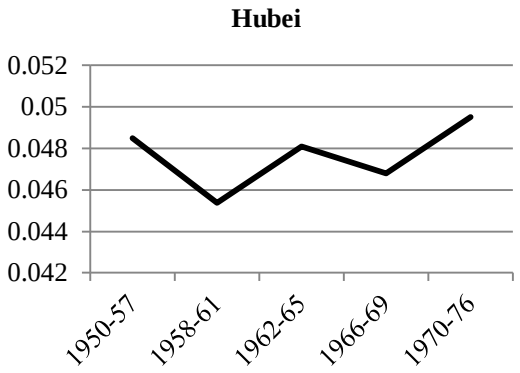
Hubei
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1950-57
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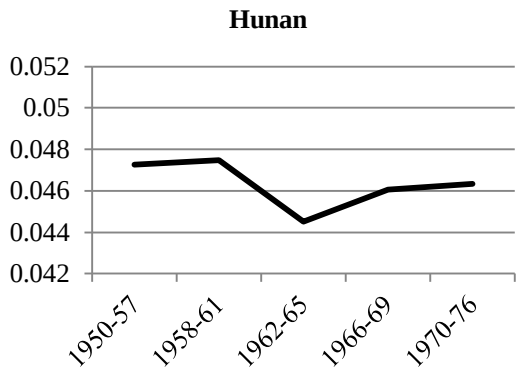
Hunan
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1950-57
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1966-69
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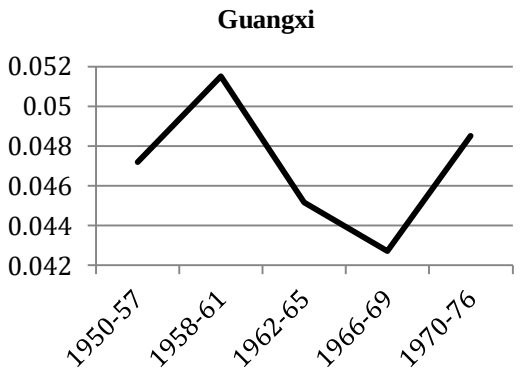
Guangxi
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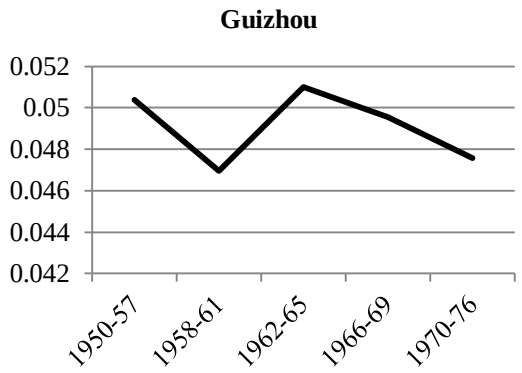
Guizhou
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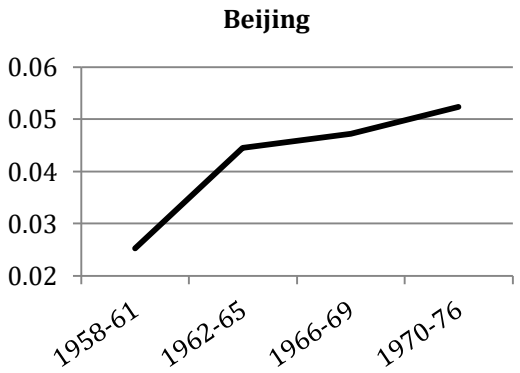
Beijing
0.06
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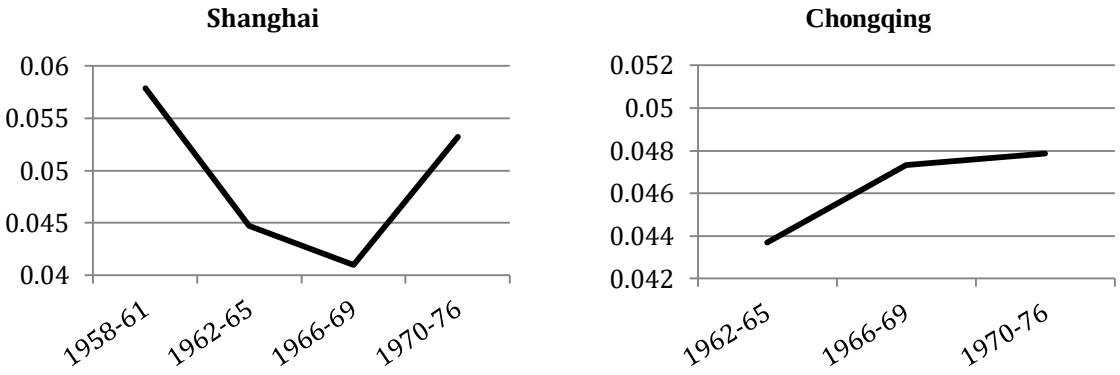
0.04
0.03
0.02
1958-61
1962-65
1966-69
1970-76



Source: Author's elaboration based on CHNS surveys (1989-2011)

9. Conclusions

In this chapter, I have analyzed the trends in biological living standards during the Maoist period, using the mean height of the population as an alternative measure to other well-being and economic indicators. This corroborates on the previous findings as well as suggesting new assumptions regarding China's economic history. While previous studies analyzed biological standards of living in Maoist China, from my knowledge, this is the first attempt to use yearly series for the mean height of Chinese population and analyze inter-inequality and intra-inequality among provinces, gender, and settlement (urban and rural populations).

Several conclusions can be drawn from the present analysis. First, we have uncovered a moderate increase in the mean height of the Chinese population during the Maoist period. Indeed, the mean height of the male population during that period is higher than in other Asian countries, such as Japan and India. Therefore, I corroborate previous assessments of health with using traditional health indicators. However, results indicate that there was no constant growth of human stature during the whole period, but it was characterized by unceasing fluctuations. The data used in this study indicates that the greatest deterioration of the biological standards of living in Maoist China was not during the GLF but during the CR. Other health indicators published in previous studies show that the living conditions were worse during the GLF. Therefore, we attribute the results of this study to the selection effect that was activated during the famine years.

As to whether Mao Zedong's policies were effective in overcoming inequality in the nutritional status I conclude with several remarks. On the one hand, my data shows that intra-inequality declined during the Maoist period. Results indicate that only Beijing, Chongqing, and Guangxi province suffered an increase of inequality. Data also indicates that intra-inequality declined among the male and female populations, but the gender gap increased, with the exception of the GLF stage when the gap narrowed significantly due to the abrupt increase of the female stature. While the increase of the biological standards of living of the rural population was moderate, the inequality in nutritional status among the rural population declined. This is not the case in urban areas, where we detect an increase of inequality in the nutritional status among the rural population. In addition, the gap between urban and rural areas, as well as between regions were statistically significant, corroborating previous findings based on traditional economic indicators set out in Chapter 1. These results indicate that despite the industrialization process given during the period under study and the general economic growth, the Kuznets' hypothesis is rejected for the Chinese case. Only some heavily industrialized regions such as Heilongjiang, Jiangsu, and Chongqing comply with the hypothesis.

The findings in this article open the door to new research questions. What are the most significant determinants explaining the increase in biological living standards and in the inequality during the Maoist period? Moreover, did the increase in the biological living standards of the Chinese population during that period have a positive effect on economic improvements in China after 1978? I will analyze the first question in the following chapter. The second question is not addressed in this Doctoral dissertation and will be attended in future research.

Appendix 2

Figure 18. CHNS height data: Histogram

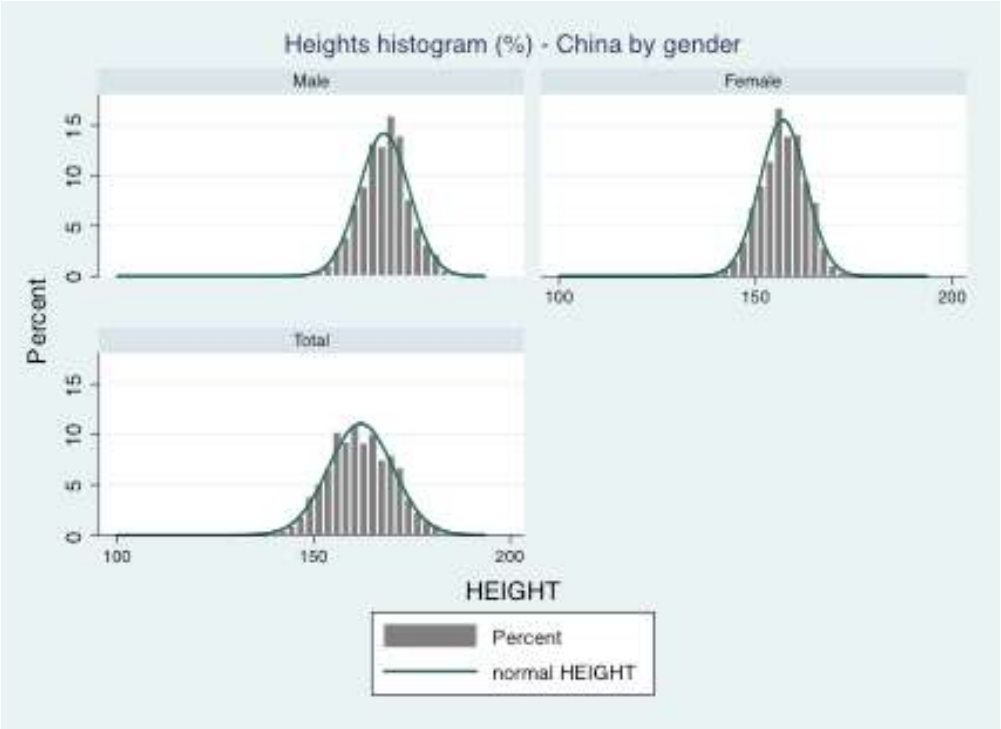
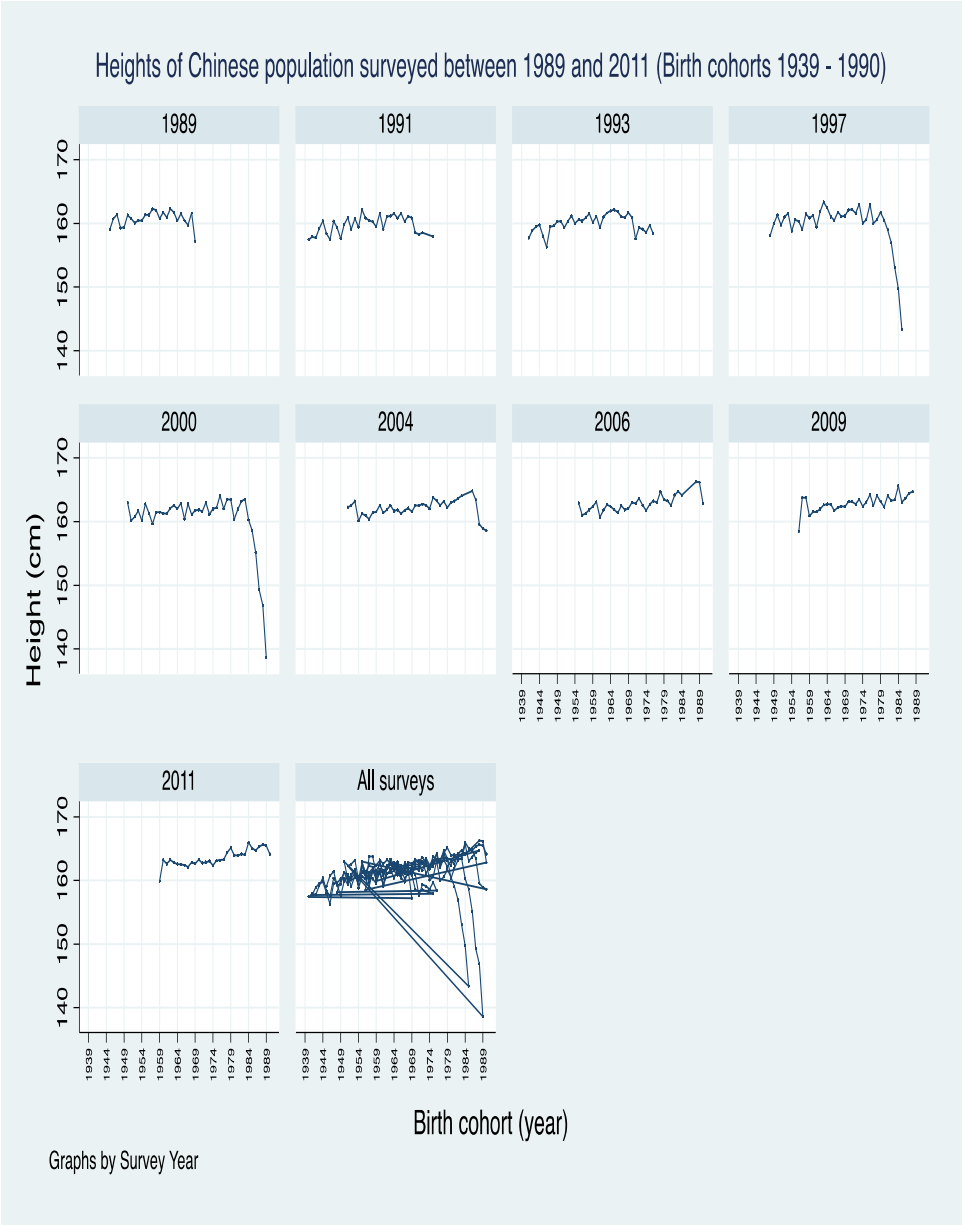


Figure 19. CHNS surveys 1999-2011: Height trends (birth cohorts 1939-1990)



Chapter 3. China: The development of the health system during the Maoist period (1949-76)

1. Introduction

Since the 1980s, the health of the Chinese population has improved and entered to a new nutritional and health transition linked to the spread of obesity, diabetes, and cardiovascular diseases (Deaton 2015; Y. Li et al. 2011; Popkin 1997, 2008; Popkin and Du 2003; Food and Agriculture Organization of the United Nations 2010).[34] Some scholars suggest that the decline of infectious diseases among the Chinese population in recent decades might be associated with the increase in incomes, rather than the efficiency of the health system (Whyte and Sun 2010; Kwon and Schafer 2016; Y. Li and Wei 2014).

The transition towards a market economy after the late 1970s opened the way to the emergence of economic and social inequalities in China (Zhu 2013; Keidel 2009). In the health sector these inequalities are also evident between urban and rural areas (Biao 2006; Feng et al. 2012; Yin and Lu 2007; Zhao 2006; Chou and Wang 2009; Evandrou et al. 2014), as well as between different provinces (Pan and Shallcross 2016; X. Zhang et al. 2015; Qin and Hsien 2014; Y. Li and Wei 2014). This reflects the fact that health-care reforms have sometimes been deferred in order to concentrate on economic reforms (Zhu 2013).

While health inequalities have been studied intensively for the years following the economic reforms, there is less literature on inequalities in the health-care system during the Maoist period (1949-76). Already in the 1980s, international health agencies claimed that China had taken the path of an epidemiological transition during this period, by reducing mortality and birth rates by 50 percent and 40 percent respectively, and increasing life expectancy from 44 years to 68 years (White 1998; Brown et al.

[34] Some of these studies are based on health surveys conducted in China in recent decades such as the China Health and Nutrition Survey (CHNS), which have rich information about individual and household health since the late 1980s.

2012). This success was attributed to the great improvements in the health system in a country with lower incomes than in any industrialized country in the past, achievements that were described as unique in the developing world (Hipgrave 2011; White 1998).

During the Maoist period the clear objective was to spread an egalitarian health-care system to the whole country and reduce existing health inequalities, which had increased during the Republican era (1912-49) (Huang 2013). However, the evidence indicates that, while there were health improvements at the national level, there were also great inequalities in health, especially between the rural and urban populations (Huang 2013). This has been proven to be true also in terms of the nutritional status (see Chapter 2, Section 5.3).

A range of publications has concentrated on health outputs during this period using indicators such as infant mortality rate, morbidity, life expectancy, and a variety of anthropometric measures (Salaff 1976; Mason et al. 1996; Campbell 2001; Banister and Zhang 2005; Yuyu Chen and Zhou 2007; Hipgrave 2011; S. Song and Burgard 2011; Eng and Sohn 2020), yet to my knowledge, few have studied the specifics of the distribution of health resources in China (Jamison et al. 1984; Babiarz et al. 2015). Previous studies claim theoretically, that the geographical distribution of health resources contribute to health improvements in a society (Andersen, Rice, and Kominski 2011; Horev and Pesis_Katz 2004; World Health Organization 2000) because the supply side of inputs (health resources) has an impact on the demand side of outcomes (access to health care) (Pan and Shallcross 2016). Based on this assumption, we should expect a positive relationship between the availability of health resources and human stature. In this chapter I investigate whether the allocation of health resources in China is correlated with the improvement in the biological standards of living studied in Chapter 2.

Also, previous studies conclude that the focus on economic reforms contributed to the deterioration of the quality of the health system and dismantled the near-universal health system of the previous decades (S. L. Hu et al. 2008; Wagstaff and Lindelow 2008; W. Yip and Hsiao 2009; Y. Li and Wei 2014). Therefore, in this chapter I also investigate whether the provincial disparities that exist in the health sector today were already present prior to the economic reforms. To this end, I analyze the geographic distribution

of health-care resources among the different provinces in China during the Maoist period.[35]

From 1949 to 1976 the health system assumed different forms in response to demand and social structure, and more importantly, to the prevailing political circumstances. Therefore, the analysis is based on four different political phases within this period: (1) the Initial Stage (1949-57); (2) the Great Leap Forward (1958-61); (3) the Adjustment Stage (1962-65); and (4) the Cultural Revolution (1966-76). Health policies were focused on preventive medicine linked to national political campaigns and investments in medical institutions and medical personnel

This study is based on records of health resources (hospitals, clinics, beds, and doctors) compiled from four Chinese statistical sources: Comprehensive Statistical Data and Materials on 50 years of New China (1950-1998) (*Xin Zhongguo Wushi Nian Tongji Ziliao Xupian*); and a new dataset including different health indicators from the Provincial Archive of Public Health Records (*Weishengzi*), the China Statistical Data Compilation (1949-2003), and the 1988 National Survey of Fertility and Contraception.[36]

The findings in this chapter follow a similar inclination to the final conclusions in Chapter 2. That is, of improvements in health and health resources nationwide, but with significant differences between the provinces and the political phases. Therefore, despite the universal health system established in Maoist China, health resources were not equally distributed in the country, living with less entitlement to the populations located in the western provinces. Though, we do find a significant and positive correlation between the allocation of health resources and the improvements in the biological living standards during the whole period.

The use of aggregate data published by the government implies certain limitations for this study. First, the reliability of official statistical data in China cannot be assured,

[35] While the privatization of the health system rapidly spread during the economic reforms, for most of the Maoist period, the health system was state-owned, and therefore, the allocation of the health inputs had greater relevance to understand health access, than the income of households.

[36] This new dataset developed by the Stanford University and Central University of Finance and Economics has recently been available to the public. The dataset includes health records at a provincial level from 1950 to 1988. Find additional information at (Babiarz et al. 2015). I kindly thank the authors for giving me direct access to the dataset Mao Mortality Analysis.

especially for the Maoist period. I address to this issue in Section 3, where in certain provinces some figures appear to have been exaggerated, particularly during the GLF stage. Secondly, the aggregated data cannot be used to assess the development and availability of health resources at the prefectural and county level, nor in the rural and the urban areas.

This chapter is divided into five sections. Section 2 describes the different policies and health institutions that were introduced in China during the Maoist period, based on the four different stages listed above. Section 3 analyzes the data at both the national and provincial levels. Section 4 indicates the relationship between population heights and health resources. Finally, Section 5 offers some final conclusions.

2. A brief history of the health system in Maoist China

2.1. The Initial Stage (1949-57)

When Mao Zedong came to power in 1949, China's health situation was in a precarious situation. The scarcity of health institutions and the unequal distribution of health resources between rural and urban areas left a great percentage of the Chinese population with no access to health-care.[37] Immediately after the establishment of the People's Republic of China (PRC), the Chinese Communist Party (CCP) focused on the development of a state-run health-care system based on the communist ideals developed during the revolutionary era (1927-49), in defense of a public health system governed by policies concerned with the control of epidemics. In November of that year, the Ministry of Health (MOH) was established as the organization responsible for health, with subnational local branches. Labour insurance and government health insurance were introduced in the early 1950s, with free health care being provided to industrial workers and families, government employees, teachers, and students. However, because of financial constraints, the central government allocated only 1.2 per cent of the national budget to the health-care sector, rapidly creating congested health services

[37] Seventy-five per cent of hospital beds and 62 per cent of the senior Western-style physicians were located in urban areas (Huang 2013). Note that at this point in history over 90 per cent of the population was located in the rural areas.

demand and limitations on state finance. Ironically, this situation widened the gap between the urban and rural areas, leaving the peasants behind.

The central government was aware of the precarious situation in the rural areas and its own financial constraints. As a result, it became important to concentrate on the *prevention first policy*, which insisted in averting the spread of infectious diseases, thus allowing the state "gain political capital by reducing human suffering" (D. Perkins and Yusuf 1984). The means to accomplish this objective relied on the state's control of society, especially in the countryside, by launching patriotic health and mass mobilization campaigns to increase health awareness. While at the beginning of the 1950s private health facilities still existed, by the mid-1950s the healthcare system had become mostly an activity of the state. The MOH identified twenty communicable diseases, but due to the financial and institutional constrains, only cholera, smallpox, and the plague were targeted as a priorities (Huang 2013). In addition, by 1957 the fight against schistosomiasis and venereal diseases had become a central goal. At the end of this stage, two thirds of all the counties in China had an epidemic prevention station (EPS) applying communicable disease control (CDC) programs, vaccination, and environmental sanitation and hygiene (Hipgrave 2011). While the *prevention first policy* was successful in the long run (for example, the last outbreak of smallpox was in 1960, twenty years before its global eradication) (X. Xu 1994), the health-care system had a long way to go in providing the rural population, with curative treatments and tackling infectious diseases not targeted by the CDC programs, which remained a latent problem. Nevertheless, by the end of the initial stage of implementing the health-care system, Mao had won popularity among peasants and local officials, to the extent that he felt powerful enough to weaken the intervention of the MOH bureaucracy, as he understood it, thus acquiring complete authority to supervise health activities in the years that followed (R. Li 1995; Huang 2013; D. Perkins and Yusuf 1984).

2.2. The Great Leap Forward (GLF) (1958-61)

Policies during the GLF were basically concentrated on collectivizing China's socioeconomic structure. The establishment of a commune system in rural areas, controlled politically, clearly changed the social and economic structure of the system

and also had an impact on health-care. Already in the mid-1950s some communes in Central China adopted the so-called Cooperative Medical Schemes (CMS), which provided free health-care for the whole of the rural population. By the end of 1958, all cooperatives had adopted the CMS. Mostly decentralized, free medical services, financed by county and commune budgets, provided peasants with an incentive to adopt the system of collectivization system in its entirety. The rural public health-care system was supported by two main sources of funding: the commune members' annual fees, and the revenues collected from the agricultural production. The former provided only very low revenues and ultimately became practically non-existent, while the later was only likely to be effective if the primary sector of the economy at the provincial level was successful; this proved not to be the case, and three years after the GLF's policies had been implemented, the system had reached a state of collapse.

The *prevention first policy* nonetheless remained the focal domain in the public health system during the GLF. One of the most emblematic hygiene campaigns was the so-called *Four Pests,* which made the wiping out of mosquitos, flies, rats, and sparrows a top state priority in order to eliminate schistosomiasis. Avoiding most of the technical and professional leaders of the MOH, Mao proclaimed the mobilization of rural labour to catch and kill the *four pests* (Y. Xu 1960). By the end of 1959, fifty per cent of patients suffering from schistosomiasis disease had been cured (Huang 2013). However, the Hundred Flowers Campaign in 1956 and the Anti-Rightist Campaign in 1957 "set in motion a bandwagon effect with localities competing for rapid elimination of schistosomiasis" (Huang 2013). The same pattern was evident in the setbacks to agricultural production during this period, one of the main reasons for the famine in the GLF.[38] Low nutritional intake and the unprecedented consumption of non-edible goods during the subsistence crisis increased disease levels, especially in the rural areas. By 1961, the decrease in the amount of revenue allocated to health resources could not support the increased demand for medical provision, leading to greater fiscal constrains with clear negative effects for maintaining an efficient health-care system. The national budget also fell during the period due to the increased investment in the secondary sector in urban areas, meaning that the communes and counties could not turn to the

[38] Other reasons attributed to the famine are natural disasters and the elimination of all sparrows in rural areas, which contributed to locust pest. However, main reasons are contributed to political and institutional setbacks in the GLF.

central government for financial assistance. To confront the problems of welfare funding, local cadres considered increasing peasant's fees for access to health, but levels of poverty at the commune level had reached their peak. In addition, contrary to Mao's initial objectives, the health gap between the urban and rural areas widened due to intensification of the industrial sector.

2.3. The Adjustment Stage (1962-65)

After the GLF Famine, the state and local governments worked to improve the agricultural system in order to increase food production based on more bureaucratically oriented policies. This was the beginning of the modernization of the primary sector, which would be pursued with greater force in the mid-1960s. Collectivization was relaxed; but the setbacks during the GLF met their response in Mao's silence on healthcare issues from July 1960 to August 1964 (Hipgrave 2011; Huang 2013). The subsistence crisis at the previous stage weakened the rural population's ability to engage in mass mobilization on preventive health issues, and patriotic hygiene campaigns were discouraged until 1964. During this new stage, commune health centers declined in all respects, and the gap between rural and urban areas increased. By 1964, only 16 per cent of government health-care funding was being allocated to rural areas. In addition, 90 per cent of senior health workers were appointed at or above the county level, leaving behind residents in the communes, which constituted the greater part of the Chinese population (Ministry of Health 1999).

