

# **Information Distortion in Hierarchical Organizations: A Study of China's Great Famine**

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February 2016

## **Abstract**

The literature has attributed China's Great Famine of 1959-1961 to sharp declines in grain output caused by reduced peasant incentives and excessive grain procurement. We provide evidence to further connect these failures to information distortion inside the government system. Specifically, we document the following findings. First, local officials competed with each other in massive inflation of local grain yield in an effort to cater to Mao's wishful thinking about the Great Leap Forward. Second, as a result of the inflated yield inflation, the central government failed to realize the widespread famine and organize systematic famine relief until two years after the famine started. Third, during the first two years, the central government transferred a substantial amount of grain out of the provinces that experienced severe famine while local officials in these provinces redistributed grain back to peasants using locally controlled grain stock. By revealed "knowledge," the last finding illustrates the information gap between the central government and local officials at the peak of the famine. Overall, our analysis highlights severe consequences of information distortion induced by subordinates' incentives to cater to their superior's wishful thinking.

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\* PRELIMINARY DRAFT. We are grateful to Roland Benabou, Janet Currie, Bentley MacLeod, Nancy Qian, and seminar participants at New York University, Princeton University and the TCFA Symposium at Fordham University for helpful discussion and comments.

China's Great Famine of