2.4.The Cultural Revolution (1966-76)

By the mid-1960s, Chairman Mao felt he was losing political control after leaders such as Liu Shaoqi and Deng Xiaoping had gained political influence with revisionist policies during the adjustment period to overcome the failures of the GLF. In 1964, the coup against Nikita Khrushchev in the USSR alerted Mao that a similar outcome could take place in China. At this point, loyalty towards party personnel became more important than its policies, and Mao concentrated all his power on preserving its

leadership (MacFarquhar and Schoenhals 2006). This political environment produced a new stage in China that lasted for ten years: the Cultural Revolution (CR). During this decade, major changes took place in the country that involved political repression, which also affected the health-care system. By the mid-1960s the confrontation between Mao's revolutionary views and the MOH's bureaucratic practices returned to the situation of the mid-1950s. At this point, Mao's major concern regarding health issues was the existing inequalities, between the rural and urban areas, and he referred to the MOH as the "Ministry of Urban Lords" (Yu 1976; Z. Li 1994).

Mao's political agenda had two main policies for the health system. The first was to transfer a large number of professional doctors from urban to rural areas. The second was to restructure the education of medical technical personnel by reducing the number of years of training from six- and eight-year programs to three-year programs (Dobson 1981; Huang 2013). These measures faced great opposition from the MOH. However, between 1968 and 1973, after the fall of Liu Shaoqi and Deng Xiaoping in 1967, the MHO lost all its influence in the policy-making process. Mao's most engaging health program at the time was the *barefoot doctor* (BFD) program, established as national policy in 1968 and regarded as an effective measure solving the problem of the scarcity of doctors in rural areas and minimizing costs (T. Hu 1976).

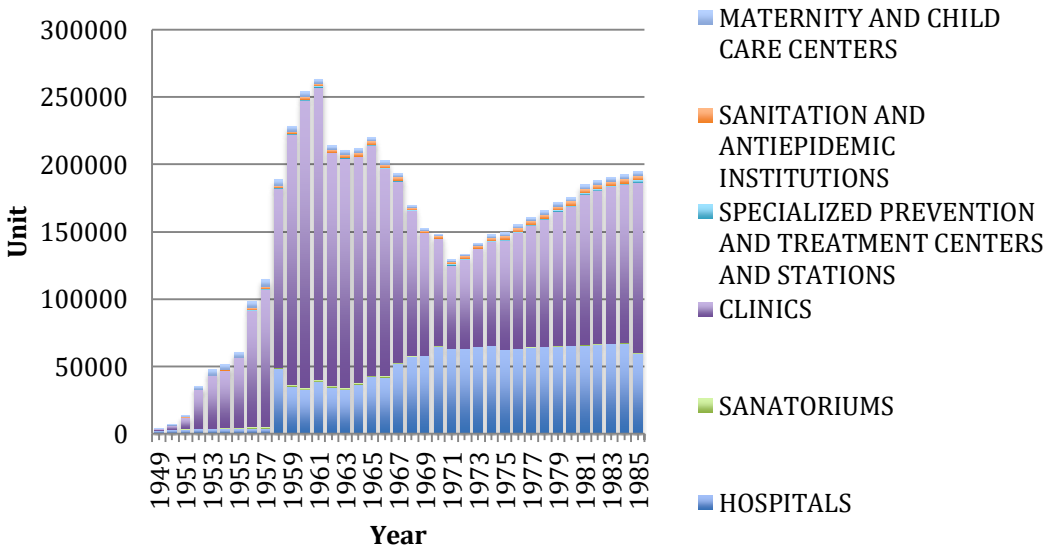
The typical BFD was actually a peasant who provided basic health care, sanitation, health education, and preventive medicine at the brigade and working team levels. However many BFDs, who received credits for work points in health and agriculture, were urban medical personnel transferred to rural areas. In 1965, fewer than 19,000 medical personnel were sent to the countryside; at the end of the period, the figure peaked at 1.8 million (Wu 1975; Hipgrave 2011). The package, mainly founded by brigades, provided a more continuous service and achieved a higher population reach than the preventive campaigns of the 1950s (Lee 1974). Together with midwives and physicians, the new system adopted a bottom-up rather than top-down approach and responded to the failures of the GLF, using fees and other market mechanisms to prevent overuse and unnecessary use of health services (Cook 2004; Huang 2013). The BFD program remained in existence until the 1980s.

3. Analysis of the data

3.1.National statistics

During the Maoist period, great achievements in health were related to the improvement of health institutions dating from the previous Republican era and the construction of new ones. From the establishment of the PRC in 1949 to 1976, the number of health institutions increased by 23.2 per cent (see Figure 20). These institutions included mainly hospitals and clinics, and to a lesser extent also in sanitary and epidemic stations, sanatoriums, specialized prevention and treatment centers and stations, and maternity and child-care centers.

Figure 20. Health institutions in China (1949-85)



Source: Author's elaboration from the Comprehensive statistical data and materials on 50 years of new China (1950-1998)

Maternity and child-care centers represented a low proportion of total health bodies, but they experienced the greatest increase during the period, reaching at 36 per cent. The introduction of health institutions was one determinant to reduce infant mortality in China. Based on public health records, from 1950 to 1976, the infant mortality rate and the mortality rate of children under five years old decreased by 62 per cent and 90 per cent respectively. Nearly one million midwives were re-trained, reducing newborn and

puerperal infection rates, including the rate of neonatal tetanus (Banister 1987; Hipgrave 2011). The increase in women's enrolment in education was also positive for the reducing infant mortality, as it not only contributed to the provision of health information, but also increased the age at marriage for females from 17.5 years in 1952 to 22.3 years in 1980 (Wang and Yang 1996; S. Song and Burgard 2011; Babiarz et al. 2015). Sanitation and anti-epidemic stations and specialized prevention and treatment centers also experienced representative increases, reaching 26.3 per cent and 25.7 per cent, respectively. As previously mentioned in Section 2, the *prevention first policy* played a major role in reducing infectious diseases in the long-run.

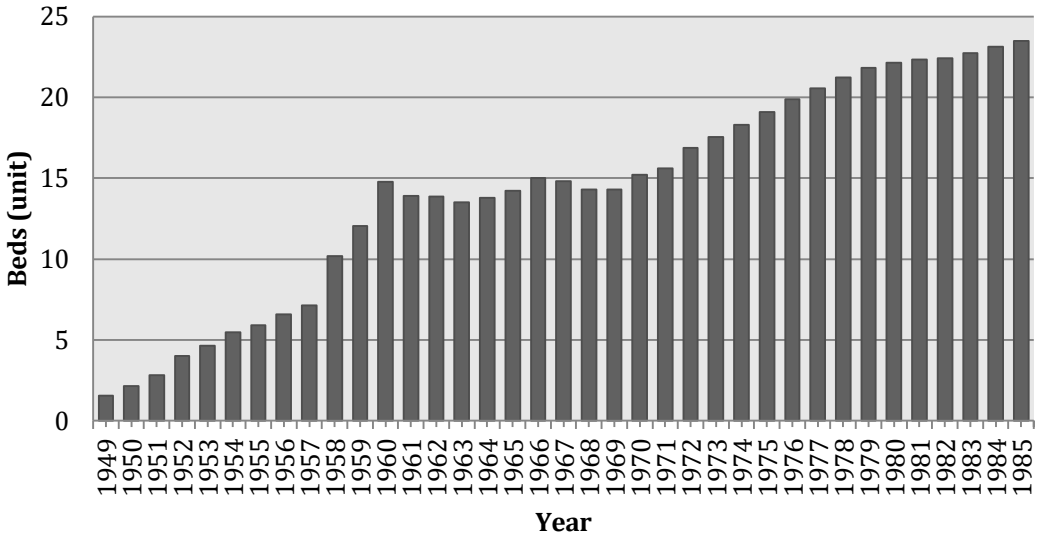
Medicine and chemical test laboratories and medical science research institutes, not shown in Figure 20 due to their low representation in the total figures for health institutions, also increased by 38.6 and 34.8 per cent respectively. These figures are not representative in the whole picture for two main reasons. First, even though Western medicine started to play a greater role in the health system during the Maoist period, Chinese traditional practices still had greater representation. Statistical records show that until 1970 more doctors were practicing traditional Chinese medicine than Western medicine (Department of Comprehensive Statistics of National Bureau of Statistics 1999). This situation was reversed in 1971, when there were 206,000 doctors of traditional Chinese medicines and 241,000 doctors of Western medicine. By 1976, the figures had reached 236,000 and 308,000 respectively. The second explanation is related to the intellectual and scientific setbacks experienced during the Cultural Revolution. The limits placed on the MOH in the process of policy-making had a great negative impact on the developments in this particular area. It was not until 1978, with the new economic reforms of Deng Xiaoping, that medical research would win a representative share of the health system.

Despite the remarkable increase in the number of health institutions during the Maoist period, the pace of growth at each stage of the health system differed greatly. The most outstanding increase came at the initial stage, with a 55 per cent growth rate; no other stage was to reach such a representative rate. In fact, after 1958, the growth in health institutions not only slowed to 8 per cent during the GLF, but also suffered stagnation and a decline in growth after 1962 (0.7 per cent growth during the adjustment stage and 2.4 per cent decline during the Cultural Revolution). Such percentages show the fiscal defaults since the beginning of the 1960s, previously explained. However, in Figure 20

we can see that in any case the records were lower than in the achievements of 1957. Even in 1971, with fewer health institutions being registered since 1959, the figures are higher than in 1957. It should also be noted that the decrease in the number of health institutions after the mid-1960s is to be explained by a decline in the number of clinics, despite which the number of hospitals almost doubled, from 35,500 in 1959 to 65,000 in 1970.

The number of beds in health institutions is another indicator of improvements to the health system. From 1949 to 1976, the number of beds available increased by 18.7 per cent. **Error! Reference source not found.**Figure 21 shows that, despite the increase in the number of beds in health facilities in the initial stage, the figures are not representative when taking the total population into account. In addition, in light of the clear inequalities between rural and urban areas, we should stress that figures did not exist for the countryside. Even during the Cultural Revolution, when a great effort was made to reduce the gap between rural and urban areas, two thirds of these resources were allocated to the latter. During the GLF there is a clear increase in the number of beds per ten thousand persons, which can be attributed to the change in the population structure, given that this particular period is characterized by high mortality rates (the levels of mortality and infant mortality in China increased to 15 per thousand and 66 per thousand respectively). The situation remained one of stagnation until the early 1970s, when there was a constant increase in the number of beds. By the end of the Maoist period, records give a figure of twenty beds per ten thousand persons.

Figure 21. Number of beds in health institutions (per 10,000 inhabitants) (1949-85)



Source: Author's elaboration from the Comprehensive statistical data and materials on 50 years of new China (1950-1998)

In terms of medical technical personnel and doctors, the figures increased by 8.5 per cent and 5.4 per cent respectively. Even though the highest figures are recorded after the 1960s, the growth rate is higher in the initial stage (4.7 per cent) and the GLF (4.6 per cent), when compared to the remaining two stages (2.6 per cent). Annual figures show that the number of medical personnel and doctors per ten thousand persons declined significantly during the initial stage of the Cultural Revolution to rates very close to those of 1957 and did not fully-recovered until the end of the Maoist period (see Figure 22). There are no specific notes in the official statistics showing whether the BFDs were included in the category of doctors or in some other category of medical personnel. In any case, while a great emphasis was placed on the BFD program covering rural areas, there was also a strong campaign to reduce the number of years of training, leading to the shutting down of a great number of medical universities nationwide.

Figure 22. Medical personnel (per 10,000 inhabitants) (1949-76

Source: Author's calculation based on the Comprehensive Statistical Data and Materials on 50 Years of New China

3.2.Provincial differences in health endowments

Health policies were implemented nationwide during the Maoist period. Yet, the decentralized system translated into provincial differences in fiscal revenues and, therefore, investment in local health-care systems (Huang 2013). Records show that the adoption and construction of health institutions remained very low in Western China (especially Qinghai, Ningxia, Xinjiang) (see Table 8). Qinghai and Ningxia provinces did not reach 1 per cent share of the total health-care facilities in the country for the whole period. A similar pattern is shown for Xinjiang and the southern region of Hainan until the decade of the 1960s. Even then, the share remained lower than 2 per cent. Table 8 shows a similar picture when the share of total hospitals in China is examined. Several features may explain this pattern. First, the western regions were, as they still are today, low-income provinces with high levels of poverty (Morgan 2021). Secondly, although these provinces constitute a great proportion of China's total geographical area, most of its land is infertile and cannot be used for agriculture. Given that, at some stages in the Maoist period the communes based partially on agricultural production funded the health system in rural areas, it is understandable that the budget for health-care

would be lower in these regions. Thirdly, the western provinces are not only less populated, but a greater proportion of minority populations are settled in these regions. Unbiased political mechanisms might be used in these cases.

In Section 2 I mentioned how during the GLF requiring the different localities to compete in the areas of health and agriculture allegedly led to actual socioeconomic achievements being exaggerated. Figures for the total number of health institutions and hospitals recorded during the GLF prove to be misleading when the share by province is computed. Such estimations suggest that provinces such as Henan, Anhui, Shandong, Hunan and Shaanxi may indeed have exaggerated their statistics regarding the number of hospitals each had (see Table 8). Many of the figures in these regions are exaggerated by as much as a facto of ten, going back to the same records as at the initial stage during the adjustment period.

Table 8. Percentage of hospitals per province during the Maoist period (1949-1976)

Provinces	Initial stage 1949-57	Great Leap Forward 1958-61	Adjustment stage 1962-65	Cultural Revolution 1966-76	Reform stage 1977-85
Beijing	1,6	0,3	0,3	0,6	0,6
Henan	4,5	42,(b)	3,0	3,3	3,9
Tianjin	1,1	0,1	0,1	0,1	0,5
Hebei	5,9	3,5	4,6	6,8	6,6
Shanxi	3,6		1,0	3,6	3,6
Jilin	2,4	1,9	0,8	1,9	1,9
Heilongjiang	3,5	2,0	2,7	2,5	2,7
Shanghai	5,9	1,1	1,2	0,7	0,7
Jiangsu	3,3	5,1	1,3	3,7	3,8
Zhejiang	3,6	8,7	0,8	5,5	5,4
Anhui	2,8	24,8(b)	1,0	3,4	4,8
Fujian	3,2	3,9	1,0	1,6	1,7
Jiangxi	3,2	20,9	0,8	2,8	3,3
Shandong	5,9	19,2	1,2	3,6	3,9
Hubei					
Hunan	4,3	12,1	1,2	6,8	6,7

Guangdong	5,2		3,5	2,9	3,0
Guangxi	3,3	0,5	0,7	1,9	1,9
Yunnan	4,0	3,5	0,6	2,7	2,8
Shaanxi	3,8	20,1[b]	0,7	4,2	4,7
Gansu	2,5	3,1	1,9	2,5	2,5
Qinghai	0,7	0,2	0,1	0,2	0,8
Ningxia	0,5	0,1	0,1	0,5	0,5
Xinjiang	2,5	1,4	1,9	1,2	1,4
Hainan	0,7	0,9	0,5	0,7	0,7
Inner Mongolia	2,1		1,0	2,5	2,7
Remaining provinces [a]	27,3	-88,7[c]	69,4	41,3	25,9
Total hospitals in China	**3.580**	**37.073**	**35.562**	**62.766**	**65.450**

Source: Author's calculation based on the Comprehensive Statistical Data and Materials on 50 Years of New China. Notes: (a) This group includes 9 additional provinces, where not data is available. We have estimated the percentage share of this group from the figures of the other provinces. (b) and (c) Our estimations give evidence that some figures were exaggerated during the GLF.

A similar pattern is observed in Table 9, which focuses all health institutions. While the increases in these figures are not as evident as when the figures for hospitals alone are examined, there is a general and representative increase in the proportions of institutions in almost all regions. The absolute figures indicate that the total number of hospitals during the GLF increased to 247,000 units from 52,000 in the previous stage. It has proved difficult to determine the reasons why these figures increased at such great rates during the GLF and with such variations across provinces. In any case, the alleged over-reporting during the GLF shown in Table 8 and Table 9 suggests that the number of health institutions had had a representative increase since the beginning of the 1960s and that the number of hospitals reached its peak during the Cultural Revolution. All through this twenty-seven years period, Hunan and Hebei Provinces seem to have had the greatest shares of the total of health institutions and of hospitals respectively. Yet both regions had high infant mortality rates during this period.

Table 9. Percentage of health institutions per province during the Maoist period (1949-1976)

Provinces	Initial stage 1949-57	Great Leap Forward 1958-61	Adjustment stage 1962-65	Cultural Revolution 1966-76	Reform stage 1977-85
Beijing	1,0	0,8	1,2	1,5	2,1
Henan	5,4	11,6	7,9	4,3	4,4
Tianjin	1,0	0,6	1,0	1,7	1,8
Hebei	4,5	2,6	3,5	5,1	5,3
Shanxi	7,2		1,6	3,0	2,9
Jilin	3,2	4,5	2,9	2,3	2,3
Heilongjiang	3,7	2,0	2,6	3,8	4,7
Shanghai	2,3	1,3	1,3	1,4	3,3
Jiangsu	6,1	6,6	5,4	4,9	5,5
Zhejiang	3,6	3,7	2,8	4,1	4,1
Anhui	4,8	9,3	3,9	4,0	3,7
Fujian	1,6	3,2	3,2	2,8	2,3
Jiangxi	3,8	5,5	2,7	3,1	2,9
Shandong	7,0	8,9	8,0	4,7	5,0
Hubei	6,0	4,9	4,9	5,3	3,5
Hunan	6,5	7,6	5,3	5,4	5,4

Guangdong	3,9		6,0	3,9	4,2
Guangxi	5,4	5,7	2,7	2,7	3,0
Yunnan	1,2	4,0	2,7	3,1	3,2
Shaanxi	2,0	5,0	2,3	3,3	3,2
Gansu	1,0	5,5	2,0	1,9	2,0
Qinghai	0,2	0,9	0,4	0,6	0,6
Ningxia	0,4	0,2	0,2	0,4	0,5
Xinjiang	0,6	1,0	0,9	1,4	1,6
Hainan	0,4	0,9	1,0	2,1	1,9
Inner Mongolia	2,7		1,7	2,8	2,4
Remaining provinces [a]	19,3	-0,6[b]	28,0	28,5	17,6
Total health institutions in China	**52.038**	**246.577**	**216.738**	**151.733**	**190.126**

Source: Author's calculation based on the Comprehensive Statistical Data and Materials on 50 Years of New China. Notes: (a) This group includes 9 additional provinces, where not data is available. We have estimated the percentage share of this group from the figures of the other provinces. (b) Our estimations give evidence that some figures were exaggerated during the GLF.

In Section 3.1 we discussed the increase of medical personnel nationwide, however the allocation of doctors was not equally distributed. **Error! Reference source not found.**Figure 23 illustrates the development of the geographical allocation of doctors in China from 1949 to 1985. It is notable that during the initial stage (Figure 23 (a)) there is a low share of doctors per ten thousand inhabitants in most regions, with the exception of Shaanxi, Hubei, Shanghai, and Beijing. During the GLF Shanxi and Shaanxi increased the rate to 27 and 20 doctors per ten thousand inhabitants respectively. While there was a general increase in the allocation of doctors nationwide, Liaoning and Guangdong reduced their share of doctors, while Tibet and Gansu Provinces remained with the same proportion (see Figure 23 (b)).

Figure 23 (c) and (d) show a clear decline in the allocation of doctors during the Cultural Revolution. While the share of doctors is greater during this period than at the initial stage and during the GLF, the adjustment stage seems to have had a greater allocation of this type of medical resources. Indeed, during the Cultural Revolution 20 out of 28 provinces decreased the share of doctors by between 2 per cent in Zhejiang Province and 41 per cent in Henan Province. However, while we notice an increase in the share of doctors at the recovery stage, previous publications indicate that the allocation was distributed mainly in urban areas, thus widening the gap between them and the rural areas.

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Figure 23. China: Allocation of doctors (per 10,000 inhabitants) by province (1949-85)

(a) Initial Stage

(b) GLF

(c) Adjustment stage

(d) Cultural Revolution

(e) First Economic Reforms

	0	5
	5	10
	10	15
	15	20
	20	40

Source: Author's elaboration from the Comprehensive statistical data and materials on 50 years of new China (1950-1998)

During the initial years of the reform stage, the allocation of doctors per ten thousand persons increased to as high as 18 per cent in Ningxia and 154 per cent in Tibet. Note that only Anhui (2 per cent increase), Fujian (1 per cent increase), and Gansu (no increase) remained stagnant in terms of health allocation. Indeed, Gansu Province had very low share of doctors (0,1 doctors per ten thousand inhabitants) and a high infant mortality rate (70 per thousand) throughout the Maoist period.

4. Health endowments, infant mortality rate, and nutritional status

In Chapter 2 we discussed the improvements of the nutritional status in China during the Maoist period. The findings indicate a positive trend of the mean heights of the population, yet with clear setbacks during the CR. Also, while the levels of inequality declined nationwide, geographical disparities of the biological standards of living remained evident, especially between the Northern and the Western provinces.

Also, as mentioned in previous sections of this chapter, infant mortality rate (IMR) declined significantly throughout this period. Figure 24 illustrates the substantial developments at a provincial level between 1950 and 1985. Most provinces reached IMR higher than 55 per thousand in the initial stage (1949-57). The excessive deaths of infants under a year old in China during the GLF are attributed to the critical effects of the Great Famine (notice that some Western and Central provinces reached levels as high as 115 per thousand). During the Cultural Revolution, over 50 per cent of the provinces indicated on the map decreased their infant mortality to rates to between 15 per thousand and 35 per thousand. Once again, these figures indicate that despite the generalized improvements, there was a substantial gap between the Northern and Western regions. Indeed, by the end of the Maoist period, Guizhou Province remained as the region with higher IMR rates and lower levels of the nutritional status.

Figure 24. IMR (per mil) by province (1950-76)

(a) Initial Satge (1950-57)

(b) GLF (1958-61)

(c) Adjustment Stage (1962-665)

(d) Cultural Revolution (1966-76)

(e) First Economic Reforms (1977-85)

	0	15
	15	35
	35	55
	55	75
	75	115
	No data	

Source: Author's elaboration from the Provincial Archive of Public Health Records **¡Error! Vínculo no válido.**

Because both the mean height of a population and the IMR are indicators of health output, in this section I investigate the association between these two variables and the health resources described in the previous sections of this chapter. The estimates in Table 10 indicate a moderate and positive correlation between heights and health resources, with greater significance for doctors. The economic determinant (GDP) also appears to be significantly associated no the improvements of the biological standards of living, though to a lower extent. Health endowments (doctors and hospitals) and GDP also show to be strongly and negatively correlated with IMR. Even though correlation does not imply causation, the findings in Table 10 suggest that the spread of health resources had a significant role in explaining the improvement of the nutritional status and the wellbeing in Maoist China.

Table 10. Coefficients of correlation

	Height	Doctors	Health institutions	Hospitals	IMR	Calories	LN GDP
Height	1,00						
Doctors	0,69	1,00					
Health institutions	0,62	0,47	1,00				
Hospitals	0,61	0,84	0,54	1,00			
IMR	-0,54	-0,92	-0,41	-0,80	1,00		
Calories	-0,07	0,19	-0,35	-0,10	-0,42	1,00	
LN GDP	0,53	0,92	0,22	0,77	-0,95	0,41	1,00

Source: Author's elaboration based on CHNS surveys (1989-2011), Comprehensive statistical data and materials on 50 years of new China (1950-1998), and the Provincial Archive of Public Health Records

5. Conclusions

The Maoist period is characterized by improvements in health indicators nationally, leading to the demographic transition in China and increased life expectancy. However, between 1949 and 1976, institutional changes can be divided into four different stages in the health-care system. The GLF (1958-61) was by far one of the greatest setbacks in China from every

perspective, including health and welfare. In terms of health institutions there were representative increases, but there are irregularities in the data, a problem noted in subsection 3.2. Also, while health institutions increased nationally during the Cultural Revolution (1966-76), the number of medical personnel per ten thousand persons declined from 1966 to 1972, reaching the same levels as in 1957. The decade of the Cultural Revolution is divided into two stages: a first period, from 1966 to 1971, when allocation of health resources suffered a decline; and a second period, from 1972 to 1976, when the distribution of health resources increased at an accelerated rate.

During the Maoist period, improvements in the health-care system were not positive in all provinces. Indeed, allocations of health infrastructure in the western regions, such as hospitals and clinics, were not representative nationwide. This is a problem, given that the population of the western regions is sparser than in other Chinese regions and therefore a greater number of hospitals and beds per person in such regions should reduce inequality nationally, a setback that still has to be solved in China (Pan and Shallcross 2016). Still, the allocation of doctors per ten thousand inhabitants was representative in comparison to other provinces located in the southeast of the country, especially after the adjustment stage (1962-65). These findings are consistent with the height difference between provinces revealed in Chapter 2, where western regions such as Guizhou and Chongqing remained with significantly lower figures than the northeastern regions such as Heilonjiang and Liaoning (about 7 cm difference throughout the whole period). Results also indicate a significant association between the allocation of health resources and the improvements in the biological standards of living and the decline in IMR, revealing the relevance to invest in the health system to improve wellbeing.

There are some limitations to this article that must be mentioned. First, the data it uses give no information about exactly where the health resources were allocated within each province, making impossible to determine whether the health inputs were equally distributed between the urban and rural areas, nor which counties and/or districts were better provisioned. Therefore, it cannot be determined whether access to health resources was equal throughout the local population. Secondly, there are no specific figures about the number of barefoot doctors during the Cultural Revolution. While this might prevent the figures during this period being clearly interpreted, it must be remembered that not only did the number of doctors and medical personnel per ten thousand inhabitants decline at this stage, so did the

quality of the health inputs because of the fewer years spent in medical education and research. Finally, so far, it has not been possible to make a clear correlation between the inequalities of health inputs and the health outputs; further study is needed in this regard. In any case, we have found a relationship between the increase in allocations of health resources and the general improvements in health.

Despite these limitations, it has proved possible to answer the questions set out in the introduction to this chapter. Contrary to Mao's aim, to reduce health inequalities in China, variation was indeed found in the distribution of health resources among the provinces before the spread of the economic reforms at the end of the 1970s. Indeed, today's disparities between western and eastern China, in terms of inputs and outputs of health, were already existent prior to the development of the special economic zones. Also, it can be concluded that, while health inputs increased from 1950 to 1976, the health policies implemented during the GLF and, especially, the Cultural Revolution simply produced a weakening of the health system in some provinces, where deterioration of the nutritional status also took place (see Chapter 2). Future research must be carried out to determine the degree of correlation between inequality in the distribution of health endowments and inequality in health outputs.

Chapter 4. New evidence of the Great Flood of 1975 in Henan province, China. A last forgotten famine?

1. Introduction

In August 1975, one of the most catastrophic hydrological failures in world history took place in Henan province, China. The disaster occurred after Typhoon Nina hit Zhumadian prefecture in Henan province, causing the failure of 62 dams and unleashing one of the most devastating floods in the history of the province. The calamity, known as the *Qiwu-ba* great flood (七五八大洪水) in China, had substantial, disastrous effects on land, infrastructure, and human lives in the region. Today the number of human lives lost is still unknown, but the estimates of casualties range from 26,000 to 230,000 (Human Rights Watch Organization 1995; Yi Si 1998; Ying 2012).

Recent publications have analyzed the flood of 1975 from a technological perspective (Tie-sheng et al. 2012; Y. Xu, Zhang, and Jia 2008). Because one of the main explanations for the disaster lies in the failure of hydrological policies implemented in the 1950s and 1960s, the authors offer the flood as a case study to criticize the environmental, technological, economic, and safety issues concerning hydrological plans and constructions, such as the Three Gorges Dam in the mid-1990s and the South-North Division Project at the beginning of the 21st century (Human Rights Watch Organization 1995; Yi Si 1998). According to several publications, heavy rains and the collapse of the dams on August 8th of that year resulted in approximately 85,600 perishing immediately from drowning; and up to 144,400 deaths from starvation and related diseases in the following months (Human Rights Watch Organization 1995; Yi Si 1998). Despite the response from local and national government to provide food and medical aid, the means to enable the distribution of such provisions were not sufficient to overcome the dimensions of the flood; months after the disaster, hundreds of thousands of people were remained trapped in water, had no communications, and were coping with survival strategies. The aim of this article is to analyze the impact of the flood of 1975 on agriculture and population in order to capture food availability and

understand the humanitarian crisis that took place in the region. To do so, we make a long-run comparison of the impact of droughts and floods on grain per capita and the mortality rate in Henan province from 1950 to 1985, spanning the Maoist era and the early years of economic reform.[39]

The relevance of this article relies on three main points. First, although the flood of 1975 has been studied previously, to our knowledge, no former research has analyzed the disaster from a long-run perspective, capturing the dimension of the flood in comparison to earlier and later years also struck by natural hazards.[40] Second, even though the famine that took place in the aftermath of the catastrophe has yet to be officially acknowledged by national and local government today, in the early 1980s, eight members of the National Committee of the Chinese People's Political Consultative Conference (CPPCC) reported that the total death toll was 230,000 people from, both drowning and famine (Qiao et al. 1987). Proof of excess mortality in 1975 relating to a decline in food availability from a historical standpoint is relevant to better understanding the incident and reconsidering the statement of authorized Chinese officials, according to whom the last famine recorded in China took place during the Great Leap Forward (GLF) (1958-62).[41] While the interaction of flood and famine is a

[39] I concentrate on floods and droughts because, based on official records, these are the most habitual types of natural hazards to hit Henan.

[40] In this article I take the definition of *disaster* as "the result of a vast ecological breakdown in the relation between humans and their environment, a serious and sudden event on such a scale that the stricken community needs extraordinary efforts to cope with it, often with outside help or international aid". Disasters can be divided into two categories: natural or man-made disasters. The former arises from the forces of nature, while the latter can be derived from technological disasters or complex emergencies. I take this definition from (National Center for Environmental Health and Centers for Disease Control and Prevention 1997), p.26. I understand the *Qiwu-ba* flood disaster to have been instigated by a high rate of precipitation and aggravated by the complexity of the hydrological construction policies set during the Maoist period. Aside from this particular event, I do not draw any distinction as to whether all other disasters fall into one category or the other. In any case, if there are no severe consequences from flood or drought, I address these events as natural hazards.

[41] The famine took place during the Great Leap Forward, a period in which the people's communes took over 99 per cent of total rural households, affecting numerous provinces in the country, including Henan. This famine has been classified as the most emblematic famine in world history, where between 15 and 45 million people perished out of a total population of 650 million inhabitants (2.3 percent to 6.9 percent of the total population nationwide). Until recent years, the number of deaths remained between 15 and 32.5 million. For relevant demographic work, see (Coale 1984; Ashton et al. 1984; Peng 1987a). Recent research based on new historical archives estimates losses at 45 million lives, see (Dikotter 2010). This figure has been criticized by Ó Gràda on several grounds. First, for the use of unreliable sources; second, exaggerating the death toll by adding a 50 percent mortality rate to the highest estimation made by demographers on the topic (32.5 million deaths); third, for taking into account deaths from suicide and torture during the period of famine, rather than concentrating mainly on mortality rates due to starvation and related disease, (Ó Gráda 2011). Latest estimates set the total population loss at 53 million, including

limitation on my ability to determine the main cause of mortality, our approach uses well-founded and current methodological scales to identify famine under the international standards, using indicators such as the crude mortality rate per day, social and market conditions, and coping and survival strategies (Food and Agriculture Organization of the United Nations 2008) .

Finally, the historical analysis allows a comparison to be drawn between the GLF famine and the hidden famine of 1975. While the nature of their causes differs, a comparative analysis allows a better understanding of the magnitude and intensity of the crisis, within the same geographical context and under the governance of Mao. That is not to say that the regime remained static from 1949 to 1976. Indeed, a perceived change in implemented policies for famine prevention is a specific feature of the period.

I can detect the dimension of the flood at a prefecture level. However, the results reflect a rather marginal impact on agriculture across the province. The explanation for this lies in the fact that, despite the political and social turmoil of the Cultural Revolution (1966-1976) with negative effects on the health and educations systems, the decade is characterized as a period of agricultural intensification in Henan province; it is identified with the widespread adoption of the Green Revolution. Tackling the impact of the disaster on population at a provincial level is a rather difficult task. At a first glance, the demographic transition that characterized the period blurs the impact on the mortality rate and the fertility rate in the years immediately after the flood. Consequently, I use a moving average for the mortality rate and birth rate from 1954 and 1985 in order to identify unnatural deaths and shortage of births for crisis years in the period under discussion. This allows drawing new conclusions on the total number of lives lost for 1975. Even though the results for unnatural deaths are much lower than the highest figure of 230,000 deaths found in some sources, our estimated figure is more than three times as high as the official number given by the government since the 1980s. In addition, as previously mentioned, I analyze the aftermath of the flood based not only on the mortality rate, but also on food security descriptors, capturing that year's famine.

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21 million unnatural deaths and shortage of births of 32 million, see (J. Yang 2012); even though considered a less reliable conclusion, other scholars put their estimate of the death toll during the period of famine at up to 60 million, see (Becker 1996). In any case, this is a subject that continues to remain uncertain today.

The results of the study encourage to consider the hypothesis that the famine was triggered by a decline in food availability in the prefectures directly affected by the flood and was intensified because of the government's unsuccessful response to the major hardship generated by the disaster and, therefore, generating a decline in the living standards among the population residing in the effected areas. This is linked to Amartya Sen's theory that famine causation can be explained not only by a decline in food availability, but also by deprivation of food entitlements.[42] The statement rises to an open question for future research focusing on other aspects, such as grain storage, government aid, and transportation issues after the flood. This article, however, concentrates mainly on the food supply, since the aim of the study is to take a historical approach to the direct impact of the flood.

2. The sources

Referring to the GLF famine, Ó Grada highlights that "the cost of famine is often controversial, because famines are nearly always blamed on somebody, and excess mortality is reckoned to be a measure of guilt" (Ó Gráda 2011). This is not only true in accepting the death toll, but also in accepting a famine's causation. The Henan famine of 1975, which is still unknown among a large part of the Chinese populace, is an example of why some calamities are kept quite. Authorities covered up the consequences of the 1975 flood in Henan province until the 1990s, when official data were partially made public. In August 2005, the National Administration for the Protection of State Secrets (NAPSS) declared that the death tolls caused by natural disasters in China would no longer be a state secret in order to foster greater transparency in the country and benefit disaster prevention and relief work (Congressional-Executive Commission on China 2005; G. Chen 2016). However, this statement referred to fatalities encountered from that date onward, not necessarily retrospectively from a historical perspective. These are specific issues that we have encountered in carrying out this study, especially considering that the period of analysis

[42] In 1981, Amartya Sen introduced Food Entitlement Decline (FED) as a new economic theory to explain famine. Sen considers that there is enough food in the world to prevent famine and explains such a crisis as the drop of food demand due to bad economic and governance performance. This would explain why famines sometimes affect specific areas or particular groups of people, while neighboring states or inhabitants are enjoying an adequate intake of food (Sen 1981, 1987).

concentrates on the decade of the Cultural Revolution (1966-1976), which was characterized by social and political turmoil. Even so, the data used in this article show the dimensions of the shock and the records in the gazetteers, especially at a prefecture level, yield qualitative data on the specifics on a monthly basis, providing a better understanding of the historical facts for the period in question.

The sources used in this study are official records from Henan province, including both statistical annals and chronicles. The historical archives contain both quantitative and qualitative information collected in a variety of areas, such as climate, population, and agriculture. In order to better capture the flood of 1975, we use provincial and prefectural data, mainly concentrating on Zhumadian prefecture, the epicenter of the disaster. The sources used for the analysis at a provincial level are the Henan province Statistical Yearbook (1985) (*Henan Tongji Nianjian*; 河南统计年鉴); Henan gazetteers (1985) (*Henan Sheng Zhi*; 河南省志); Henan chronicles (1949-1985) (*Henan Tong Jian*; 河南通鉴); and the Comprehensive Statistical Data and Materials on 50 years of New China (1950-1998) (*Xin Zhongguo Wushi Nian Tongji Ziliao Huibian*; 新中国五十年统计资料汇编). Additionally, we use the Zhumadian prefecture gazetteers (1950-1985) (*Zhumadian Diqu Zhi*; 驻马店地区志) to perform the analysis at a prefecture level. This historical archive gives both quantitative and qualitative data for the region and specific information on the disaster of 1975.

3. The Banqiao collapse of 1975

3.1. Hydraulic policies in the 1950s and 1960s: the roots of the disaster

The development of hydropower constructions in China represented an essential plank in the political agenda since the establishment of the PRC. Seeking to improve agricultural conditions and bolster the industrial sector, the country engaged in a wide-ranging construction of dams during the First (1949-57) and Second (1958-62) Five-Year Plans (Habich 2017). The campaign to “Harness the Huai River” in the 1950s was established by the State Council as a response to the great damage of the Huai River flood in Henan province in 1950. The campaign consisted of building dams in order to

obtain hydropower and achieve flood control in the area. Two main dams were constructed at the beginning of the decade: the Banqiao dam (1951-52) and the Shimantan dam (1951), built on the upper reaches of the Ru River and the Hong River, respectively (see Figure 25). As with other large structures built nationwide, the construction of the two dams reflected a lack of knowledge of hydraulic engineering, expert warnings were ignored, and the socio-economic outcomes were deficient (Shapiro 2001; Zhou 2010; Habich 2017). By 1955, the dams had to be reconstructed with expert Soviet supervision. The remodeling focused on the reinforcement and expansion of both dams. The Banqiao dam, at 116.34 meters, allowed for a maximum storage capacity of 492 million cubic meters and a flood storage capacity of 375 million cubic meters. The dam was constructed to withstand 1-in-1000-year flood conditions. The Shimantan dam, at 109.9 meters, allowed for a maximum storage capacity of 94.4 million cubic meters with a flood storage capacity of 70.4 million cubic meters (Yi Si 1998).

In 1957, after the construction of both major dams, the building of other dams and reservoirs spread beyond the mountainous areas and towards the central plain. In total, more than one hundred structures were built in Zhumadian prefecture over the following two years. By 1958, the “Harness to the Huai River” campaign in Henan province had become a model to follow nationwide. However, despite criticism from hydraulic experts, the dams and reservoirs constructed in Zhumadian prefecture during this period were built based on negligent decisions, such as a reduction in sluice and spillway gates. Such decisions led to serious floods in the region during the Great Leap Forward (1958-61). This fact gave rise to a new campaign in 1961: “rectify deviations and correct past errors”, which led to the repair and demolition of several dams. However, despite the efforts of Zhou Enlai to achieve a more comprehensive approach to water resource management in 1962, the campaign of the 1950s remained latent and several hundreds dams were built again, while many others were neglected even though they were not in good conditions (Fu 1998; Habich 2017; Yi Si 1998). In the early 1970s, 32 million cubic meters of retention structure were added to the Banqiao dam, surpassing the dam’s safe capacity. With similar negligence, a 1.9-meter-high earthen embankment was added on top of the Shimantan dam (Yi Si 1998).

Figure 25. Location of the Banqiao dam in Zhumadian Prefecture, Henan Province

3.2. The development of the flood of 1975

The flood was a three-stage process of continuous rainfall between August 5th and August 8th, 1975, in the prefecture-level cities of Zhumadian, Xuchang, Nanyang, Luohe and surroundings (see Figure 26). The torrential rains came with Typhoon Nina, which originated in Taiwan, gathered increasing force through Fujian, Jiangxi, and Hunan provinces, and finally reached its peak in Henan province. In the first stage, on August 5th, precipitation reached 448.1 millimeters, a figure never before recorded in the region. On that day, the Banqiao dam reached near-full capacity rising to 107.9 meters. The second stage, on August 6th, developed into a rainstorm that lasted for sixteen hours, raising the levels of rainfall in the Banqiao dam to 112.91 meters and surpassing its safe storage capacity by more than 2 meters. Finally, in the third stage, on August 7th, the rainfall lasted for thirteen hours, resulting in a total of 1600 millimeters of precipitation over the three days, almost doubling the figure for yearly average

precipitation.[43] The rainfall for these days was recorded as a 1-in-2000-year condition, exceeding expectations at the time of the dam's building.

The Zhumadian Municipal Committee warned of potential flooding from the collapse of several small dams. According to prefectural gazetteers, several communications to neighboring prefectures were reported in the initial days of the storm asking for emergency assistance from the People's Liberation Army (PLA) and the flood control headquarters. But the torrential rain destroyed soon all communications. Early on August 8th, the Banqiao dam surpassed its maximum capacity by reaching 600 million cubic meters and a height of 118 meters high. The structure collapsed. In seconds a waterfall measuring 6 meters by 12 kilometers flooded the whole area. The Shimantan dam also collapsed after reaching 120 million cubic meters capacity, 25 million cubic meters greater than its capacity. The calamity resulted in a lake measuring 300 kilometers by 150 kilometers, 1-to-7-meters in depth, submerging entire counties and having a severe effect on thirty-three districts. In the process, 842 rivers flooded; 296 bridges were destroyed; 3 million houses were washed away; and 666,667 ha of arable land went underwater.

[43] Based on the Henan Province Annals, the yearly average precipitation between 1951 and 1980 in Zhumadian prefecture was 953.8mm. Based on the China Meteorological Administration, the yearly average precipitation between 1971 and 2000 in Zhumadian prefecture was 972.9mm.

Figure 26. Henan Province by Prefecture

4. Analyzing the impact of the flood: Instability in agricultural production, mortality, and morbidity

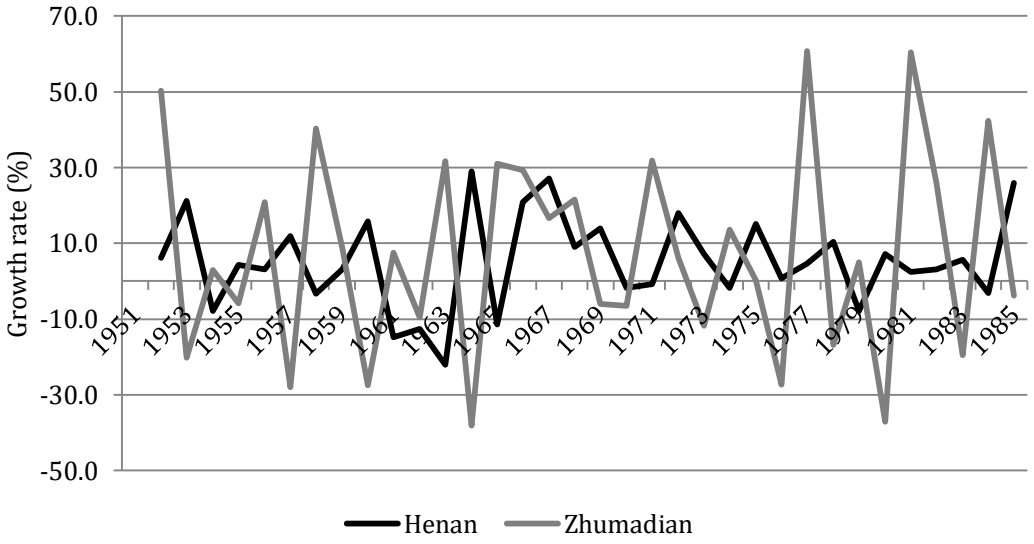
The areas affected by the flood of August 1975 were in south Xuchang, Luohe, east Nanyang, and Zhumadian prefectures in Henan province and Fuyan prefecture in Anhui province. The following analysis concentrates on the comparison between Henan province and Zhumadian prefecture, the epicenter of the disaster.

4.1. Agriculture and grain output

In terms of grain yield, the impact of the 1975 flood in the province was not as representative as other natural calamities between 1950 and 1985. Figure 27 shows an increase of 4.6 per cent in grain yield in Henan, regardless of the flood and drought recorded that year. This stands in contrast to the impact of drought and flood recorded between 1958 and 1961, during the GLF, where grain yield decreased by 40 percent the period of the GLF famine, when there was a 40 per cent, representing an extreme case

of crop failure comparable to Garnaut's estimation of a 40 percent decline in 1942, also a famine year instigated by drought (Garnaut 2013).

Figure 27. Grain yield growth rates in Henan Province and Zhumadian Prefecture (1950-85)



Source: Author's elaboration based on (Henan Tongji Nianjian 1985 [Henan Statistical Yearbook 1985] 1986) and Zhumadian Gazetteers

Figures for Zhumadian prefecture show an extremely disturbing picture. Figure 27 illustrates a 27.4 per cent decrease in total grain yield in 1975 compared to the previous year. Considering that neighboring Luohe, Nanyang, and Xuchang prefectures were also severely damaged, the situation may be seen as even more alarming. The comparison with the period of the GLF famine is also shocking; between 1959 and 1962, when no natural disasters are recorded with the exception of hail in 1959, we compute a 29.4 per cent decrease in grain yield. That the declines are nearly the same for both episodes is distressing, if we recall that the comparison is between a three-year period in the case of the GLF famine and only a one-year period for 1975. Given that the total fatalities during the GLF famine were over 300,000 in Zhumadian prefecture, at this point we should at least question the real impact of the 1975 flood on the total mortality rate arising from starvation and related diseases reported by the local government up until today.

Another important aspect to consider is the decline in grain yield in 1979 and 1982 in Zhumadian prefecture, which can be seen in Figure 27. The flood of 1979 had a notable impact on grain yield that year, resulting in a reduction of 37.2 per cent from the preceding year, the lowest figure recorded since 1966. As for the severe flood of 1982 the impact was a 19.5 per cent reduction from the previous year. In July 1982, the precipitation level reached 541 mm to 539 mm in a three-day-period, flooding 666,667 ha of land. The result: 600 million kg of food crops damaged; 300,000 houses washed away; the collapse of 7,000 bridges; and the over-flooding of 94 river embankments. In Henan province, flooding also took place in the western regions of the province and severe drought was recorded for that year as well. The total area affected by drought was over three million hectares. The effects of 80 to 90 percent less than normal annual precipitation in some areas of the province included the loss of the harvest in various prefectures, the drying-up of small reservoirs and a 50 per cent loss in total motor-pump water wells, and hardship in accessing water consumption for over 450 people and 85,000 livestock. Regardless of both flood and drought, the overall provincial grain yield increased by 5.7 percent from 1981 to 1982. Also, the 1979-grain yield represented an increase of 6.7 percent relative to the previous year in the province, despite the flood and severe drought on record.

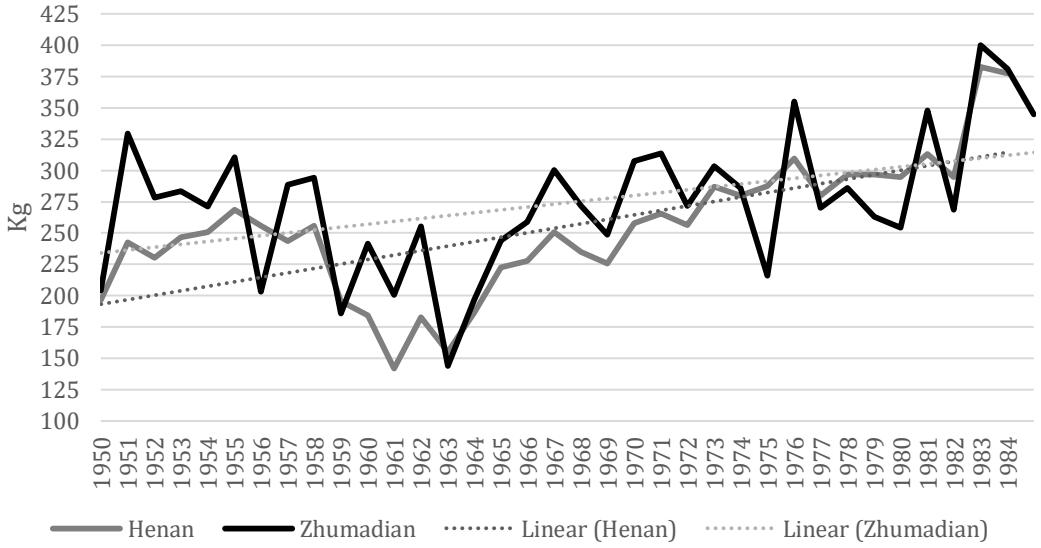
Why these two years with their representative decrease in grain yield for Zhumadian prefecture did not devolve into famine deserves future analysis. However, we are to consider that the improvements made in the post-Mao period lessened the humanitarian impact of natural disasters, despite their increase in volatility (Courtney 2017; G. Chen 2016). This is not to say that during the whole Maoist period the state failed to overcome great disasters after natural hazards hit the country. Indeed, several cases have been studied as successful management plans that prevented the development of major catastrophes after flooding occurrence (G. Chen 2016). Yet this was not the case for the *Qiwu-ba* Flood. Several interrelated mechanisms developed into a humanitarian crisis, including famine and the spread of disease. The components entailed conditions of vulnerability both before and after the consecutive rainfall between August 5th and August 8th of that year. In the last section of this article, I address the issue as to why the government in this case, contrary to other floods, was unable to prevent a major catastrophe.

Figure 28**Error! Reference source not found.** shows constant fluctuations of grain per capita between 1950 and 1985 in Henan, which can mostly be explained by natural hazards.[44] In the case of the 1975 flood, the impact is evident in Zhumadian prefecture, which shows a decrease of 24.5 percent from 1974 to 1975. The grain per capita in 1975 (215 kg) was only slightly above the rate recorded at the end of the GLF (201 kg). While I limit my analysis to grain production in this study, it is worth noting that neither of the recorded figures during the GLF and 1975 reached the benchmark established at 275 kg to 300 kg of raw grain per capita for rural food self-sufficiency in China during the Maoist period.[45] Indeed, these rates represent very low standards of caloric intake. From 1975 to 1976, grain per capita increased by 65 per cent. Local sources describe how the widespread presence of corpses in Zhumadian after the flood helped as a fertilizer to boost the harvest in 1976. In addition, the increase in lives lost from one year to the next also contributed to the sharp increase in grain per capita. However, despite the flood and drought recorded in Henan in 1975, the figure for grain per capita remains at "self-sufficient" levels; we calculated a 3 per cent increase over the previous year, reaching 287 kg per capita.[46]

[44] Due to lack of information in the sources, I am limited to provide only an approximation measure of the grain per capita consumption. Please note that these figures include feed grain and food grain, and do not account for exports and imports to the region.

[45] During the Maoist period, production between 275-300 kg of raw grain per capita (after provision for seed and some livestock feed) is set as a benchmark figure to represent rural food "self-sufficiency" (providing between 1700 and 1900 calories). Rates of grain production near 200 kg per capita are considered to provide very poor levels of caloric intake (between 1200 and 1400 calories). On the other hand, 310 kg per capita or more is considered to provide between 1900 and 2000 calories and the extra-quota amount was expected to be sold on a voluntary basis to the state or the market (Walker 1984a), p. 3.

Figure 28. Grain per capita in Henan Province and Zhumadian Prefecture (1950-85)



Source: Author's elaboration based on Henan Statistical Yearbook (1985) and Zhumadian Gazetteers

For the period of the GLF, with evident fluctuations between 1958 and 1961, the reduction in total grain per capita was of 31.7 per cent in Zhumadian prefecture (from 294 kg to 201 kg respectively). However, if I take 1963 into account, the decrease in grain per capita since 1958 was 51 per cent, falling to 144 kg per capita, the lowest figure recorded in the prefecture for the whole period since the establishment of the PRC. The low rate of grain per capita in 1963 can be partially understood by the exceptional combination of a representative decrease in grain production for that year and a remarkable increase in natural population growth. While this issue deserves further investigation, a detailed analysis lies outside the scope of this study. Between 1958 and 1964 though, no natural hazards were recorded, with the exception of 1959, a year hit by hail. The decrease in grain per capita after 1958 would not recover to figures preceding those of the GLF until 1967, at both provincial and prefectural levels. Indeed, there would not be a recovery in terms of "grain self-sufficiency" until the early 1970s (see Figure 28).

Other years that must be considered at a prefecture level are 1956 and 1982. Both years suffered from flooding and saw a reduction in grain per capita of 34.6 per cent and 22.8 per cent, respectively, in comparison to the previous year. The flood of 1956 was due to

a higher than normal precipitation rate that lasted 20 days during the summer season (100 mm rainfall per day). Six hundred rivers overflowed affecting 400,000 ha across the whole province and, having a serious impact on Zhumadian prefecture. In autumn of that same year, drought also developed in the whole province with 50 to 90 per cent less than normal precipitation (less than 22 mm rainfall for three consecutive months). Indeed, the occurrence of natural disasters that year spurred on supporters of the massive construction of dams and reservoirs in the province during the GLF (Yi Si 1998).

Both Henan province and Zhumadian prefecture reached their peak point in 1983, with 383 kg per capita and 400 kg per capita, respectively. These figures surpassed the benchmark for "self-sufficiency" grain production per head, the level at which peasants were expected to sell their surplus production on a voluntary basis to the free market or to the state as a function of the market price.[47] Indeed, between 1983 and 1985 the excess of grain production at a national level dropped market prices to close to the above-quota price set by the state, leading farmers to sell their surplus supply to the state. This created a financial burden on the government and over-storage in state-owned granaries (L. Li 2007).

Finally, I capture agricultural instability at both the provincial and prefectural levels by estimating the intensity of the annual fluctuations in grain per capita in Henan and Zhumadian.[48] To do so, I calculate the standard deviation in the variation of the logarithmic rate in grain per capita at both the provincial and prefectural levels. Several conclusions can be drawn from Figure 29, which illustrates the trend in agricultural instability. First, in the long term, there was greater stability in Zhumadian Prefecture than the provincial level. Second, while I can discern great agricultural instability during the GLF in both Henan as a whole and in Zhumadian, the variation shows its greatest intensity in the prefecture. This coincides with recent estimates of population loss during the GLF famine, indicating that 23 per cent of unnatural deaths and birth

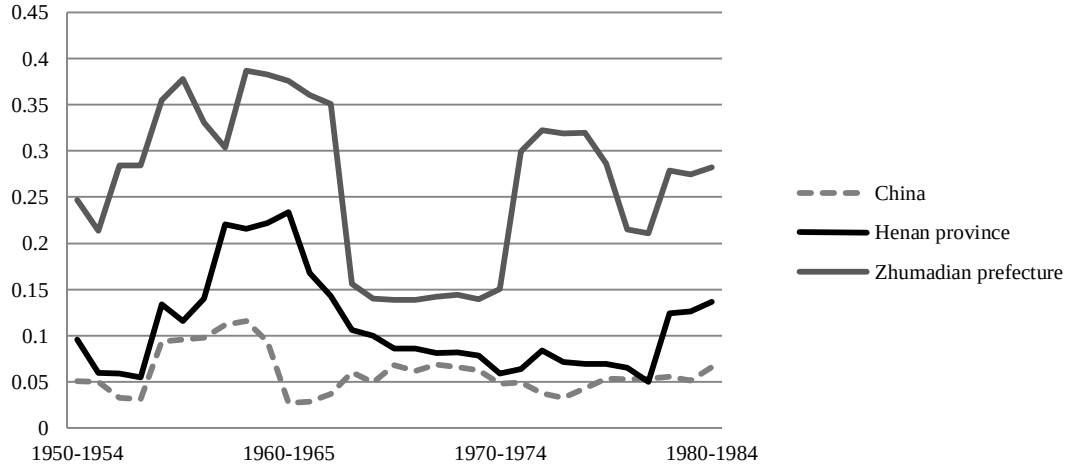
[47] In theory, after the market reforms of the late 1970s, the state sought to reduce grain procurement quotas, decollectivize production, and let prices depend on the market. In practice, up until the late 1990s, there was an interaction between government intervention and market liberalization. This allowed farmers to sell extra-quota amounts to the free market or the state, depending on the price level (L. Li 2007), p.373.

[48] Note that, due to a lack of data for imports and exports of grain, I am using figures for grain production per capita.

shortages in Henan province between 1959 and 1961 took place in Zhumadian prefecture (see Table 11). Finally, there was great variation in grain per capita by the mid-1970s in Zhumadian, which is not captured in Henan. This reflects the process of intensification in the primary sector in Henan province since the mid-1960s and the severity of the flood in Zhumadian prefecture.

Figure 29. Grain per capita instability at the national, provincial, and prefectural levels (1950-1984)

85]



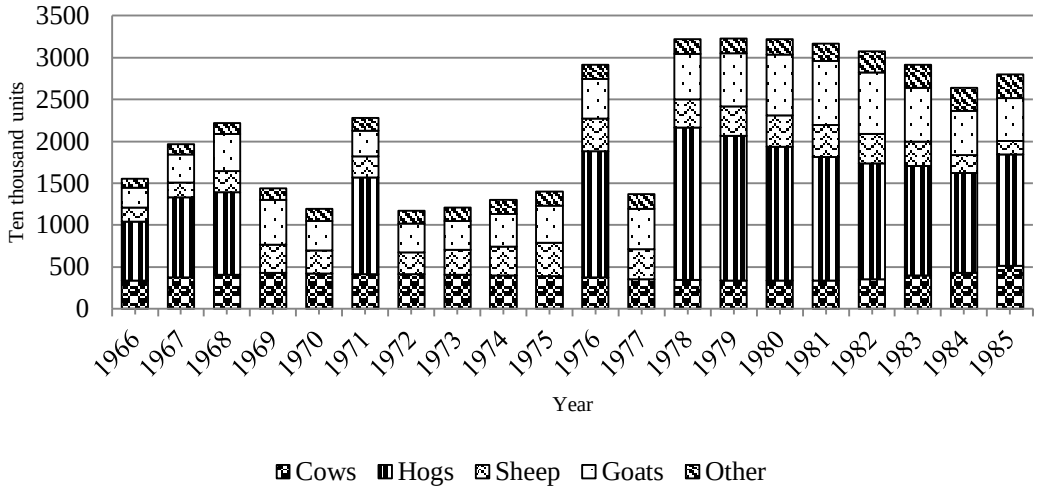
1986), Zhumadian gazetteers (1949-85), and (Department of Comprehensive Statistics of National Bureau of Statistics 1999)

At the beginning of the 1980s, livestock figures in Henan province started to increase at a continuous rate, coinciding with the reforms of 1978. It was not until 1985 that the figure reached the same level as that of 1954. The period of the Great Leap Forward corresponded to sharp decline, which started to recover in 1966, consistent with new agricultural measures, which also had a positive impact on grain yield and, therefore, the maintenance of livestock. Nevertheless, the period of the Cultural Revolution (1966-1976), despite agricultural intensification, is characterized as a period of stagnation for most types of livestock for nearly all years (including cattle, horses, donkeys, mules, goats, and sheep), with the exception of hogs, which saw a notable increase of 158 per cent when comparing the first and last years of the period (see Figure 30 (a)). Notice that data on hogs are missing for the years 1969, 1970, and 1972 to 1975, making it difficult to tackle the impact of the 1975 disaster on the most representative livestock

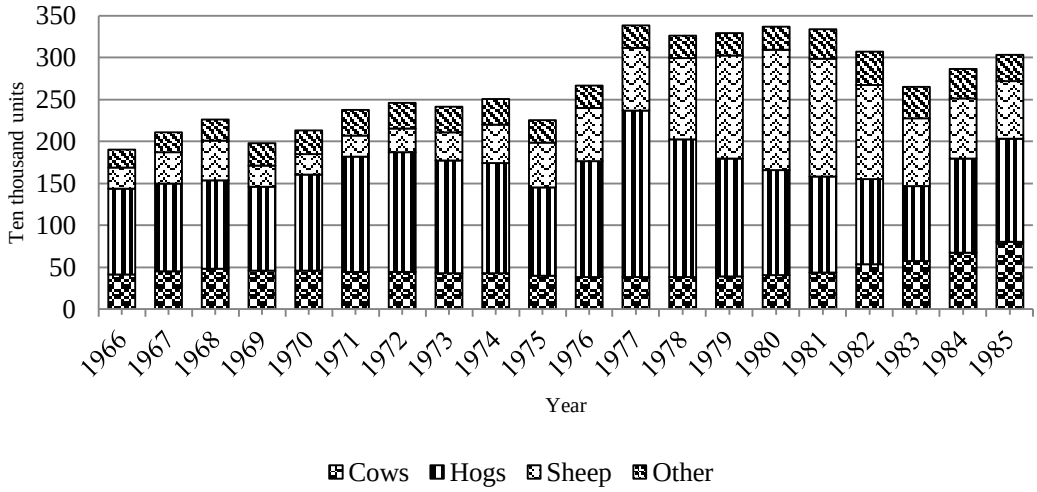
type in the province at that time. Based on the statistical data for cattle, horses, donkeys, and mules, the stagnation period persisted until the end of the 1970s. Further analysis should determine the decline in cattle to the decline in protein intake among the population and, therefore, the effects tot the deterioration of the living standards during this period. Note in **Error! Reference source not found.**Figure 30 that after 1978, livestock figures began to rise on a constantly upward slope.

Figure 30. Total livestock in Henan province and Zhumadian Prefecture (1966-85)

(a) Henan province



(b) Zhumadian prefecture



Source: Zhumadian Prefecture Chronicles (1985). (Sun 2012; *Henan Tongji Nianjian 1985 [Henan Statistical Yearbook 1985]* 1986) *Notes:* (1) "Other" includes horses, mules, and donkeys; (2) For Henan province there is lack of statistical data for hogs for years 1969, 1970, 1972-75, and 1977.

In this case, it is not possible to make a comparison between 1975 and the period of the GLF famine with respect to the different types of livestock because of lack of data on sheep, goats, and hogs for most years prior to 1966. But other sources place the total loss of livestock in the province between 1958 and 1961 at 740,000 units (J. Yang 2012). Henan gazetteers show that 300,000 head of livestock died in the flood of 1961, representing 40.5 per cent of the losses during the GLF. In addition, I make a long-term comparison by only considering the total figures for cows, horses, mules, and donkeys. Records show that total livestock for 1975 surpassed the figures for all famine years during the GLF, with the exception of 1958. However, I calculated a 4 per cent decline from 5.67 million head in 1974 to 5.46 million head in 1975. This constant decline continued until 1979. In order to better capture the impact of the disaster on livestock, I examined the data at a prefecture level. Based on Zhumadian prefecture's statistics, there is a noticeable decline for most types of livestock, especially cattle and hogs. The total loss of livestock units between 1974 and 1975 stood at 251,400, a 10 per cent decrease (see Figure 30 (b)). Therefore, most livestock losses in the province for that year took place in Zhumadian prefecture. Indeed, statistical records in the prefecture's gazetteers show that exports of hogs declined by 9.6 per cent from 1974 to 1976.

The question that arises from the analysis so far is why, then, is the impact of the disaster is mainly observed at a prefectural level, and not at a provincial level? The answer relies on the process of modernization in the agricultural sector, especially since the mid-1960s. Because agriculture is the main pillar of Henan's economy, local government placed great emphasis on the modernization of the sector. After the implementation of the new economic model during the GLF, leading to famine, and its negative consequences over the immediately subsequent years, local government focused in 1966 on a recovery based on the intensification of agriculture. This modernization was grounded in irrigation, application of fertilizers, and mechanization. We can identify this year as the starting point of the Green Revolution in the region. In fact, because of Mao's call for regional grain self-sufficiency, modernization in agriculture for this period affected China as whole, compelling peasants to concentrate on physical grain targets (Kueh 1995; Shapiro 2001).

With the aim of improving food production amid recurring droughts and floods, the main objective of the local government in 1966 was to improve the irrigation system.

This required a better use of water from the Yellow River and, as previously mentioned, the building of hydraulic engineering constructions. From a short-run perspective, the former had a positive impact on the soil by enriching saline and alkaline soil so that it became fertile. This had a decisive effect on the use of farmland in many regions within the province and contributed to an increase in grain yield. The annual growth of grain yield for the period from 1966 to 1978 was 5.4 per cent. It also explains why the impact of the 1975 disaster is not easily detectable in the province's overall grain yield when compared to the previous year.

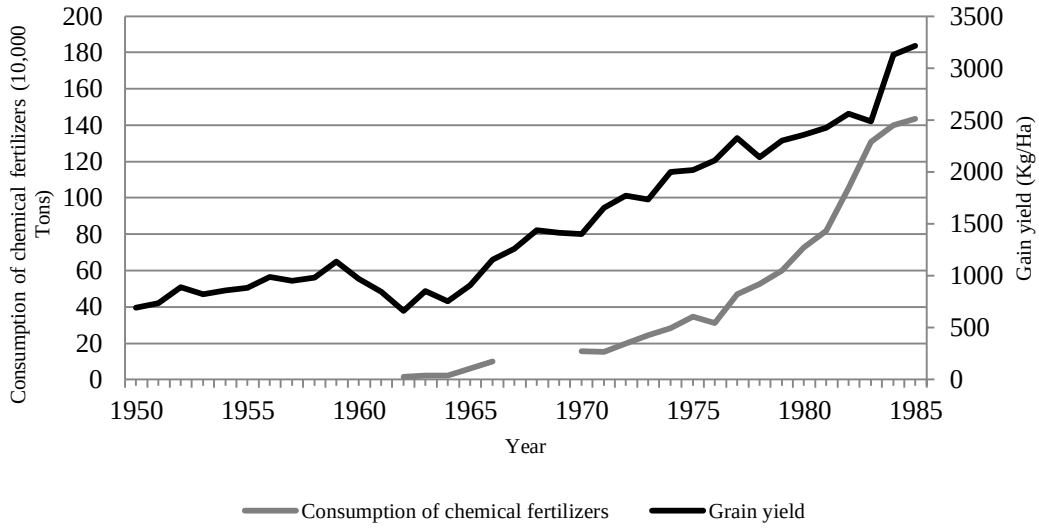
In the second half of the 1960s and especially in the decade of the 1970s, many reservoirs were also constructed and reconstructed. By the end of 1978, 2,494 reservoirs of large, medium, and small sizes, with a total water capacity of 144 hundred million cubic meters, had been either constructed or repaired (Sun 2012). This coincides with a 10.5 per cent increase in the share of irrigated area over sown area from 1972 to 1977. The improvements in water conservation for this period did not have a positive impact only on irrigation, but also on the problem of potable water, ameliorating social welfare in main cities such as Kaifeng and Zhengzhou. In addition, for the period between 1966 and 1978, a drainage irrigation system was implemented. This was based on the construction of electromechanical wells, along with other mechanized systems, in order to pump water to the surface. With the yearly increase from these types of constructions, there was simultaneously a constant rise in water-irrigated area in the province, which is considered to be one of the main explanations for the improvement in grain output, especially during the 1970s.

The irrigated area as a percentage of the total agricultural sown area increased from 4 per cent in 1950 to 28 per cent in 1985. The annual growth in the irrigated area between these two years is 5.3 per cent. From 1957 to 1959, there is a clear increase in irrigated area as a percentage of the total agricultural sown area from 9.2 per cent to 18.8 per cent, respectively. This was due to the predominant idea of dam construction, previously explained earlier in this article. However, misguided policies during the GLF led to a decline of 10.5 percentage points between 1959 and 1962, reflecting the downward slope of grain yields over the period.

Another agricultural input used to improve grain yields between 1966 and 1977 is the application of chemical fertilizers. Notice Figure 31, that the use of chemical fertilizers

is practically nil for the years prior to 1966. Even though the consumption of chemical fertilizers for this year is also low, with a rate of 9 kg per hectare, it appears to be the starting point for the application of this agricultural input and, although lacking the figures for 1967 to 1970, the tendency seems to follow an upward trend. By the end of 1977, the consumption of chemical fertilizers had risen to 43 kg per hectare. A more representative increase was to start in 1978, after the new economic reforms. Notice in the graph that the use of chemical fertilizers between 1962 and 1985 follow an upward trend similar to total grain yield. In the case of applying chemical fertilizers, there was a 22.2 per cent increase between 1962 and 1985, rising from 1 kg per hectare to 123 kg per hectare, respectively. Agricultural intensification resulted in a 7 per cent increase over the whole period.

Figure 31. Use of chemnical fertelizer and grain yield in Henan Province (1950-85)



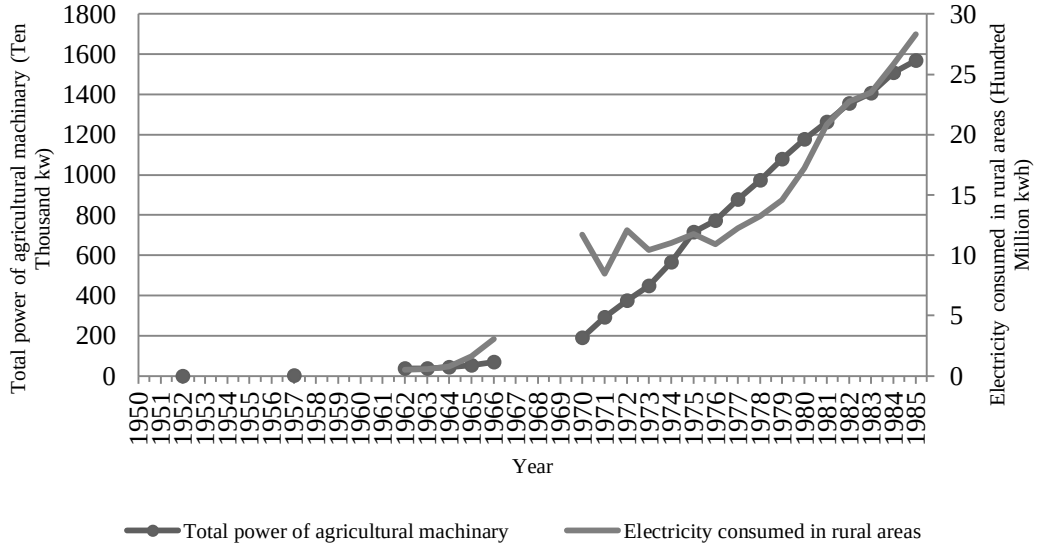
Source*:* Author's elaboration based on (Department of Comprehensive Statistics of National Bureau of Statistics 1999; *Henan Tongji Nianjian 1985 [Henan Statistical Yearbook 1985]* 1986)

The period of the Cultural Revolution is also characterized as a time of mechanization in agriculture, especially from the beginning of the 1970s. The use of machinery to plow the fields was rare in the 1950s and low in the 1960s, but in the 1970s there was a gradual increase in the use of medium and large-sized tractors, as well as mechanized walking tractors. In 1960, according to the Henan Statistical Yearbook of Agriculture, the use of medium and large-sized tractors was 2,206 units and the use of mechanized

walking tractors was 48 units. By the end of 1977, the use of this type of machinery had risen to 36,479 units and 69,688 units, respectively. Also, the use of mechanization to process agricultural products such as grain, cotton, and oil intensified during the period. These types of machines grew from 52,705 units in 1966 to 523,540 units in 1977. Figure 32 shows the trend for the total power consumption by machinery from 1950 to 1985. Notice that the upward slope starts at the beginning of the 1970s. The annual growth for the period of 1966 to 1977 is 33 per cent, whereas it is 29.7 percent from 1952 to 1985.

Another important factor of agricultural intensification in this decade is the electrification of rural areas. Figure 32 shows the upward slope between 1957 and 1985. I assume that most electricity consumption in rural areas was focused on agriculture. Based on this assumption, it can be noticed that electrification starts to increase at the beginning of the 1970s alongside the intensified use of mechanization. Electricity consumption is more obvious after the economic reforms of the late 1970s and it intensifies by the mid-1990s.

Figure 32. Consumption of electricity and agricultural machinary power in rural Henan Province (1950-85)



Source: Author's elaboration based on (Department of Comprehensive Statistics of National Bureau of Statistics 1999)

While these improvements in Henan might explain the blurring of such a localized disaster in 1975, it would be misleading to say that the modernization process in the agricultural sector had only positive outcomes. Intensification in agriculture also led to other mid and long-term social problems such as forced migrations, the ecological degradation of the soil, and the role of grain as the basic wage good. Several points must be stressed in this regard. First, the *san ziyi bao* (三自一包) program established during the years of recovery after the GLF famine (1962-1965) was practically abolished during the Cultural Revolution, encouraging peasants to concentrate on physical grain targets and leading to an absence of economic diversification in the farm sector.[49] Institutional changes led to large-scale labor mobilization and egalitarian farm distribution similar to the commune system, resulting in disincentivized peasants and farm inefficiency, which had negative effects on non-grain sectors. Second, in the mid-1960s nitrogenous fertilizers were used to produce high grain yields in the short term, ignoring long-term issues such as nutrients requirements, soil types, and application techniques (Ash 2006a; Kueh 1995). Third, as previously explained, the state-driven hydraulic initiatives pursued under negligent conditions since the 1950s led to the catastrophic collapse of dams in Henan in the mid-1970s and long-run economic and environmental effects nationwide, including deforestation, siltation, and erosion. Indeed, by 1980, almost 3,000 dams had collapsed and over 10 million people had been relocated countrywide (Shapiro 2001). The political instability at the time posed an additional social issue with major repercussions in the economic arena. During the Cultural Revolution, any criticism voiced by intellectuals and experts would end in severe persecution (Habich 2017; Shapiro 2001; Zhou 2010). Moreover, even though there had been a positive increase in grain per capita since the implementation of the Green Revolution, as previously shown in Figure 28, records did not reach self-sufficient requirements until the early 1970s in Henan province and the early 1980s in Zhumadian prefecture.[50] Therefore, agricultural development during the Cultural Revolution blurred the impact of the disaster of 1975 on grain production and on grain per capita at a provincial level, but it did not lead to exceptional food sufficiency among

[49] The *san ziyi bao* program was characterized by an expansion of the private plots, the presence of rural trade fairs, and the sideline activities on private account. During the Cultural Revolution, new policies led to re-opening rural markets, the return to price and production planning, and sanctions of contracts between individual farm households and production teams.

[50] Based on the estimations made by (Walker 1984a), p. 3.

the rural population. The situation made the survivors of the flood more vulnerable to the famine conditions that arose in the following months.

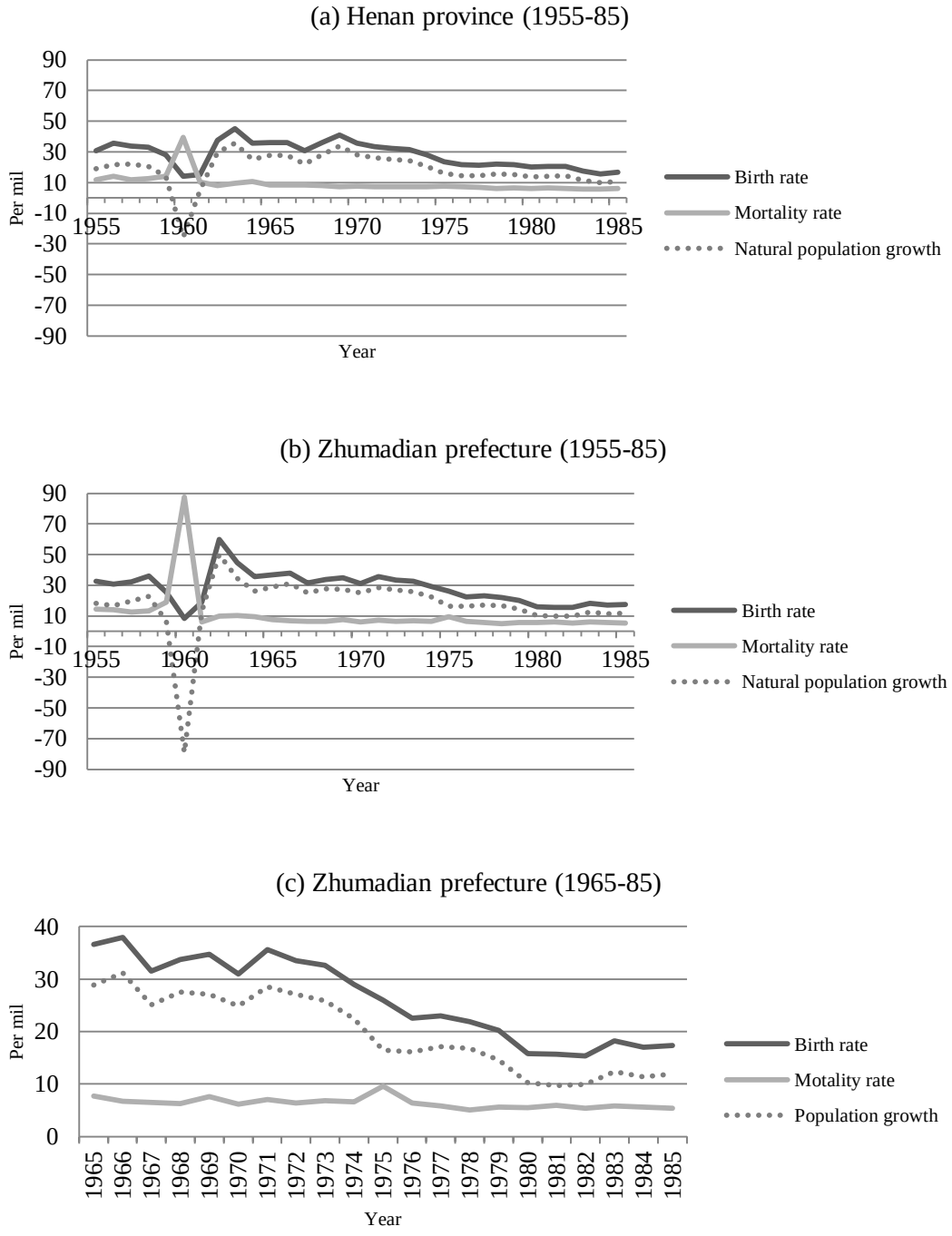
4.2. Population loss and the spread of disease

The widespread reach of the Green Revolution since the mid-1960s had a positive impact on food production; it also contributed to an improvement in water quality. Both factors, together with investment in health and education, ameliorated the living conditions by declining mortality rate (especially infant mortality). From the beginning of the 1970s, the implementation of birth control polices forced a decline in the fertility rate, which translated into an additional cause for the decline in mortality. These changes in the region's demographic patterns developed into the demographic transition. Despite its importance in understanding the modernization of the region, the fact that this process took place in the 1970s becomes an issue when analyzing and interpreting the impact of the disaster of 1975 on Henan's population.

The disaster occurred in only four out of the 18 prefectures in the province at the time of the demographic transition. For this reason, the mortality figures recorded in Henan Province Statistical Yearbook and Henan Province Annals do not show the dimensions of the disaster at first glance; the records reflect an increase of only 3 per cent in the rate of mortality from 7.44 per mil in 1974 to 7.66 per mil in 1975, and a 6.3 per cent decline to 7.18 per mil in 1976. The most representative figure for the rate of mortality from 1950 to 1985 is given during the peak of 1960, when it reaches 39.6 per mil, coinciding with the toughest famine year during the GLF in Henan province (see Figure 33 (a)).

Zhumadian prefecture shows a tendency similar to Henan during the GLF. Based on the chronicles of the prefecture, the mortality rate reached its pick at 87.5 per mil in 1960 (see Figure 33 (b)). For the flood of 1975, Figure 33 (c) gives a more representative picture of the impact of the disaster in Zhumadian in contrast to the figures on the mortality rate observed for the province as a whole. The mortality rate for the prefecture reflects a sharp increase of 45.5 per cent between 1974 (6.6 per mil) and 1975 (9.6 per mil), falling back to 6.3 per mil in 1976 and not surpassing 5.9 per mil in the remaining years.

Figure 33. Mortality rate, birth rate, and population growth in Henan Province and Zhumadian Prefecture



Source: Author's elaboration based on (a) (Henan Tongji Nianjian 1985 [Henan Statistical Yearbook 1985] 1986) and Henan Province Chronicles (1985) and (b), (c) Zhumadian Chronicles (Volume II)

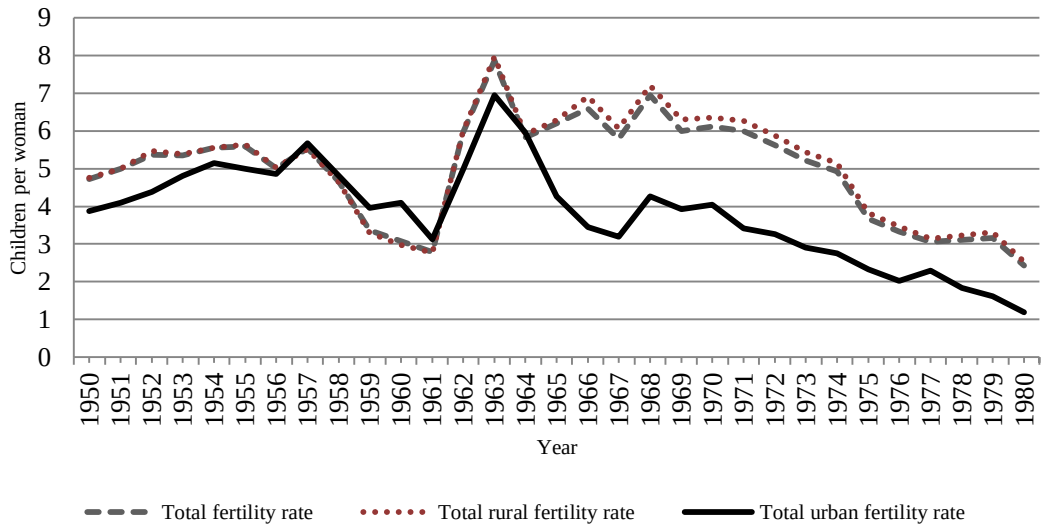
Uncertainty over the rate of mortality is not new in famine history. In China, undisclosed data have been a problem for approximating the death toll in the Henan famine of 1942-43 and the GLF famine, among others. A methodology to estimate the mortality rate for famines has been applied in previous studies by using information from the population tree and converting these figures into a quantitative measure of the demographic impact of a famine. Methodologically, theses studies measure the relative size of age cohorts born during and immediately after the famine and comparing the results from a long-run perspective in order to identify the gaps corresponding to famine years (Freeney and Kiyoshi 1990; Garnaut 2013; Meng, Qian, and Yared 2015; Peng 1987a). Using data on age cohorts has two main advantages. First, this type of data is more reliable than the mortality rate, solving the problem of underreported mortality. Second, it provides a more accurate understanding of the severity of the famine, considering that couples will more likely decide not to have children in times of hardship; women will be in worse health conditions for childbearing; and children under 5 will be more vulnerable to early death from starvation and related diseases than adults.

Error! Reference source not found. Figure 34 shows the consistent results of previous studies, which demonstrate that the GLF famine had a crucial impact on the average number of children born to a woman of childbearing age during the affected years; in this case the figure reached its highest point in 1961 with 2.8 children per woman. I have calculated a 51.4 percent decrease in the fertility rate from 1957 to 1961; this rate is 6 percentage points over the national average for the decline in the fertility rate over the same period based on Peng's study (Peng 1987a). Notice that contrary to before and after the famine years, the period of 1958-1961 is characterized by a higher fertility rate in urban areas than in rural areas, providing evidence that the rural population suffered more during the famine years. This coincides with other statistical and econometric studies of the GLF famine (J. Lin and Yang 1998, 2000; Peng 1987a). Another indicator of famine is the increase in the fertility rate in the years immediately after the famine. This pattern is indicated in Figure 34. Fertility rate in Henan Province (1950-80), where there is an increase of 117.4 per cent and 185.1 percent in 1962 and 1963, respectively, in relation to the fertility rate in 1961.

As for the 1975 disaster, the impact is not well captured. The problem of using fertility rate data for this period is the introduction of birth control policies during the 1970s. The one-child policy was applied in Henan province in 1980; however, other policies

controlling population growth had started to be implemented in 1971. These policies sought to delay the age of marriage and, therefore, to postpone childbearing age and reduce the number of children per woman. This same pattern of family planning had also taken place in Zhumadian prefecture since the beginning of the 1970s and the encouragement of one child per family had been established since the mid-1970s. The impact of such policies could result in explanation bias regarding for the decreasing trend in the fertility rate in Henan province from 1971 onward, masking the presumed famine of 1975 (see Figure 34). The application of these new polices, alongside the improvement of food production, had contributed to the demographic transition of Henan province since the beginning of the 1970s, as illustrated in Figure 33 (a).

Figure 34. Fertility rate in Henan Province (1950-80)



Source: Henan Province Chronicles (1985)

The impact of the 1975 flood on the population of Henan province is still undetermined. Immediately after the disaster, Qian Zhengying, Minister for Water Resources and Electric Power in 1975, announced that the death toll in the region had reached 85,600. This number corresponded to the people who had drowned in a two-hour period, immediately after the failure of the dams. The Ministry of Water Resources and Electric Power published this figure in July 1989. However, the limited number of printed copies never reached the general public. Three years later, a second edition published by the same source replaced this figure with 26,000 dead and referred to the first estimate

as a mistake.[51] Also in the 1980s, eight members of the National Committee of the Chinese People's Political Consultative Conference (CPPCC) reported that the figure reached approximately 230,000 (Qiao et al. 1987). This rate corresponded to 85,600 fatalities immediately during the flood and 144,400 fatalities after the disaster due to starvation and related disease.[52] The Henan Province Annals for 1975 specify that 12.3 million people (18.2 per cent of Henan's total population) were affected by the year's flooding in the province. Bearing in mind that the population of Zhumadian prefecture that year was 5.98 million (9 per cent of Henan's total population), this provides evidence of the dimensions of the impact on the prefecture and neighboring regions. However, when referring to casualty figures, the source gives a rough number such as "more than tens of thousands of people [died]".

Previously, we identified the decade of the 1970s as the beginning of the demographic transition. Despite the implied advances implied in the transition process, it does present issues for my analysis of the impact of the Qiwu-ba flood on Henan's population. In order to overcome the problem, I use a methodology applied by Del Panta and Livi Bacci to identify demographic crises from a historical perspective by integrating a moving average of the number of births and number of deaths in each year over a particular period (Del Panta and Livi-Bacci 1977). This methodology entails calculating the truncated average of eleven years, computing only six after discarding both the two maximum values and the two minimum values. This allows for the exclusion of the two highest values, which usually correspond to a period of crisis, and the two lowest values, which correspond either to years with exceptional, favorable conditions or to years of post-crisis conditions. Therefore, the average values represent the development of normal deaths for the period of study, taking into account the population and its nutritional, health, and climatic conditions. Values that deviate from the mean of the moving average indicate a year of crisis, given the absolute number of unnatural deaths for that particular year and the shortage of births usually for years of crisis and immediately after famine. The sums of both values represent the total population loss.

[51] This second edition was published four months before the China's National People's Congress approved the Three Gorges Project, the largest dam construction in the world, which had been questioned within the government and by academics and has led to great controversy (Human Rights Watch Organization 1995).

[52] Presumably, the eight members of the CPPCC had direct access to internal government files on the disaster of 1975 in Henan province, including the confidential Huai River Water Resources Committee report of March 1979 (Qiao et al. 1987).

This approach sheds more light on the impact of the Qiwu-ba flood on the population in Henan in three particular areas. First, the mortality rate provides the absolute number of people who died in a specific year, without making any distinction between natural and unnatural deaths. By using this methodology, I determine the number of people who perished in a single year due to an exogenous shock, that is, who would not have died in normal conditions. Second, the figures for individual deaths due to the flood vary within a wide range depending on the sources (from 26,000 to 230,000). Therefore, it is important to estimate the excess number of deaths for the affected years based on a period marked by normal mortality. Results show that the latest official figure given by the government - 26,000 deaths - is underestimated, proving a misreported death toll for 1975. Finally, by employing this approach, I also determine the absolute number of unborn children that would have been born in normal conditions. Because I use a moving average for the period from 1954 to 1985, I am able to isolate the issue encountered when using the fertility rate, which would have been affected by the demographic policies implemented since the beginning of the 1970s. Finding the unnatural deaths and the shortage of births gives the total population loss in a crisis year. In this case, the total population loss provides a better understanding of the actual impact of the 1975 flood on Henan's population.

Results estimate population loss during the whole Maoist period is 4.9 million: 1.7 million unnatural deaths and 3.2 million shortage of births. Most population loss took place during the GLF. For the flood of 1964 estimates indicate 78.000 unnatural deaths due to drowning and with no indication of famine in the aftermath despite the decline in grain production, based on the provincial gazetteers. No shortage of births is registered as a consequence of this particular event. For the initial stage of the CR (1967 and 1968) estimates indicate the population loss summed to 431,000, including 21,000 unnatural deaths in 1967 and 410,000 shortage of births between both years. Only a minor flood was registered in 1968 and Graph 2 indicates that grain per capita increased during these two years. Therefore, I attribute such demographic decline to the effects of political repression during the initial stage of the CR and not to the presence of a humanitarian crisis. Results show that the Qiwu-ba flood led to a total population loss of nearly 300,000 lives in Henan province between 1975 and 1977. This corresponds to a shortage of births of 203,546 and nearly 90,000 unnatural deaths (see Table 11). Because the aim of this chapter is to analyze the state of humanitarian crisis during the

Maoist period, the following paragraphs concentrate on the particularity of the GLF famine and the great flood of 1975.

The estimate of 90,000 unnatural deaths as a consequence of the *Qiwu-ba* Flood shows nearly 64,000 additional fatalities to the figure given today by the government reports. This is a representative finding because although the figure is still significantly lower than the highest number of 230,000 deaths reported in other sources, it provides evidence that the number of deceased given by the government is misrepresented and that the actual figure is more than three times the official amount.

Table 11. Total population loss during crisis years in Henan Province and Zhumadian Prefecture

Famine	Location	Year	Shortage of births	Unnatural deaths	Total population loss
GLF	Henan	1959	441.476	137.697	579.173
		1960	1.267.503	1.363.050	2.630.553
		1961	846.920		846.920
		1959-61	**2.555.899**	**1.500.747**	**4.056.646**
GLF	Zhumadian	1959	40.354	31.983	72.337
		1960	114.451	309.789	424.240
		1961	76.945		76.945
		1959-61	**231.750**	**341.772**	**573.522**
***Qiwu-ba* Flood**	Henan	1975	9.334	50.918	60.252
		1976	194.212	20.661	214.873
		1977		17.297	17.297
		1975-77	**203.546**	**88.876**	**292.422**
***Qiwu-ba* Flood**	Zhumadian	1975	688	20.203	20.891
		1976	17.100	1.001	18.101
		1975-76	**17.788**	**21.204**	**38.992**

Source: Calculation based on Henan province Population Annals (1954-1985).

My estimations show that 24 per cent of the unnatural deaths took place in Zhumadian prefecture. However, the prefecture's chronicles indicate that 22,564 people drowned during the flood of 1975 and that 1,633 died of disease after the disaster, adding a total of 24,197 casualties. This figure exceeds my estimation based on the statistical records of the prefecture by more than 3,000 deaths. This, in turn, suggests that the statistical figures in the historical archives are also underestimated and the number of unnatural deaths should be even higher. Even though the figure of fatalities recorded in Zhumadian chronicles resembles the lowest number of fatalities reported by government officials, the figures correspond to only one of the five prefectures affected by the flood. Therefore, we presume that death rates are much higher than the 26,000 losses reported in January 1992. This interpretation reinforces our findings of nearly 90,000 unnatural deaths. The prefectural sources indicate that significant amounts of aid provided Zhumadian until August 1976. Indeed, even neighboring prefectures effected by the flood, sent significant amounts food and medical resources. This may explain why the 75 per cent of the unnatural deaths were registered outside the boundaries of Zhumadian prefecture.

Shortage of births is a common indicator of famine due to nutritional and disease effects on the population, especially females. It can also be attributed to economic issues insofar as they directly affect decisions made by couples to postpone marriage and childbearing. I estimate the shortage of births for both years 1975 and 1977 at a provincial and prefecture level. In each case, I estimate that the shortage of births is lower in the year of the flood than in 1976. This proves reasonable considering that the flood took place five months before the year ended and, therefore, the impact would be more noticeable in the year immediately after the disaster. In the case of Henan the total shortage of births for both years reaches 203,546, nine per cent of which took place in Zhumadian (see Table 11). The total population loss between 1975 and 1977 is 293,000 for Henan and 39,000 for Zhumadian prefecture.

In the case of the GLF famine, the total shortage of births at a provincial level exceeds 2.5 million and unnatural deaths reach 1.5 million for the years between 1959 and 1961. The total population loss totals almost 4.06 million, similar to Yang's estimation, which

totals to 4.01 million from 1958 to 1961.[53] The total population loss in Zhumadian prefecture for the same period reaches 573,522. This figure includes a shortage of births of 231,750 and 341,772 unnatural deaths (see Table 11). Notice that 7.5 per cent of the total population in Zhumadian perished and 23 per cent of deaths in the province took place in this prefecture. In this case, we should take into account that the excess deaths were not only due to starvation and related diseases, but also to the political repression at the time. Explaining the causes of famine during the GLF goes beyond the aim of this article, but it is important to highlight that the application of new agricultural policies such as the commune system, the over-reporting of grain production at a provincial level and consequent increase in procurement quotas by the state government, and the inadequate communication between different governmental levels in the country led to a clear decline in food availability and food entitlement in Henan province, the epicenter of the famine, as it did in a vast portion of the country. Any kind of criticism of the system and the suffering caused by starvation per se was treated with severe punishments by local authorities and supporters, including torture and being beaten to death (J. Yang 2012).

One limitation of this study is to consolidate the cause of mortality. Because one of the objectives of the study is to identify famine after the flood, we must address this issue. From previous publications and sources, there is no question that the intensity of the flood caused fatalities from drowning in the immediate stage of the disaster. But what was the cause of death in the disaster's aftermath? Zhumadian gazetteers, in a survey conducted on August 13th of that year, indicate that four out of nine counties in Zhumadian prefecture suffered from disease. From a total population of 2,068,843 inhabitants in Xincai, Pingyu, Runan, and Suiping counties (34.6 per cent of the prefecture's total population), 52.2 per cent suffered from disease. It has been determined in previous studies that flood fatalities might be related to an increase in

[53] Yang estimates the normal mortality rate and birth rate by averaging the mortality and birth rates for the three years before and after the crisis. The result is subtracted from each year's death rate and birth rate respectively, and multiplied by that year's total population. This calculation gives the total unnatural deaths and total shortage of births for each particular year. The reason I have used Del Pant and Livi Bacci's methodology instead of Yang's is to exclude extreme values in the time series and obtain a more accurate average that avoids issues such as the implementation of demographic policies at the beginning of the 1970s. My results do not show unnatural deaths for 1958 because the methodology does not allow me to calculate the figure for this year, given that I have the mortality rate in the prefecture since 1954. Results for total population loss during the GLF using both methodologies are similar enough to validate my estimations (J. Yang 2012).

disease and food insecurity (Malilay 1997). There is no question that the humanitarian crisis resulted in an increase in morbidity and mortality in the subsequent months. Identifying whether the morbidity was related to the flood or famine is extremely difficult because the cause of death during famine is mostly due to microorganisms and not starvation. In any case, it is of extreme importance that infectious diseases are treated immediately. However, in the case of Zhumadian, 370,000 people were still trapped in the water almost one month after the disaster and the rescue process did not end until September 26th of that year. For almost 50 days, a large part of the population could not be reached because of major damage to the railroad and highway infrastructure. This impeded the arrival of adequate medical aid and food to the affected population.

Table 12 shows the percentage of the population suffering from different diseases after the flood in Zhumadian prefecture, mainly gastrointestinal and infectious illnesses related to flood and famine conditions.[54] How can this be attributed to famine conditions? Three approaches may explain it. First, digestive diseases can evolve in an environment of food quality deterioration. Based on the Zhumadian chronicles, after the flood of 1975, people were eating rotten grain and dead animals, and drinking contaminated water. This is evidence of the severity of the situation, as well as a clear explanation as to why 54 per cent of the population affected by disease suffered from gastrointestinal syndromes. Second, illnesses such as fever, typhus, and malaria in a famine scenario are explained by a decline in hygiene standards. The flood washed away three million houses in Henan, leaving hundreds of thousands without shelter. This condition exposed the affected population to microbial regimes to which they were not immune. Finally, infectious diseases are aggravated by a decrease in physical energy output, which is caused by serious malnourishment (Centers for Disease Control 1992; Mokyr and Ó Gráda 1999; R. Yip 1997). In the previous section, I pointed out that the levels of grain consumption in Zhumadian for the affected year were between 1,200 and 1,400 kcal/day/person. Guidelines from the World Food Programme and the United Nations High Commissioner for Refugees set 2,100 kcal/day/person as a minimum ratio during a humanitarian crisis (United Nations High Commissioner for Refugees and

[54] Most of the diseases illustrated in Table 2 are mainly related to famine conditions based on the study of (Mokyr and Ó Gráda 1999). Also see (Malilay 1997), p. 315-321

World Food Programme 1997). While food aid was sent from other provinces, the dimensions of the flood did not allow the aid to reach hundreds of thousands of people. Note that the available data on diseases refer only to those that had been reached by rescue teams. In addition, the Center for Disease Control states as follows:

Famine is usually caused by the amplification of pre-existing conditions characterized by widespread poverty, intractable debt, underemployment, and high malnutrition prevalence…when additional burdens related to the production or availability of food arises, generalized starvation occurs rapidly (Centers for Disease Control 1992).

Since the 1950s, both men and women had been involved in demanding physical labor related to agriculture, construction, mining, and heavy industry. As Walker points out, "a total calorie requirement of 2,100 per head of total population might be regarded as a conservative standard" (Walker 1997). Based on Walker's estimations, Henan reached only 1,733 kcal/day/person in 1974 (Walker 1997). This gives evidence that the general population, while reaching "self-sufficient" grain standards, was indeed vulnerable to any external shock. The conditions created by the *Qiwu-ba* flood in the following year represented a critical situation for those facing a clear decline in food availability.

The flood explains other representative diseases, such as conjunctivitis, Japanese encephalitis, cold, and trauma (see Table 12). Was a local government successful at preventing the spread of disease and undertaking its treatment? While prefectural gazetteers specify the rescue teams, including doctors, sent to the affected areas, there is no specific information on the percentage of people who were treated, nor whether any deaths resulted from such diseases. This entails an additional limitation to the study and once again raises questions about the mortality rate reported in the records. In any case, prefectural gazetteers indicate that the flood had destroyed all hospitals in the affected areas and Henan Annals show a clear decline in investment in healthcare during the Cultural Revolution in the province, which might have given rise to additional constraints during the rescue period.

My interpretation of the presence of disease to identify famine must be treated with caution, because, as previously mentioned, flood fatalities can also be related to most of the diseases shown in Table 12. Therefore, assigning morbidity only to famine would be presumptuous. In the following section, therefore, I use qualitative data to determine the presence of famine as a consequence of the flood.

Table 12. Population affected by disease in Zhumadian Prefecture, 1975

Disease	Affected population	% of total population affected
Enteritis	336,285	33.6
Dysentery	162,494	16.2
Fever	21,172	2.1
Malaria	23,967	2.4
Conjunctivitis	96,306	9.6
Trauma	94,205	9.4
Cold	92,442	9.2
Japanese Encephalitis	1,000	0.1
Typhoid	892	0.1
Indigestion	38,770	3.9
Oedema	1,130	0.1
Other	132,301	13.2
TOTAL	1,000,964	100

Source*:* Zhumadian Prefecture Chronicles. Note: The files used in this study also indicate that 922,096 people were injured in the disaster.

5. Defining Mao's famines in Henan

I take a step forward in this analysis by using two famine scales introduced by Devereux and Howe to capture the intensity and magnitude of a famine under contemporary parameters at the international level (Devereux and Howe 2004). Because establishing an agreed definition of *famine* still poses a challenge today, the authors put forward a new methodology to identify famine in order to facilitate famine prevention and/or the response of governmental and non-governmental agencies, so as to avoid major catastrophes. The methodology is used by, among others, the Integrated Food Security Phase Classification (IPC) Global Partners, which is made up of key international organizations focused on improving food security analysis and decision-making (Food and Agriculture Organization of the United Nations 2008). The adoption of the intensity scale allows for tackling the severity of a crisis at a specific point in time, while the

magnitude scale refers to the aggregate impact of the crisis on the affected population.[55] The authors stress that:

The scales aim to apply the understanding of famine contained in theoretical definitions, together with the empirical insights of the early warning and the coping strategies literatures, to the diagnosis and classification of actual cases, and thereby to introduce a degree of rigor to what has hitherto been left vague and intuitive (Devereux and Howe 2004).

Contrary to other approaches, both scales capture the multiplicity of the impact of famine. I apply this methodology from a historical perspective in order to comprehend the impact and severity of the humanitarian crisis of 1975 in Henan and compare it to the GLF famine in the region.

The indicator used to capture the magnitude of the crisis is the mortality rate. Because different sources provide different numbers for the death toll from the disaster of 1975, I consider three distinct figures: the lowest and highest numbers indicated in the sources (26,000 and 230,000 casualties) and my own estimation (89,000 casualties). However, these records include victims killed by drowning and by famine. Therefore, I concentrate only on the figures relating to the former causalities, computing 1,633 deaths as the lowest figure and 144,400 deaths as the highest. With respect to my own estimation, I assume the official figure provided by the government of 26,000 killed by drowning and subtract it from our estimation of total unnatural deaths, resulting in 63,000 deaths by starvation and related diseases. Based on the magnitude scale shown in Appendix 4 (see Table 15), I identify this year of crisis at the provincial level as a major famine (Category C) when considering the lowest figure and as a great famine (Category D) when considering the highest figure. At prefecture level, I classify the magnitude as moderate famine (Category B). As for the GLF famine I apply the mortality rate for 1959 and 1960, the toughest famine years in Henan. At a provincial level I classify this period as a catastrophic famine (Category E), considering that the death toll from starvation and related diseases totaled over 1.5 million people. At a prefecture level, we identify the magnitude of the crisis as a great famine (Category D), taking into account the record of 341,772 excess deaths (see Table 13).

[55] For other studies using this methodology see (Rubin 2009).

Table 13. Magnitude scale. Crises in contemporary Henan Province

Famine	Year	Location category	Estimated mortality	Magnitude classification	Phrase designation
GLF	1959-60	Henan	1,500,747	Category E	Catastrophic famine
GLF	1959-60	Zhumadian	341,772	Category D	Great famine
***Qiwu-ba* Flood**	1975	Henan	63,000	Category C	Major famine
			144,400	Category D	Great famine
***Qiwu-ba* Flood**	1975	Zhumadian	1,633	Category B	Moderate famine

Sources: Author's estimations based on (Henan Tongji Nianjian 1985 [Henan Statistical Yearbook 1985] 1986); Zhumadian Prefecture Chronicles

In order to capture the severity of the crisis in 1975, I use the indicators in the intensity scale (see Appendix 4, Table 16). Because I do not know the specific time framework in which the excess death toll took place, I consider a minimum and a maximum length of time to compute a crude mortality rate (CMR) per day: 48 days, which is the length of time in which the affected population was trapped in water, and 145 days, which is to the period spanning from the first day after the disaster to the last day of the calendar year.[56] Once again, I consider the lowest and highest mortality figures recorded in the sources and my own estimation presented from Table 1. Based on the lowest figure of excess deaths documented, which refers only to Zhumadian prefecture, the computed CMR for every 10,000 inhabitants per day is as low as 0.02 and 0.1. The number is also low when considering our own estimation: 0.1 to 0.3 CMR for every 10,000 inhabitants per day, classified on the scale as level 0 and 1, respectively. However, when considering the highest excess mortality on record, referring to all affected prefectures, the CMR is representative, ranging from 0.6 to 1.8 deaths for every 10,000 inhabitants a day. According to the measurements on the intensity scale shown in Appendix A, the most significant CMR figure computed shows a famine condition in the region

[56] Notice that I only consider the figures for 1975. Therefore I consider 25,000 deaths for my estimations (51,000 deaths [our estimations for year 1975] – 26,000 deaths [figures given by the governments] = 25,000 deaths). The period 1976-77 is left out of this analysis for caution of the final interpretation. Based on the latest data I have in my domain since 2017, deaths causation in 1976 and 1977 are mostly related to disease (see explanation in Chapter 6, Section 2 ("The Nutritional Status in China during the Maoist Period (1950-1976)," n.d.)). Therefore we should be cautious to determine famine or humanitarian crisis when refereeing to the whole affected period, 1975-77.

classified as Level 3. If I assume that the 144,400 victims died between August 9th and December 31st, 1975, the level on the intensity scale declines by one, showing a food crisis condition (see Table 14).

Furthermore, even though the lowest CMR figure designates food security conditions, other indicators used in the scale support the highest CMR figure computed. Based on the gazetteers in Zhumadian prefecture, I identify widespread of social breakdown. A large number of communes lost between 33 per cent and 80 per cent of their entire population; over one million people lost their homes; and weeks after the failure of the 62 dams, at least 370,000 people were still trapped in water. I do not have specific records for food prices, but I have identified a representative decline in food production. Indeed, exports of related food items decreased substantially between 1974 and 1976. I have calculated that exports of soybeans, eggs, and hogs decreased by 94 per cent, 63 per cent, and 10 per cent, respectively. Also, granaries, mostly located near the railroad, were totally destroyed by the flood. Food aid was sent into the affected areas from other provinces as a response to the incident. These four factors provide evidence of food as a pervasive problem.

Because the markets were inaccessible to the affected population for almost two months due to the flooding and the destruction of railroads and highways, the food supply was parachuted in, with 50 to 60 per cent landing in water (Yi Si 1998). This situation forced the population into survival strategies such as eating rotten food and dead animals. Moreover, Table 12 shows the presence of edema among the affected population. Even though the recorded cases registered are low in number, it is an additional and very particular feature of famine conditions. Finally, the Henan Province Annals show that in Zhumadian at the beginning of 1976, hogs were sold at a county level due to the difficulties still apparent in the areas affected by the disaster. The sale of livestock is a common coping strategy when food stress is prolonged, trading short-term gain for long-term problems (Wlaker 1989; Devereux and Howe 2004).

Livelihood features on the intensity scale are a determinant condition for the identification of famine. As Devereux and Howe underscore in their study:

Any intensity level of 3 or above will register as famine on the magnitude scale, even if it occurs in a much-localized area, and even if no deaths are recorded. Nonetheless (…),

food crisis conditions may result in mortality, but the crisis associated with these deaths will not be classified as famine unless the intensity of conditions reaches level 3 or above [in the scale] in at least one assessment area (Devereux and Howe 2004).

In the *Qiwu-ba* flood, I find all the food-security descriptors classified at level 3, meaning that, despite the CMR categorizing famine conditions only when considering the highest mortality rate and the shortest time framework, I can catalogue the crisis overall as famine (see Table 14 in reference to

A	Minor Famine	0-999
B	Moderate famine	1,000-9,999
C	Major famine	10,000-99,999
D	Great famine	100,000-999,999
E	Catastrophic famine	1,000,000 and over

Source: Devereux and Howe, Famine Intensity and Magnitude Scales: A proposal for an Instrumental Definition of Famine.

Table 16 in Appendix 4). In addition, following this assumption, while it is very difficult to determine whether the excess mortality related to disease was linked to starvation or to the flood per se, we should consider all other famine indicators to be pointing in the same direction and giving support to the first statements of famine conditions made by the CPPCC in the early 1980s, and thoroughly neglected one decade later.

As expected, I identify the GLF famine at level 5, that is, a severe famine. This is the most emblematic famine in world history when considering all the affected provinces and all the years of crisis (1958-62). Because I lack information about the exact number of people who perished due to political repression and starvation per se, I use the estimations of unnatural deaths in Table 1 to calculate CMR without making any

distinction for causes of death. This is a limitation that distorts the actual number of deaths per day due to starvation and related diseases. In spite of the fact that I use additional livelihood features of great weight to analyze the famine, I consider that this limitation does not distort the conclusion of the analysis. I calculate CMR based on the time framework of the famine's duration in Henan province: from October 1959 to April 1960. Results show that Zhumadian prefecture was in a stage of food crisis conditions in 1959, while the province as a whole suffered from food insecurity conditions, showing that from the beginning, some prefectures were in worse circumstances than others. By 1960, both the prefecture and the province as a whole are classified under famine conditions with 4.3 and 2.6 deaths per day, respectively, for every 10,000 inhabitants per day, reflecting greater severity in Zhumadian than the provincial average. This is understandable, given that, as previously mentioned, 23 per cent of the deaths in the province took place in Zhumadian prefecture.

Thus far, based on CMR, the famine is classified as level 3 along the intensity scale. Nevertheless, as discussed above, food-security descriptors are of great importance to determine the actual severity of a crisis. Food is identified as a pervasive problem in 1959 and 1960; misguided governmental decisions led to a decrease in the food ratio per family and, in turn, to the total closure of communal kitchens. A shortage of food and poor food distribution devolved into a complete social breakdown. Some governmental authorities saved a fraction of the available food for themselves, while everyone else, lived in an environment of severe scarcity that led them first to robbery and obstructing food, and eventually to extreme survival strategies: the ingestion of rice straw, cornstalks, egret droppings, and cannibalism. These were not one-off occurrences: they were regular measures taken to alleviate the state of hunger. Conditions of severe malnutrition led to acute cases of edema among the affected population. At the beginning of the crisis, families and neighbors buried their corpses; but as the months passed, the bodies were left behind on roads, in fields, and in houses, providing evidence of the sheer breath mortality.[57]

Despite the limitations of the sources, the GLF famine has been well studied for the past 35 years. Classifying the famine as catastrophic and extreme on the magnitude and intensity scales is not a new finding. However, this supports findings for the hidden

[57] For specifics on the development of the GLF famine in Henan province see (J. Yang 2012), p. 21-86.

famine of 1975. Despite governmental intentions to conceal the severity of the crisis, I identify famine conditions for 1975 with a magnitude of major to great famine, depending on which mortality figures in this study are used.

Table 14. Intensity scale. Crisis in contemporary Henan Province

Famine (Year)	Location	CMR[a]	Presence of oedema	Social system situation	Market Situation	Coping strategies	Survival strategies	Identify food as a dominant problem	Level	Phrase designation
GLF (1959-1960)	Henan	0.3/10,000/day [b] 2.6/10,000/day [c]	Yes	Complete social breakdown	No grain in the local granaries	Robbery of food	Eat non-edible goods	Yes	5	Extreme famine condition
	Zhumadian	0.8/10,000/day [b] 4.3/10,000/day [c]		Widespread of mortality	Shut down of communal kitchens Decrease of the food ratio per family		Cannibalism			
***Qiwu-ba* Flood (1975)**	Zhumadian	0.02-0.1/10,000/day [d]	Yes	Widespread of social breakdown	Markets are inaccessible to affected population	Food aid	Eat rotten grain and dead animals	Yes	3	Famine conditions
	Zhumadian Luohe	0.1-0.3/10,000/day [e]			Representative decline in food supply	Sell of livestock				
	Xuchang Nanyang	0.6-1.8/10,000/day [f]			Destruction of granaries in affected area					

Sources: For the Qiwu-ba Flood see Henan Province Population Yearbook and Zhumadian prefecture Chronicles. For the GLF famine see Henan Province Population Yearbook and Yang (2012) "Tombstone". Notes: [(a)] To calculate CMR for every 10,000 inhabitants per day we used the following equation: $\frac{n\ deaths}{Total\ population\ year \times n\ days} \times 10{,}000$ in World Food Program (2005) "A manual: measuring and interpreting malnutrition and mortality" Rome, The United Nations Refugee Agency, pp. 37-38 and 50. [(b)]Refers to year 1959. [(c)] Refers to year 1960. [(d)] Based on 1,633 casualties. [(e)] Based on 25,000 casualties. [(f)]Based on 144,400 casualties.

6. Conclusions

Previous publications have placed particular attention on the impact of the disaster of 1975 in Henan province. To my knowledge, however, no previous research has analyzed the flood from a long-run perspective. This study has analyzed the disaster in a time framework spanning from 1950 to 1985, concentrating on the flood's impact both on agriculture and on demography. This has led to the development of new conclusions and raised open questions for future research.

First, this study illustrates that there was indeed a representative impact on agriculture, if only at a prefectural level. The flood of 1975 happened at the same time that the Green Revolution was taking place in Henan province. The increase of agricultural inputs had a positive effect on agricultural productivity in the region for the period between 1966 and 1977. For this reason, it is difficult to capture the impact of the flood based on the data at a provincial level. Given that the disaster occurred only in some south-central prefectures of the province, I use statistical data at a prefecture level to acquire a better understanding of the dimensions of the disaster on food availability. In 1975, the total grain per capita in Zhumadian prefecture, the epicenter of the disaster, declined by 27.4 per cent in relation to the previous year, reducing survivors to low caloric intake. Also, by estimating the SD of grain per capita, we depict the levels of agricultural instability at prefectural levels, which is not shown at a provincial and national levels.

Second, given the fact that there was no decline in food production at a provincial level, we are compelled to consider that the development of the famine was due both to a drop in food supply in the prefectures affected by flooding and to an unsuccessful response from the government. That is to say, the government was unable to face the great hardships triggered by the disaster in the subsequent months: the destruction of major highways and railroads, granaries, hospitals, and electrical stations, among others, prevented the government from addressing the victim's basic needs, such as food aid and health-care. Also, the comparative analysis in the long run has shown that other years hit by natural disasters, such as 1956 and 1982, experienced a more representative drop in grain per capita in the province than in 1975 without resulting in famine. This

reflects the importance of government response to adversities in natural and social environments that, if not properly treated, may devolve into catastrophic situations. However, since the aim of this article is to investigate the direct impact of the *Qiwu-ba* flood on grain output and population rather than on the decline in food entitlement, this hypothesis remains to be studied in future research, which should take into account variables such as the granary system and aid at a local and national level.

Finally, the disaster of 1975 in Henan province also had a relevant impact on population. Previous publications have set the number of fatalities between 26,000 and 230,000. Because the famine took place at the beginning of the demographic transition caused by the implementation of birth control policies in the early 1970s, the fertility rate cannot be used in this case to tackle the problem of a hidden famine as has been done in other famine studies. By using an alternative methodology to identify the demographic crisis in the long run, I have estimated nearly 300,000 losses, including 89,000 unnatural deaths and a shortage of births of 204,000 between 1975 and 1977. Also, based on the historical archives, the highest number of deaths in Zhumadian prefecture reaches 24,197. It is important to note that, in this article, I have analyzed only one of the five prefectures that were affected by the flood that year, meaning that the death toll must be a great deal higher than the figure reported by the government. In addition, we identify specific food-security descriptors in 1975, which depict the population in Zhumadian as stressed by famine, such as an increase in gastrointestinal illness, the use of coping strategies, and survival strategies. New findings differ from the statement of government officials, according to whom the last famine recorded in China occurred during the GLF. Nevertheless, I treat this conclusion with caution due to the limitations of the data and further research must be done to substantiate the inference.

This article shows that the modernization in agriculture that took place in Henan province between 1966 and 1977, viewed as the spread of the Green Revolution, improved agricultural productivity and, in turn, food availability. Further, from the beginning of the 1970s, Henan province entered in its demographic transition, which, along with agricultural improvements, facilitated an increase in grain per capita. However, the vulnerability to natural hazards had not disappeared and the possible recurrence of shocks to grain production remained. This provides evidence that preventive policies for the deterrence of humanitarian crises are of enormous importance. The present study opens a new window for future analysis of government

responses to the flood of 1975, the study of possible declines in food entitlement in the aftermath, and comparisons of the role of government in famine prevention before and after 1975.

Appendix 4

Table 15. Famine magnitude scale framework

Category	Phrase designation	Mortality range
A	Minor Famine	0-999
B	Moderate famine	1,000-9,999
C	Major famine	10,000-99,999
D	Great famine	100,000-999,999
E	Catastrophic famine	1,000,000 and over

Source: Devereux and Howe, Famine Intensity and Magnitude Scales: A proposal for an Instrumental Definition of Famine.

Table 16. Famine intensity scale framework

Levels	**Phrase designation**	**"Levels": Malnutrition and mortality indicators**	**"Livelihoods": Food-security descriptors**
0	Food security conditions	CMR < 0.2/10,000/day and Wasting[58] < 2.3%	Social system is cohesive; prices are stable; negligible adoption of coping strategies
1	Food-insecurity conditions	CMR >= 0.2 but < .5/10,000/day and/or Wasting >= 2.3 but < 10%	Social system remains cohesive; price instability, and seasonal shortage of key items; reversible "adaptive strategies" are employed

2	Food crisis conditions	CMR >= .5 but <1/10,000/day and/or Wasting >= 20% but < 40% and/or prevalence of Edema	Social system significantly stressed but remains largely cohesive; dramatic rise in price of food and other basic items; adaptive mechanisms start to fail; increase in irreversible coping strategies
3	Famine conditions	CMR >=1 but < 5/10,000/day and/or Wasting>=20% but < 40% and/or prevalence of Edema	Clear signs of social breakdowns appear; markets begin to close or collapse; coping strategies are exhausted and survival strategies are adopted; affected population identify food as dominant problem in the onset of the crisis
4	Severe famine conditions	CMR >5= but <15/10,000/day and/or Wasting >= 40% and/or prevalence of Edema	Widespread social breakdown; markets are closed or inaccessible to affected population; survival strategies are widespread; affected population identify food as the dominant problem in the onset of this crisis
5	Extreme famine conditions	CMR >=15,/10,000,day	Complete social breakdown; widespread mortality; affected population identify food as the dominant problem in the onset of the crisis

Source: Devereux and Howe, Famine Intensity and Magnitude Scales: A proposal for an Instrumental Definition of Famine.

Chapter 5. Humanitarian crisis and biological living standards in Maoist China. A case study of Henan Province.

1. Introduction

During the Maoist period (1949-76), outstanding achievements in health evolved into a demographic and epidemiologic transition in China. In the late 1970s, international development and health agencies were greatly impressed by these achievements: not only did standards of health surpass those in other developing countries, but this happened at a faster rate and in a situation of lower incomes than those in industrialized countries in previous decades (Hipgrave 2011; Wang 2011; White 1998). However, improvements were not evident in all regions, and standards of welfare varied among provinces and populations. Even though warfare ended with the establishment of the People's Republic of China in October 1949, political instability remained latent in the country, either preventing, on many occasions, an adequate response to external shocks, such as natural disasters, or triggering survival conditions due to the implementation of inappropriate policies. One of the most obvious deprivations of welfare was the existence of a humanitarian crisis.

The most devastating famine in world history took place in China during the Great Leap Forward (GLF) of 1958-62. The famine affected several provinces, including Henan. This particular episode in Chinese history has been extensively studied by academics since the 1980s, when China's archives were partially opened to the public. Since then, the crisis has been studied from different perspectives: demographic, economic, political, and anthropometrical. However, not much academic work has been published on the humanitarian crisis of 1975-76 in Henan province. In Chapter 4, I analyzed the direct consequences of disaster: food production decline, excess in population loss, morbidity, and finally, presence of famine conditions. In this chapter, I analyze the health consequences of the survivors of the Great Flood. For that, I use mean height as a proxy for nutritional status. Mean height is an indicator used to study a population's

health, nutritional intake, and environmental conditions. In recent decades the mean height of the adult population has been used to compare different birth cohorts in the long run and to obtain a better understanding of the biological living standards of a particular population. While this methodology has been widely used in famine analysis in recent decades to depict the effects of shocks, usually with significant results, the findings do not always show a determining effect on height reductions for cohorts born in famine years. This is largely explained by the survival selection effect, which entails that, if the crisis is very severe, survivors are most likely to be in better health than the cohorts born immediately after the famine (Bozzoli, Deaton, and Quintana-Domeque 2009; Blum, Colvin, and Mclaughlin 2017).

Therefore, this chapter focuses on two main objectives. Firstly, study biological living standards in Henan province during the Maoist period. Secondly, analyze the long-term health effects of the humanitarian crisis recorded in the province mainly between 1975 and 1976. As a source of data for this study, I use the China Health and Nutrition Survey (CHNS) dataset, in particular the mean heights of cohorts born between 1949 and 1978 in ten different provinces in China, including Henan province. This allows a comparative study to be undertaken with other provinces and other exogenous shocks in Henan during the Maoist period. In addition, the study uses qualitative and quantitative data gathered from Henan Province Gazetteers and official statistical records gathered by the National Statistics Bureau of China.

The results show that there was an improvement in biological living standards in Henan province during the Maoist period, with an increase of 1.7 cm in the mean height (p= 0.000). However, in some years there was a reverse trend towards stagnation and deterioration. The most significant decrease in mean height in the population came during the worse years of the CR, when the cohorts born during the initial stage of this particular period have a height penalty of 1.7 cm (p=0.000). There is evidence of a reduction of 1.1 cm for the cohorts born during the crisis of 1975/76 (p= 0.000). As indicated in Chapter 4, the flood disaster affected mainly Zhumadian prefecture. Considering that the records on stature used in this study are only available from an aggregated provincial level, it is worth considering that the effects on biological standards might have been greater if I had been able to look into disaggregated data by prefecture. Finally, although no reduction in stature was found for the cohorts born

during the GLF famine due to survival selection, there was evidence of a period of stagnation.

This chapter is divided into six sections. Section 2 presents a literature review on the anthropometrics of famine. Section 3 describes the data selection and methodology used in the research. Section 4 analyzes mean height trends in Henan province. Section 5 concentrates on analyzing the effects of the GLF famine and the Qiwu-ba Flood. Finally, Section 6 offers conclusions to the study.

2. Literature review

Because the components of the development of human stature (health, caloric intake, and workload) are highly determined by one's living conditions before one reaches adulthood, mean height has become a common indicator with which to analyze the long term consequences of epidemics and famines during periods of humanitarian crises.[59] In recent decades, a great number of studies have focused on the effects of such shocks, by using the mean height of the affected population as a proxy for health.[60] Many of these studies show a penalty of 1 cm to 5 cm in adult height for cohorts in gestation and born during the famine years or exposed to famine at an early age (between 0 and 5 years old) (Y. Chen and Zhou 2007; D. Schwekendiek 2008; Sharygin 2011; Portrait, van Wingerden, and Deeg, 2017; Brainerd 2010; Morgan 2007). Such conclusions are implied by the *fetal origin hypothesis* (FOH), which claims that the conditions in utero affect adult health and well-being (Barker 1990, 2004; O'Gràda 2016).[61] Based on this assumption, the net nutrition of both the birth cohort and the mother are important

[59] A population's average final adult height is determined by the exposure to environmental conditions and that population's living standards *in utero* and in early life, especially up to the age of two (Currie and Vogl 2013; Fogel 1990). For a more developed review on this topic see Chapter 1, Section 1.

[60] For the Irish Famine in 1845-52 see (Blum, M.; Colvin, C.; McLaughlin 2017); For the Dutch Famine in 1944-45 see (Portrait, van Wingerden, and Deeg, 2017); For the USSR famine in 1932-33 see (Brainerd 2010; Sharygin 2011); For the USSR famines in 1918-22, 1931-33, and 1942-47 see (Wheatcroft 1999); For the Ethiopian Famine in 1984 see (Dercon and Porter 2014); For the North Korean Famine in the mid-1990s see (D. Schwekendiek 2008); For the GLF Famine in 1959-61 see (Fung and Ha 2010; Yuyu Chen and Zhou 2007; Gorgens, Meng, and Vaithianathan 2010; Morgan 2007).

[61] The Dutch famine at the end of WWII has become the leading case study of the FOH. For a great recompilation of previous publications on this topic see (Lumey and Vaiserman 2013). Note that not all of the studies on this topic use human stature as an indicator of health; other studies testing the FOH concentrate on health indicators such as diabetes, hypertension, coronary heart disease, schizophrenia, and obesity (Almond and Currie 2011; Calkins and Devaskar 2011; Currie and Vogl 2013; Stanner et al. 1997), as well as on the effects on education and income during adulthood (Majid 2015).

determinants of one's final stature in adulthood. This type of analysis is relevant from an economic and public health perspective to support pregnant women and young children exposed to undernutrition, considering the positive correlation linked between taller individuals, longevity and higher earnings, reflecting a more developed cognitive system (Case and Paxon 2008; Leon et al. 1995; Persico, Postlewaite, and Silverman 2004; Paxson, Case, and Islam 2009; Schick and Steckel 2015; Waaler 1984; Y. Chen and Zhou 2007).

The intensity of such effects on height reductions in centimeters will vary depending on gender, type of settlement, ethnicity, and socioeconomic background, most of which can be explained in their own terms by the existing inequality gaps between the different social groups.[62] The existence of such disparities in terms of nutritional status is attributed to different aspects such as cultural practices, intra-household structure, socio-economic system, or the environmental features (Deaton 2008; Debnath, Modal, and Sen 2018; Modal and Sen 2012, 2010).

In addition, it is important to highlight that the anthropometric figures must be taken with caution when studying periods where humanitarian crisis have taken place. On this regard, some studies show that in this type of circumstances the selection effect is greater than the scarring effect (Almond 2006; Blum, M.; Colvin, C.; McLaughlin 2017; Deaton 2007; Dercon and Porter 2014; García 2014; Gorgens, Meng, and Vaithianathan 2010). (Bozzoli, Deaton, and Quintana-Domeque 2009) define the selection effect as "the indirect positive effect that comes from mortality selectively removing the least healthy (or shorter) members of the population, so that the survivors are healthier (or taller)…[Therefore] where mortality is sufficiently high, increases in mortality might either leave no net effect on the average height of the population of survivors, or even increase it…" Studies depicting this type of selection bias claim to have refuted the FOH (Kim, Fleisher, and Sun 2017; H. Xu, Li, and Liu 2016; Dercon and Porter 2014; Gorgens, Meng, and Vaithianathan 2010). In recent years, the GLF famine has been used as a new case study with which to analyze the validity of the FOH. At this point, conclusions range from continued rejection of the hypothesis to its approval.[63]

[62] See for example the results from published studies such as (Datar et al. 2013; Bharali, Singh, and Mondal 2019; Blum, M.; Colvin, C.; McLaughlin 2017)

[63] For studies rejecting the FOH (not strictly using heights as a health indicator) see (Kim, Fleisher, and Sun 2017; H. Xu, Li, and Liu 2016). For studies approving the FOH, see (Meng and Qian 2009, 2006; Y.

Biological differences between populations will also play a representative role in explaining disparities in the anthropometric effect for cohorts exposed to famine in early life. For example, recent studies show that during a famine the female population is more likely to survive than the male population, especially in the early stage of life (Waldron 1998; Macintyre 2002); a trend well known in medical literature as the biological fragility of the male fetus or the *fragile male phenomenon* (Mu and Zhang 2011; Neelsen and Stratman 2011; S. Zhang 2011; Macintyre 2002; Almond 2006). This suggests that famine survivors within the male cohort are most likely to represent the strongest group within the affected population and therefore that any male survivors will be healthier than the female survivors (S. Zhang 2011). Following this assumption, survivors born in severe famine conditions are on average healthier than non-famine cohorts (Alter 2004; Almond and Currie 2011; Bozzoli, Deaton, and Quintana-Domeque 2009; Blum, M.; Colvin, C.; McLaughlin 2017; Gorgens, Meng, and Vaithianathan 2010).

3. Data selection, and methodology

The present analysis is based on data on the heights of individuals recorded in the CHNS physical examination conducted between 1989 and 2011. Because the objective of this chapter is to investigate the impact of the humanitarian crisis in Henan province during the Maoist era, we need to select those individuals in the sample who were born during the years when a more severe crisis took place, namely the period of the GLF famine (1959-60) and the *Qiwu-ba* Flood (1975-76). Several points should be considered in order to include the best available data for this study. In the following paragraphs, I discuss the criteria used in selecting data for this research.

In this chapter I develop a historical series of the mean height of the population of Henan province and the remaining provinces based on the parameters discussed in Chapter 2.[64] The series include the records on human stature of the adult population age 21 to 50 years old and born during the Maoist period. The resulting sample contains a

Chen and Zhou 2007; Gorgens, Meng, and Vaithianathan 2010). For other works giving support to the FHO based on other case studies see (Dercon and Porter 2014).

[64] For a more specific discussion on the elaboration of the dataset see Section 3 in Chapter 2.

total of 1,448 observations for Henan province and 13,885 observations for China as a whole between 1949 and 1978 (see Table 17). [65]

Table 17. Number of observations in the sample for China and for Henan Province (birth cohorts 1949-1978)

Birth cohort	Obs. China	Obs. Henan province	% Henan from total sample
1950-54	1611	176	10.9
1955-59	1777	174	9.8
1960-64	2467	262	10.6
1965-69	3007	323	10.7
1970-74	2680	280	10.4
1975-79	2015	201	10.0
Total	**13885**	**1448**	**10.4**

Note: In average, the population in Henan Province represented 8 per cent of the total population in China. Therefore, we consider the weight of the observations in the sample to be representative for this study.

One problem encountered in creating the dataset is the number of observations recorded for each birth cohort when breaking down the population by gender or type of settlement (urban and rural). Although I have included all waves of the CHNS dataset in the sample, some birth cohorts include a very low number of observations. In order to overcome this problem, I adopted the position of biannual birth cohorts, choosing thirty observations as the benchmark for each birth cohort to include in the sample. Note in Table 18 that Chongqing is the only region that does not reach the benchmark for the cohorts born between 1977 and 1978.

The reason I do not include more years in each birth cohort in order to increase the number of observations is that the humanitarian crises being examined in this article lasted for as long as two years: 1959-60 and 1975-76.[66] The group of individuals born

[65] For the total number of observations by provinces see Chapter 2.

[66] While the Great Famine took place between 1959 and 1962 nationwide, in Henan province the affected years were in 1959 and 1960. Also, I have estimated population losses in 1977, however, the severe years of the Qiwu-ba Flood were in 1975 and 1976. See Chapter 4 for a more extended explanation on this topic.

during these years will be referred as the famine cohort from now on. This allows isolating the affected group from the control group. This includes the cohorts born immediately before and after the famine-cum-humanitarian crisis. I will call these cohorts the pre-famine and post-famine cohorts from now on. This allows a sample of fifteen birth cohorts to be used, from 1949/50 to 1977/78, for all population sub-groups. Including all the other provinces available in the dataset allows a comparative analysis to be conducted to arrive at a better understanding of the hidden crisis of 1975-76 in Henan (see Table 18 for the number of observations for each province by birth cohort).

Table 18. Number of observations by province for famine and non-famine birth cohorts

Birth cohort	**1957-1958**	**1959-1960**	**1961-1962**	**1973-1974**	**1975-1976**	**1977-1978**
Beijing	-	-	31	45	36	49
Liaoning	117	108	106	69	46	53
Heilongjiang	69	55	71	88	78	75
Shanghai	-	-	39	35	35	34
Jiangsu	70	61	70	93	81	62
Shandong	83	77	110	83	76	62
Henan	70	55	104	94	87	78
Hubei	77	72	107	77	66	58
Hunan	70	59	65	82	95	85
Guangxi	79	68	90	100	98	60
Guizhou	66	39	53	128	167	83
Chongqing	-	-	28	53	34	21

I computed 633 observations in the male cohort and 815 observations in the female cohort. The mean heights for each of these cohorts from 1951 to 1978 are 168.7 cm and 157.9 cm respectively. It should be noted that in the case of the famine of 1959/60 both male and female observations decrease to 28 and 27 observations respectively. This is a limitation considering that I have only included cohorts with more than thirty observations. The decrease in the sample is explained by the increase in excess mortality during the famine years. As for the difference between urban and rural from

the 1,448 observations in the total sample, 919 belong to the rural cohort and 529 to the urban cohort. The height medians for each of these groups in the database are of 161.9 cm and 164.0 cm respectively, suggesting that the urban population enjoyed better conditions than the rural population during the whole period of study, and estimating a mean height difference between the two groups of 2.1 cm. The mean height for the whole population in the database is 162.1 cm (national level), 0.6 cm lower than the mean height in Henan province (see Table 19).[67]

Table 19. Summary statistics: Henan Province mean heights

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Height Henan province	1448	162.6	7.8	140	186.5
Gender Henan					
Male	633	168.7	5.9	142.1	186.5
Female	815	157.9	5.4	140	178
Settlement Henan					
Rural	919	161.9	7.6	140	185
Urban	529	164.0	8.0	142.1	186.5
Height China	13885	162.2	8.1	140	193.6

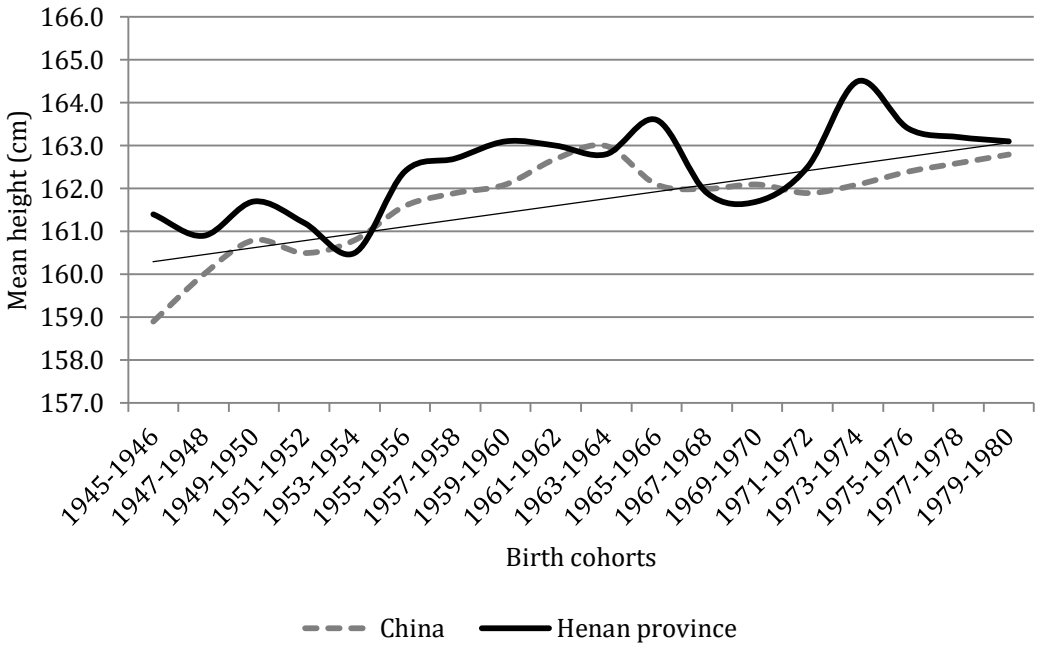
4. Trends in biological standards of living in Henan during the Maoist period

[67] For the Statistical Summary of the data for China and other provinces see Section Chapter 2.

Analyzing the tendencies in mean heights in the long run provides insights into welfare conditions during the Maoist period and allows the results to be associated with other well-being records, such as infant mortality or caloric intake. Figure 35 shows the trend of mean heights for the cohorts born between 1945/46 and 1979/80 in Henan province and China as a whole. Three main conclusions can be drawn from this tendency. First, for a great part of the Maoist period, mean heights were higher in Henan than the national average, with the exception of some fluctuations that will be carefully explained in the following subsections. Second, the GLF famine had no particular effect on the deterioration of the mean heights in Henan due to the significant increase of mortality rate during the period. However, the humanitarian crisis of 1975-76 had a clear scarring effect on the stature of Henan's population, despite the impact of the flood on grain production was not as significant at a provincial level.[68] Third, in the analysis of the biological living standards on other non-famine years, mainly in the initial stage of the CR, I detect a stronger negative effect on the mean height of the population than during the famine or crisis years. This supports the idea of previous findings suggesting that anthropometrics cannot always capture the effects of famine due to the survival selection phenomenon (Blum, Colvin, and Mclaughlin 2017; Bozzoli, Deaton, and Quintana-Domeque 2009; García 2014; Gorgens, Meng, and Vaithianathan 2010).

[68] See Chapter 4 for more accurate analysis on the effects of the flood on food production.

Figure 35. Trends in height for China and Henan Province (1945-1980)



Source: Author's elaboration based on CHNS (1989-2011)

The Maoist era is characterized by a mild degree of improvement in biological living standards in both China as a whole and Henan province.[69] These figures, in addition to other indicators previously addressed in Chapter 1, supports the argument that the health of Henan's population improved during this period. Between 1951/52 and 1975/76, the increases in mean height were of 1.9 cm (p= 0.0004) in China and 2.1 cm (p= 0.000) in Henan. Also, the period is characterized by clear phases of stagnation and decay, which are analyzed in the following sub-sections.

4.1. The Great Leap Forward

While in China generally the mean height slowly increases by 2.2 cm between the mid-1950s and the mid-1960s, in Henan province biological living standards stagnated (see Figure 35). However, it is clear that this stagnation did not start with the cohorts born during the GLF famine, but before. This is because the cohorts born in 1955/56, and therefore aged four to five during the crisis years, also suffered the consequences of the

[69] For deeper analysis on the biological living standards in China see Chapter 2.

disaster, giving support to the idea that the early stage of life is of great importance for the development of stature in adulthood.

There are two possible are two factors that explain the stagnation in the period both during and immediately after the famine years. Firstly, the famine birth cohort was born in the most devastating year in Maoist era, when mortality and infant mortality rates reached 39.6 per thousand and 46 per thousand respectively.[70] As indicated in Chapter 4, the excess mortality between 1959 and 1960 was 1.5 million and the shortage of births reached 2.6 million (see Table 11, Chapter 4). This implies that newborns during the famine years were most likely among the less vulnerable families (birth selection) and that the survivors were sufficiently healthy to respond to the environmental shock (selection effect).[71] Secondly, in 1964, Henan suffered from a devastating flood that decreased grain per capita to the same level as in 1960 (186 kg/capita) and caused 78,000 unnatural deaths (see Chapter 4). Even though this particular event did not develop into a famine, it did evolved into a period of scarcity and low nutritional intake in the province.

4.2. The Cultural Revolution

The most evident decline in biological living standards in Henan province during the Maoist era took place in the period of the CR. Cohorts born between 1966/67 suffered a statistically significant (p= 0.00) height penalty of 1.7 cm in comparison to cohorts born in 1965/66, which lasted until the early 1970s (see Figure 35). In addition, I estimated lives lost in the province at 431,000 between 1967 and 1968, the most severe years of the CR.[72] How can we explain the deterioration in welfare during this period?

One possible explanation relies on the decline in health care in Henan province during the CR. Figure 36 illustrates a representative decrease in the number of doctors per

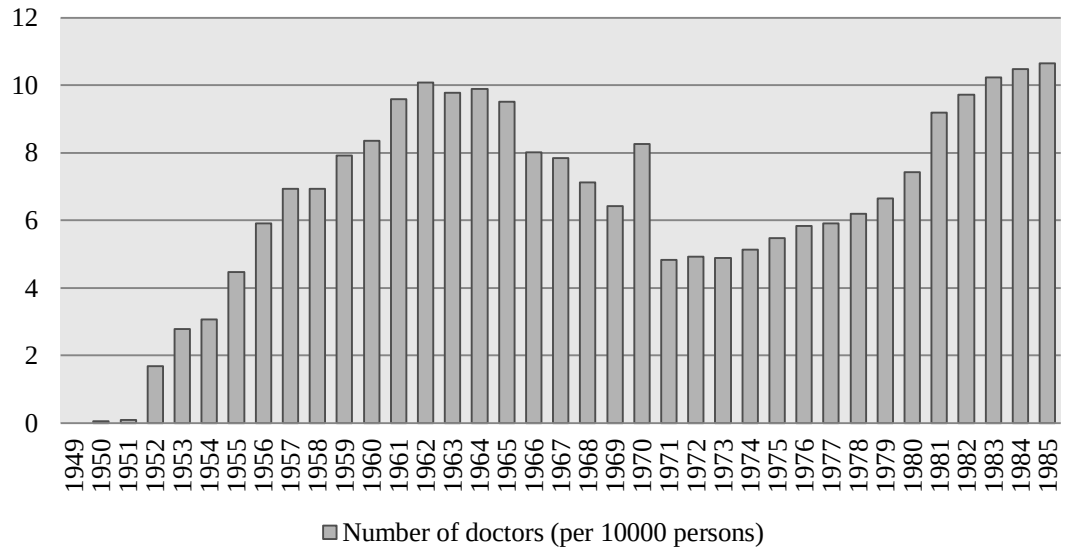
[70] Note that the great mortality in 1960 is also represented in the decrease of total observations shown in Table 1.

[71] During the GLF famine, government officials or workers in communal kitchens had greater access to food than the rest of the population (J. Yang 2012).

[72] This figure refers to the sum of shortage of births and unnatural deaths based on the same sources and methodology applied in Chapter 4.

10,000 inhabitants. The decline started at the beginning of the CR and did not recover to until the early 1980s. Note the decline from 9.5 doctors per 10,000 inhabitants in 1965 to 5.8 doctors per 10,000 inhabitants in 1976, the lowest point being reached in 1971, when there were 4.8 doctors for every 10,000 inhabitants. Indeed, during this time many hospitals in the province closed down, and all the progress of previous years in preventive medicine went into reverse, also compared to the national average (Alvarez-Klee 2019). The provincial gazetteers show that during the CR, thirteen hospitals were either merged or closed down.[73] Also, progress in introducing medical technology stagnated until the beginning of the 1970s. While sewage treatment continued during this period, its impact was such as to worsen conditions.

Figure 36. Number of doctors (per mil) in Henan Province (1949-85)



Source: Author's own elaboration based on (Department of Comprehensive Statistics of National Bureau of Statistics 1999)

The number of provincial health and epidemic stations declined from 153 units in 1965 to 62 units in 1969, adversely affecting the prevention of tuberculosis and other parasitic diseases until the beginning of the 1970s. Between 1956 and 1962 a "seven year plan to eliminate malaria" was implemented, only to fail during the GLF. By 1964 Henan had become one of the greatest success stories in malaria eradication nationwide, reducing cases to 1.3 per cent, due to the improvements during the recovery stage. Yet,

[73] Henan province gazetteers, 1949-85 (*Henan Sheng Zhi* 1949-85).

once again, the interruption of malaria treatment during the CR increased the rate of malaria cases and gastrointestinal diseases to more than 40 per cent in some prefectures.[74] At this point, Henan province became one of the worst preforming provinces in China in these respects.

While during the initial stage of the Maoist period great attention was paid to maternal health care, during the CR maternal and child health care institutions also suffered substantial declines, with nearly 70 per cent of stations, closing down between 1965 and 1969. Most women lost their protection during labor, which had been established at the beginning of the Maoist period by the local Health Department and the Provincial Women's Federation. Pre-natal and post-natal leave were canceled, and women's health rooms and nursing rooms in factories and mines were closed down. These setbacks led to an increase in common diseases among women and a greater deterioration in child health care. By 1975, the year of the Great Flood, child mortality and maternal morbidity figures had become higher than the national average. Between 1976 and 1978 Henan Pediatric Medical College conducted a survey of 100,000 children between 0 and 14 years old in eighteen brigade teams and three cities, which revealed a death rate among children between 0 and 12 months of 25.7 per cent. The death rates for cohorts aged 1 to 3 years old, 4 to 7 years old, and 8 to 14 years old were 2.9 per cent, 1.3 per cent, and 0.6 per cent respectively. The recovery began in 1978, when provincial health bureaus developed new standards for women's and children's health care, with a great focus on rural areas.

4.3. The end of the Maoist period and the initial stage of the New Economic Reforms

The second representative decline in biological living standards in the province occurred between 1975 and 1978 (see Figure 35). This corresponds to the period of the cohorts born during the *Qiwu-ba* flood and the years immediately following. The birth cohorts of 1975/76 were 1.1 cm shorter in height than the previous birth cohort (*P*=

[74] (Y. Lin 2020) also found a correlation between those provinces in China that had a greater deterioration of the health system during the CR and the increase of the malaria cases. Also note that previous studies reveal a positive correlation between malaria and stunting (though not statistically significant) (Fink et al. 2013).

0.00). The figures indicate that the birth cohorts of 1977/78 not only did not recover from the disaster of 1975, its conditions also worsened. This is supported by the stagnation in grain production per capita between 1975 and 1980 due to severe droughts and floods and the steady deterioration of the health system between de mid-1960s and early 1980s.[75] In addition, the estimates in Chapter 4 (Table 11) indicate that between 1975 and 1977, the number of lives lost reached 293,000.

The *Qiwu-ba* flood developed into spread of hunger and disease. Weeks after the Typhoon Nina hit the region, 20 per cent of the population in Zhumadian prefecture was suffering from infectious and gastrointestinal diseases (see Chapter 4, Table 12). Great array of studies indicate that the presence of these type of disease in utero and in early childhood negatively effects physical growth and that only a very high level of protein intake during the adolescence stage may lead to a full catch-up development in stature (Fogel 1990; Taylor 1983; Scrimshaw, Taylor, and Gordon 1968; Whitehead 1977).

5. The impact of the humanitarian crises over mean heights in Henan province

5.1. A spatial comparison showing the severity of the humanitarian crises in Henan province

The aim of this section is to capture the health penalty of the birth cohorts that were exposed to the nutritional and epidemiological crisis in Henan in comparison with other provinces. This allows a better understanding of the effects of the *Qiwu-ba* famine in comparison to other regions that were not affected by these particular shocks. Therefore, in this section I address the question, *was the famine of 1975 a unique event in China at that particular time?* To answer this question, I calculate the ratio of mean heights for the different cohorts in Henan province to those for the other provinces/administrative regions.[76] The ratio is calculated for the pre-famine, famine, and post-famine cohorts, so as to tackle the severity of the famine years. In order to highlight the relevance of the findings, I conduct the same exercise for the GLF famine.

[75] For further explanation on grain production, see Chapter 4, Section 3.1

[76] Ratio = $MH_{X\ Province}$ / $MH_{Henan\ Province}$

The GLF famine affected a great part of the country, but its intensity varied between provinces. Henan was one of the worst affected areas, though the famine was especially severe in the western provinces and in Anhui, located in the east of the country. I measure the intensity of the famine based on crude death rates.[77] Heilongjiang, Hubei, and Jiangsu were the least affected provinces. Not only was the excess in the crude mortality rates low, the rate of natural population increase was also positive for the whole period of the GLF. Figure 37 (a) shows that the mean height of the famine cohort in Henan province decreases relative to the famine cohort in these three particular provinces.

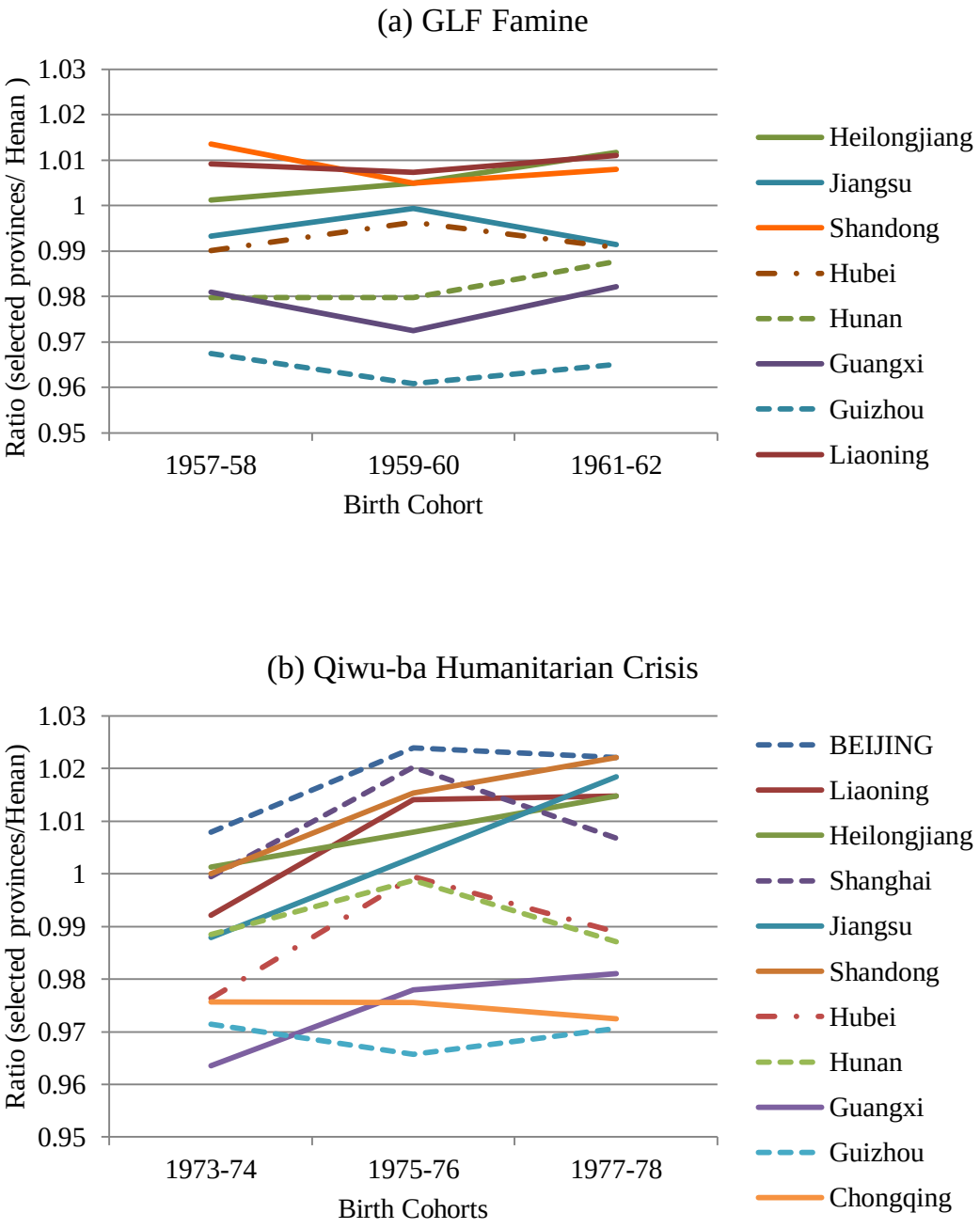
On the other hand, I estimate an increase in the mean height for the famine cohort in Henan province relative to the provinces where the crisis was more severe (only the ratio Guizhou/Henan finds to be statistically significant). This is the case for Guangxi, Guizhou, Hunan, and Shandong, where crude death rates in 1959 reached 31 per thousand, 20 per thousand, 21 per thousand, and 19 per thousand respectively. In 1960, the worse year of the famine, the crude mortality rate for Guizhou was as high as 52 per thousand. The excess crude death rate for Henan province between 1959 and 1960 reached 27 per thousand.[78]

Therefore, the results illustrated in Figure 37 (a) indicate that the effects of the GLF famine in terms of severity is also captured in terms of height penalty, allowing to observe the position of Henan province in terms of nutritional status in comparison with the remaining provinces and administrative regions, also in comparison to the pre-famine and post-famine cohorts.

[77] The figures for excess crude dead rate are taken from (Peng 1987b).

[78] I have chosen the Famine birth cohorts based on the famine conditions of Henan, where the crisis lasted for two years (1959-60). However, it is important to highlight that the famine lasted as long as five years in some provinces, such as the case of Sichuan, Jilin, Shandong, and Guangxi.

Figure 37. Ratio of mean height in Henan Province to other provinces during the famine and non-famine years



Source: CHNS (1989-2011)

In the case of the *Qiwu-ba* famine, the picture is different. Figure 37 (b) shows a clear decrease or in some cases stagnation in the mean heights for the famine birth cohort in Henan relative to the other provinces, with the exception of Guizhou province, one of the poorest regions in China (only the ratio Guizhou/Henan finds to be statistically

significant). This suggests that, while the mean heights in eight out of the eleven-provinces/administrative regions in this sample increased in the mid-1970s, in Henan the mean height fell, emphasizing the particular crisis of 1975 in this province.

While relying solely on this indicator cannot reveal the presence of famine in Henan in 1975, together with other indicators, such as lives lost and famine descriptors, it does help explain the severe humanitarian crisis that actually developed in the region. In addition, to my knowledge, excessive of lives lost did not occur in the other provinces/administrative regions used in the sample. As previously mentioned, a limitation of this study is its reliance on the fact that we only have aggregated data at the provincial level. Previous studies show that the impact of the hydrological disaster and famine in the mid-1970s was evident in the prefectures where the flooding happened, but not necessarily province-wide.[79] The findings in this study showing a decrease in mean heights in Henan province since 1975 suggest that the biological standards of living in Zhumadian prefecture deteriorated even more sharply.

5.2. The impact of the humanitarian crises on different population groups; confirming the puzzle due to survival selection?

During the Maoist period, the mean heights of the urban and rural populations in Henan province increased by 1.0 cm and 2.9 cm respectively. By the end of the period, the gap in heights between the two cohorts had decreased from 4.1 cm to of 2.2 cm. Therefore, despite the existing disparities between the urban and the rural populations during the Maoist period, the biological living standards improved more significantly in the rural areas. The gender gap in heights also converged during the Maoist period, from 13.7 cm to 11.1 cm. This is mostly to be explained by the improvements to women's health and education, which led to an increase in the mean height of 3.3 cm from 1951 to 1976, while the mean height of men increased only by 1.00 cm.

The aim of this section is to depict the population groups that were most affected by the humanitarian crises in Henan province. Therefore, in this section I address the second question in this chapter: *What were the effects of the Qiwu-ba disaster for the survivors*

[79] See Chapter 4 for further discussion

of that particular event? In Section 4.3, I already discussed the reduction of 1.1 cm in human stature for those cohorts born during the humanitarian crisis, in comparison to the pre-famine cohort. In the following paragraphs I will analyze the effects of both famines among the urban and rural populations, and the female and male populations.[80] Also, I will address to whether the gap in stature between the rural and urban populations, and the female and male populations actually increased during the famine years. In other words, I analyze the relative nutritional status between the different populations in Henan during famine years.

Graph 5 (a) indicates that the relative height of the rural and urban populations during the GLF famine only increased for the post-famine cohorts. That is because while the height of the post-famine cohorts born in the urban areas declined by 2.6 cm, the height of the post-famine cohorts born in the rural areas increased by 1.5 cm (see Figure 40 in the Appendix 5). On the other hand, the falls in the mean height between the pre-famine cohort and the famine cohort were 0.3 cm for the urban population and 0.5 cm for the rural population (see Figure 40 in the Appendix 5).

These figures could lead to biased conclusions by assuming that the urban and rural populations suffered famine to the same degree. However, there is enough evidence in the literature confirming that the famine was more severe in rural areas. How can we then explain the fact that this effect is not shown in the mean height of the rural population in comparison to the urban population? A plausible response is that this was due to survival selection. Because the mortality rate due to starvation and related diseases was significantly higher in rural areas than in urban areas (Shige Song 2009), I assume that the survivors in rural areas had a stronger physical constitution, and therefore were healthier, than the survivors in urban areas. Following the same reasoning, the fact that the fertility rate fell by 1.8 points in rural areas and by 0.7 in urban areas suggests that couples in rural areas who decided to have children during this period were healthier.

That is not to say that the urban population did not suffered from the devastating consequences of the GLF. Even though in cities there was no widespread of social breakdown, such as the cannibalism and high mortality rates as reported for rural areas, food rationing was not optimal either. Despite one of the main objectives during the

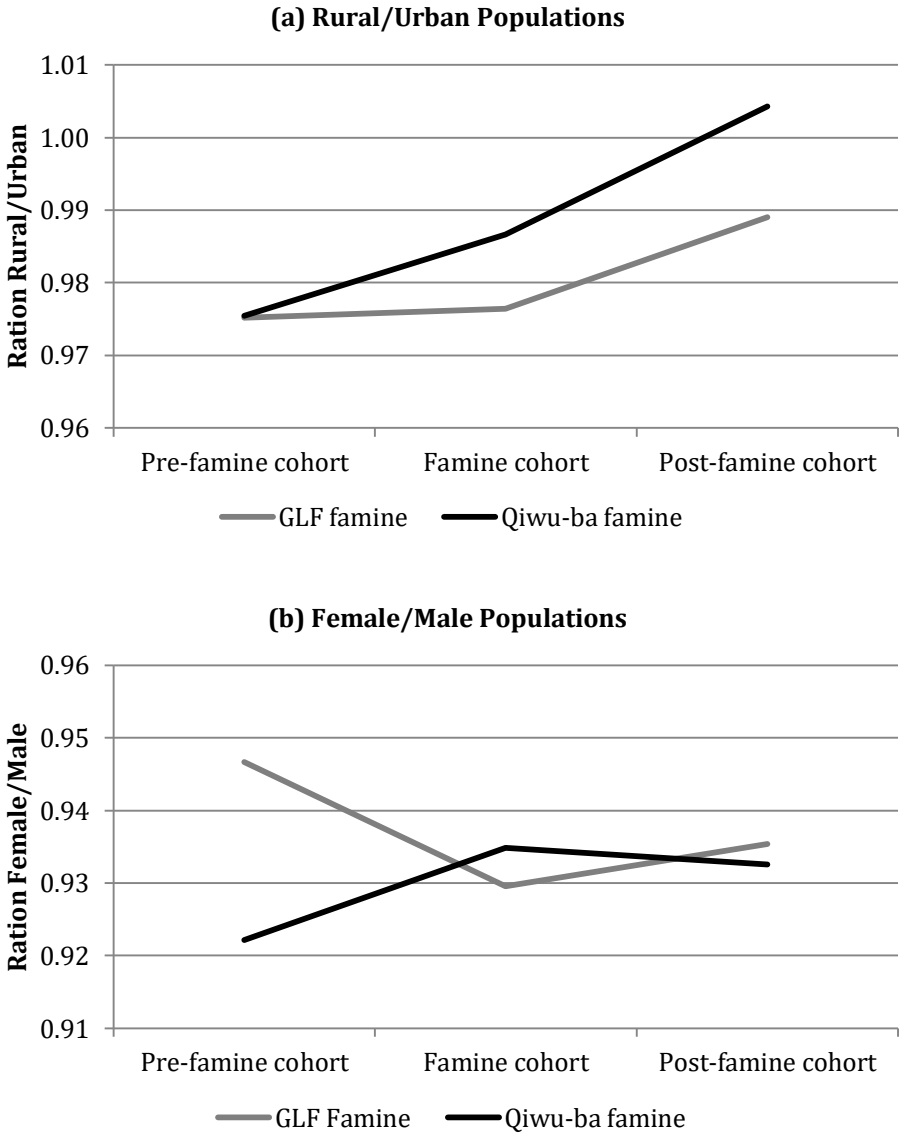
[80] For a discussion on sexual dimorphism in human stature see Chapter 2, Section 5.2

GLF having been to increase food production in order to feed industrial workers, food rationing was not equal for all urban counterparts. An anthropometric study conducted in 2007 using the mean heights of employees in seventeen different factories in Beijing concluded that the average height for workers declined between 0.5 cm and 1.00 cm, providing evidence that welfare conditions also deteriorated for the urban population (Morgan 2007). These results confirm my findings, given that even in the capital, where conditions were better than in other urban areas of the country, there was a decline in the mean height of the population.

For the Qiwu-ba famine the relative height of the rural and urban populations increased (see Figure 38 (a)). In this case, the greatest height penalty is tackled among the urban population to the extent that the mean heights of the urban and rural populations completely converge for the post-famine cohorts. Both rural and urban cohorts suffered the effects of the famine through reductions in their mean heights of 0.5 cm and 2.4 cm respectively (see Figure 40 in Appendix 5). As for the post-famine cohort, there was an increase in the mean height of 0.8 cm in the case of the rural population in comparison to the famine cohort, while the mean height of the urban population continued to decline by 2.1 cm. Because the severity of the crisis in the rural and urban areas has not yet been studied, it is difficult to determine if the results shown in Figure 38 (a) indicate a phenomenon of selection effect or if, indeed, the urban population suffered greater consequences after the flood of 1975.[81]

[81] A share of my future research entails to estimate the excess of deaths and shortages of births in the counties within Zhumadian prefecture. The Year Book of each county includes the demographic figures of rural and urban populations from 1950 to 1985. By doing this exercise I will be able to determine if the severity of the crisis was greater in the rural or the urban areas and, therefore, come up with a more conclusive interpretation of the anthropometric results presented in this chapter.

Figure 38. Ratios of mean heights in Henan Province by gender and population settlement during the GLF famine and the Qiwu-ba famine



Source: CHNS (1989-2011)

Figure 38 (b) shows a decline in the mean height of the female population in relation to the male population during the GLF famine. We estimate a decline of 1.0 cm for women born before and during the famine and an increase of 0.8 cm in comparison to the post-famine cohort (see Figure 42 in the Appendix 5). On the other hand, comparing the pre-famine cohort and the famine cohort the mean height of men increased by 2.0 cm, while the mean height remained stagnant for the post-famine birth cohort (see Figure 41 in the Appendix 5).

The findings again confirm the survival selection hypothesis. The fact that the mean height of men increases notably for the famine birth cohort does not imply that the male population did not suffer the effects of famine. The phenomenon of male fragility gives an explanation for why the mean height of men increased, while the mean height of women decreased. As noted previously in Section 2, it is well known in the medical and famine literature that females tend to have a higher resistance to famine environments due to higher body fat than their male counterparts, which translates into a higher mortality rate for men than for women in most famines. This is not only true for adults, but especially for fetus and newborn, were male are more vulnerable to external shocks than females. The theory is also supported by previous publications about the GLF famine, which not only indicate that male mortality was higher than female mortality, but also that male survivors were in better health than female survivors during their adulthood (Mu and Zhang 2011; Shige Song 2009).

Contrary to the GLF famine, I find an increase in the female mean height of females relative to that for males (see Figure 38 (b)). While the mean height of female cohorts born in 1975/76 increased slightly by 0.5 cm, the mean height of males fell by 1.7 cm, with a slight increase of 0.4 cm in the case of the post-famine cohort (see Figure 41 and Figure 42 in the Appendix 5). Therefore, in this case, the estimates do not apply to the male fragility hypothesis, though we must consider the son-preference hypothesis.[82]

An expanding body of literature indicate that in some Asian countries, sons were preferred to daughters during the crisis years, leading families to allocate more resources to males rather than females (Das Gupta 1987; Behrman 1988; Rose 1999). The son-preference hypothesis may fit in the 1975 crisis, based on two premises. Firstly, the famine of 1975/76 was less severe than the GLF famine and the governmental response was also faster, a scenario that made it easier for intra-household inequality to occur and curve the male fragility theory. Secondly, the causes of excess mortality are different in both famines due to the nature of the crisis. While the mortality during the GLF famine was mainly attributed to starvation and related diseases, the mortality

[82] A question that remains open at this point is whether the female mortality rate was higher than the male rate. Unfortunately, at this point, I have no records with which to answer this particular question.

during the humanitarian crisis of 1975 was not only attributed to these two factors, but also to drowning, where the male fragility phenomenon may play less of a role.[83]

Therefore, considering both premises, it is understandable that the height penalty was higher for the male cohort than the female cohort due to the selection effect, in the sense that mortality was feasibly higher among the female population than the male population. In any case, such interpretation deserves further analysis and no final conclusion can be drawn from the data shown in Figure 38 (b), except that the height penalty was significantly higher among the male population, a pattern that is less common in famine conditions.

6. Conclusions

The aim of this Chapter is focused in two main objectives. Firstly, examine the trends of the biological living standards in Henan province during the Maoist period. Secondly, investigate the long-term health consequences of the humanitarian crisis of 1975/76 in the province.

Regarding the first point, the analysis of the data indicates that the mean heights of the cohorts born in Henan province between 1949 and 1976 increased by 1.7 cm (p= 0.000). In addition, I have identified the stages of stagnation and deterioration in biological living standards for the cohorts born during this period, where the greatest deterioration in biological living standards occurred during the initial stages of the CR, when the stature of these birth cohorts declined by 1.7 cm (p= 0.00). This coincides with the deterioration of the health-care system in Henan during this period.

The GLF famine had no apparent impact on the deterioration in mean heights in Henan presumably due to the survival selection effect, but the humanitarian crisis of 1975 did have such an effect on the survivors. I find a reduction in stature of 1.1 cm (P= 0.000) for the cohorts born during the *Qiwu-ba* flood disaster in comparison to the pre-famine cohort. While this is a relevant finding, I reflect to whether the height penalty may be

[83] Indeed several publications indicate that the female mortality rate is higher than the male rate during natural disasters, especially floods, due to the difference in the physical strength between men and women (Neumayer and Plümper 2007; Ikeda 1995). Also, in this sense, the fact that pregnant women died during the flood curves the male fragility theory.

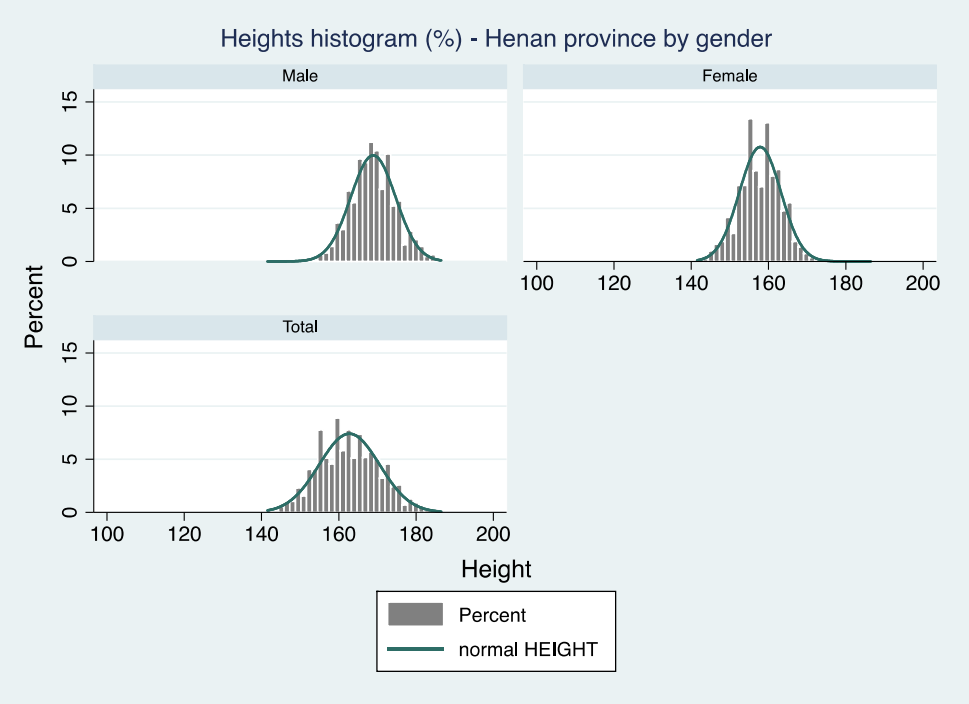
optimistic given that the humanitarian crisis of 1975/76 was a very localized crisis, it being difficult to assess its real dimensions by using provincial data alone. This is one admitted limitation of this study. Another limitation of this study is not fully considering the catch-up age within the analysis. This aspect will be treated in future research.

By calculating the mean height ratio of Henan in comparison to other provinces for the famine cohorts in relation to the years immediately before and after the crisis, I can show that, while mean heights in China were increasing during the 1975-76 crisis, mean heights in Henan province were falling. This pattern is not shown for the GLF famine, in which the variation in the ratio for Henan in relation to other provinces depends on the intensity of the famine in each province, as measured by the total mortality rate. This pattern indicates that the humanitarian crisis of 1975 in Henan province indeed resulted in a decline in the nutritional status of the population during this time, despite the more general improvements in the country as a whole.

Finally, in terms of the relative nutritional status between the different population groups (rural/urban and female/male), results indicate that the ratio increased for the cohorts born during the 1975/76 humanitarian crisis due to the more intense height penalty suffered among the urban and male populations.

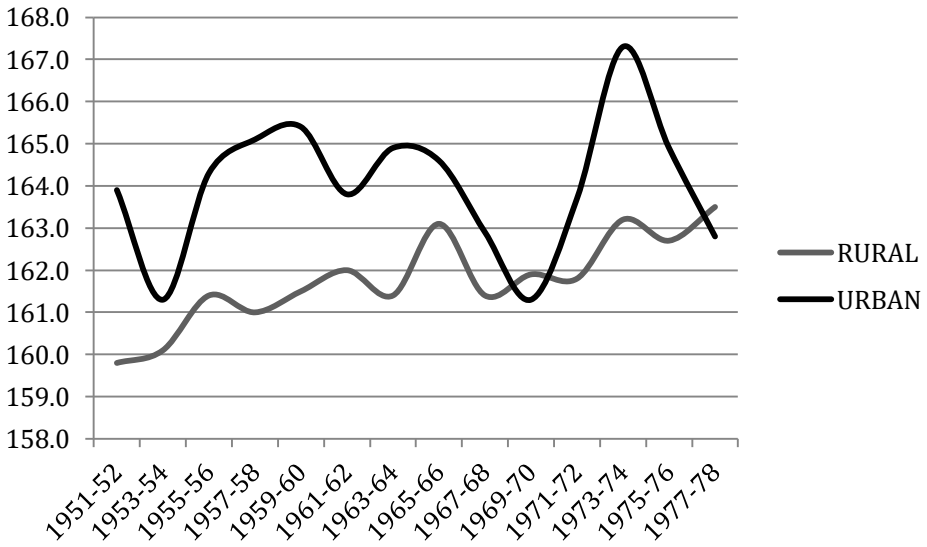
Appendix 5

Figure 39. CHNS heights data, Henan Province: Histogram



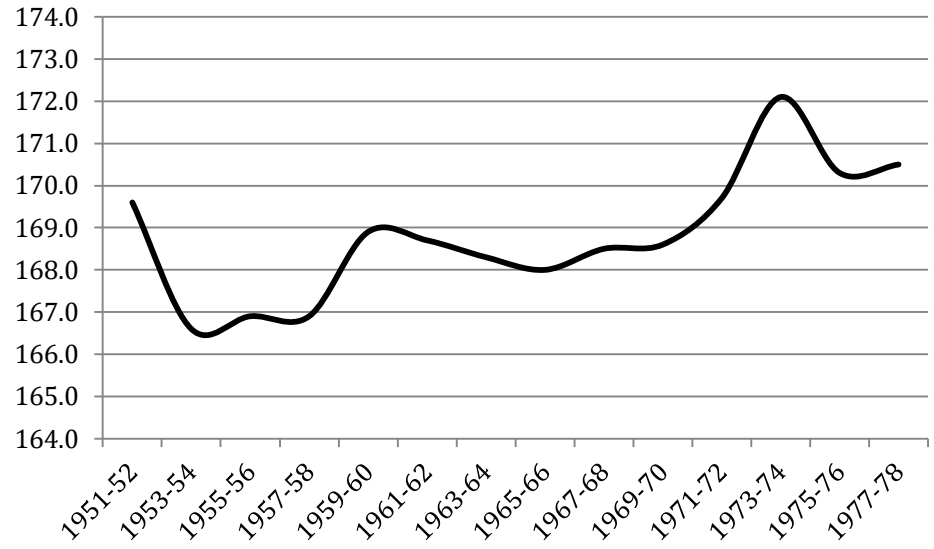
Source: Author's elaboration based on CHNS (1989-2011)

Figure 40. Mean height trend of urban and rural Henan Province (1949-78)



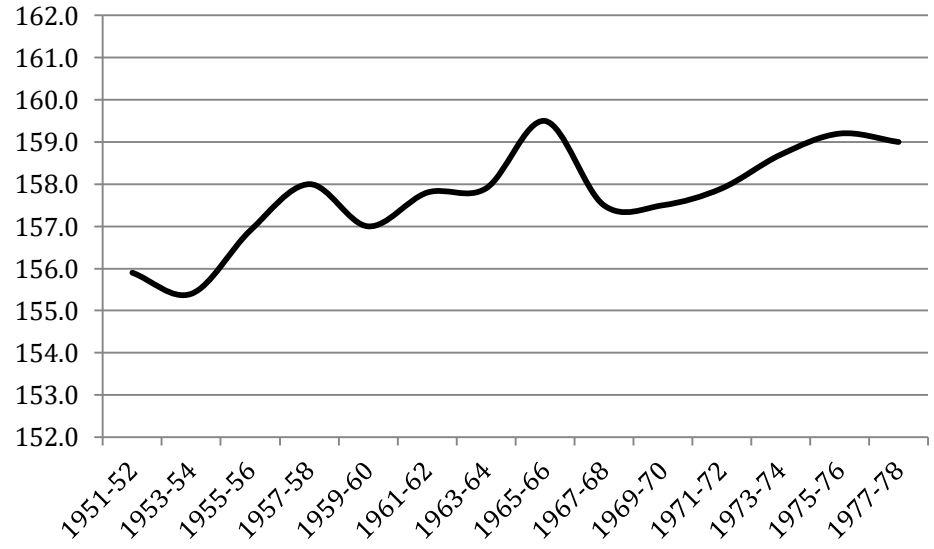
Source: Author's elaboration based on CHNS (1989-2011

Figure 41. Mean height trend of male cohorts, Henan Province (1949-78)



Source: Author's elaboration based on CHNS (1989-2011)

Figure 42. Mean height trend of female cohorts, Henan Province (1949-78)



Source: Author's elaboration based on CHNS (1989-2011)

Chapter 6. Conclusions

1. Concluding remarks

Since the beginning of the 20th century, China has made the effort to improve the well-being of the population. The major gains in health, in terms of life expectancy and reduction of IMR, were achieved during the Maoist period. After the implementation of the new economic reforms, China has continued to ameliorate the living conditions, yet still falling behind from Western countries and Japan. Nevertheless, one of the major problems encountered in the country today is the rural-urban health gap, as well as inter-regional and gender inequalities. The World Health Organization (WHO) indicates that health inequality in China has been growing in the past decades. Indeed, in relative terms, the rural-urban gap in life expectancy is nearly the same as in the 1940s. Most given explanations to understand the inter-provincial and rural-urban inequalities in China today are based on the new economic reforms implemented since the 1980s. Most studies indicate that, while growth in income has allowed for greater access to medical resources, lower-income share of society has lost entitlement to health endowments (Hongbin Li and Zhu 2006). Also, latest research indicates that the Special Economic Zones (SEZ) have higher levels in health than those that started their economic development in the early 21st century (Suhang Song et al. 2019). While these results are coherent, the findings in this dissertation indicate that the inter-regional inequalities, and gender and urban-rural gap were already consistent during the Maoist period.

This PhD dissertation has attempted to shed more light on the topic of standards of living in Maoist China. This question started to gain great interest among scholars in the early 1980s. After the death of Chairman Mao in 1976 and the implementation of new economic reforms in the late 1970s, official records on the Maoist period started to be made available to the public. Since then, a great range of publications has made significant contributions to the understanding of China's economic growth and development between 1949 and 1976. However, this particular period in Chinese

history remains open to final interpretation. On the one hand, Maoist China set out the path to modern economic growth and the epidemiological transition. On the other hand, inequalities in standards of living, especially between the urban and rural populations and male and female populations, widened during this period. Also, the economic policies developed during the GLF and the CR led to great setbacks in the Chinese economy, with significant effects on the well-being of the Chinese population.

The research engaged for this thesis has contributed to the debate of well-being in Maoist China by using anthropometric measures. Human stature allows the net nutrition of a population to be measured by taking into account inputs to health, such as nutritional intake and health care, and the demands placed on the individual's biological system, such as exposure to disease or the intensity of workload during the growth years. Therefore, the analysis conducted in this thesis on the trends and inequalities in the mean height of the Chinese population provides a deeper understanding of standards of living in China during the 1950s, 1960s, and 1970s.

In the early 1950s, the government aimed to rapidly modernize the economy and increase income, improve the living standards of the Chinese, and reduce inequality. For the latest, the government established an alleged egalitarian welfare system that, by the end of the Maoist period, had mostly favored the urban population. The political speech defending gender and urban-rural equity preserved during great part of the Maoist period. However, the findings in Chapter 2 reveal, that despite the moderate improvements in the rural and urban areas from the early 1950s to the mid-1970s, the gap in the nutritional status between both social groups increased. The explanation relies on the functioning of the welfare system, that clearly favored the urban population (Dillon 2015; Naughton 2018). Only during the GLF the nutritional status between the urban and the rural populations totally converged. This same pattern is found in the gender trends and inequality, suggesting that while the welfare system had a positive effect in improving the nutritional status of male and female populations, the gap between both cohorts increase during time; with the exception of the GLF stage. Indeed, except Jiangsu and Guangxi provinces, we find that intra-inequality declines during this stage. This would follow the theory that high unstable periods in world history have led to the decline of inequality (Scheidel 2017; Bambra 2021).

Because we are not using an economic indicator, but the human stature to measure inequality, I attribute the abrupt increase of the mean height of the rural and female cohorts during the GLF due to the selection effect discussed in also in Chapter 5. It is well studied that the mortality rates among the urban and female populations were much higher than their counterparts; therefore the female and the rural survivors resulted to be healthier than the male and the urban cohorts. This contributes to the debate about heights and the scarring and selection effect. Contrary to previous studies, analyzing the Maoist period, the current research has investigated the behavior of the nutritional status by political stages. Because the variation in the policies within this short period in history were so abrupt and distinct, it allows us to understand the direct effect on the well-being of the birth cohorts

Following the same patterns as in present times, the East and Northeast regions were more favorable in the nutritional status, whereas the Western regions remained with very low levels during the whole period. Whys is the pattern already present in Maoist China? First, the East and Northeast regions were the most industrialized, with higher levels of urban population, and more revenue. Therefore, the benefits and subsidies of the welfare system were focused on these regions. While the Western provinces had little transformations in terms of modernization and urbanization, and therefore depending on low revenue. This thesis reveals a moderate correlation between health endowments and nutritional status, giving evidence to the importance in health investment to improve people's well-being. However, unequal allocations of health resources between the different provinces and regional discrepancies in the availability of grain may explain the inequality gaps in nutritional status nationwide. This is corroborated by the fact that those regions with less access to health endowment, suffered of lower levels of nutritional status. That is the case of Western regions such as Guizhou and Chongqing. On the other hand, provinces with greater health resources and grain availability per capita, such as Heilongjiang and Liaoning, have been shown to have higher biological standards of living. Also, administrative cities such as Beijing and Shanghai, with their mostly urban populations, have been identified as the regions with the highest nutritional status. This shows an inverse effect to that in most Western countries, which experienced industrialization in the nineteenth centuries, but for which previous anthropometric studies show the existence of an urbanization penalty.

Also, I identified the first stage of the CR as that which experienced the greatest decline in nutritional status. Eight of the twelve regions I have analyzed show a decline in human stature for the cohorts born between 1966 and 1969, which is related to the deterioration in the allocation of health resources in most of these regions. Also, even though there was a general increase in the availability of grain due to agricultural intensification, most regions experienced low levels of self-sufficiency in grain, meaning that nutritional intake did not exceed 1700 kcal per person. However, this conclusion must be treated with caution. It is well known that it was in the GLF that nutritional intake was at its lowest and this developed into the most emblematic famine in world history. The fact that this is not well captured in my data when they are analyzed from a historical perspective supports previous findings which concluding that using anthropometric measures may overlook the scarring effect in periods of severe crisis due to the representative increase in mortality rates and the shortage of births.

In chapters four and five I have mainly concentrated on the Great Flood of 1975 in Henan province. This thesis has attempted to shed light on the effects of the great disaster of that year, which the Chinese authorities concealed until the second half of the 1990s. Previous studies had focused on the causes of the flood and its immediate aftermath. This thesis provides new evidence regarding the long-term effects of the disaster. Two of the greatest questions concerning this flood are the number of lives lost and whether a humanitarian crisis developed in the following months. The methodologies applied in chapter four finds that between 1975 and 1977 the number of lives lost reached almost 300,000, including nearly 90,000 unnatural deaths and over 200,000 birth shortages. This is a relevant finding given that even today official sources claim that *only* 26,000 people died during the flood due to drowning. The findings of this research are more in tune with the claims of local officials, who at the beginning of the 1980s announced that 280,000 people had died in Henan province as a consequence of the *Qiwu-ba* Flood, from both drowning and famine.

The existence of famine in the region was identified by using the international magnitude and intensity famine scales. Famine descriptors gathered from the local gazetteers support this finding, while the anthropometric measures used in chapter five corroborate a deterioration of the nutritional status. In the analysis I show that there was a scarring effect for the birth cohorts born in 1975 and 1976. Indeed, during the second half of the 1970s, while the national mean height increased, the mean heights in Henan

province declined significantly. Moreover, I consider these findings optimistic given that the data used in this study are provincial data and that the humanitarian crisis took place in only four of the eighteen prefectures in the province. However, this research shows that the greatest decline in biological living standards in Henan province also took place during the initial stage of the CR due to the great setbacks in the health system. Again this finding should be taken cautiously given that during crisis years the increase in the mortality rate was much higher than during the CR, especially for the period of the GLF, for which I estimate there were 1.5 million unnatural deaths and over 2.5 million shortage of births.

2. Limitations and future lines of research

This thesis presents some limitations and also opens up new lines of research. One of the greatest difficulties encountered during this research has been obtaining access to additional new sources. To a certain extent, this was a limitation in developing of this research, especially in analyzing the Great Flood of 1975. Due to the nature of the topic and the fact that Henan province is considered one of the regions with the most hermetic governmental system, in many instances I was denied access to official files that could have helped me reach more definite conclusions. Nonetheless, in 2017 Henan University provided me with the financial resources and institutional support to access official files kept in county governmental offices that are normally of limited access to the public. These files contain statistical records on health, food availability, and the different resources of aid were provided during the *Qiwu-ba* Flood (doctors, food, cloth, construction material, and financial aid). Also, with the help of the research team in Henan province, I was able to conduct oral surveys with survivors from these events. The research consisted in going to a great number of towns and villages in Zhumadian prefecture surveying government officials and peasants who had suffered the *Qiwu-ba* Flood. Not all of these data have been included in this thesis due to limitations of time, but this valuable material will be used in future research.

With the aid of this new material I will address one of the limitations of this thesis, namely the difficulties in studying the government's response to the disaster of 1975. Having this new material for the county and village levels at my disposal will allow me

to arrive at new findings on the aftermath of the flood. This is valuable information because, as mentioned on several occasions throughout this dissertation, the disaster of 1975 was a very localized humanitarian crisis. The new data will allow me to conclude whether the grain production in some counties was greater than what the present study has been able to determine. However, the fast response of local and national government might have prevented the disaster from causing a major loss of life. This provides a very different picture from how the humanitarian crisis developed during the GLF, when government assistance did not reached the famine-affected population until three years after the famine had started. This corroborates the findings of recent publications, which claim that, by the end of the Maoist period, the government's response to natural disasters and the food crisis had greatly improved. Therefore, one of the events that restricted the government's attempts to prevent crisis from developing was the extent of the Great Flood itself, which barred those trapped by water from being reached for months. On the other hand, another impediment was the Tianjin earthquake of 1976, believed to be the largest earthquake of the twentieth century, when 255,000 people died. At that point, government assistance was pulled out of the most severely flood-affected areas in Henan province and directed to the neighboring region of Tianjin.

Another new line of research that will build on this thesis will be to conduct an econometric study to identify the most significant determinants explaining variations in height during the Maoist period. While in the present study I have found a relation between nutritional status inequality and food and health resource allocation between the different provinces, it is important to include more variables to determine the level of correlation between different economic and development components and the mean height of the population.

Finally, the findings suggesting a selection effect on the cohorts born during the Great Famine, deserves to be defined with empirical methods that allows to depict the behavior of heights variation during severe crisis.

Despite the limitations mentioned in this Subsection, this dissertation gives a great array of evidence about the well-being during the Maoist period. Some, confirming previous studies that used other type of indicators and methodologies. In any case, the increase of the biological standards of living and the different patterns of inequality depending on the social groups sheds more light to the puzzling welfare system that developed during

the 1950s, 1960s, and 1970s. This is relevant to interpret the reality in China today because, despite the economic changes that the country went through since the 1980s, we still find the same patterns of regional, gender, and urban-rural inequalities.

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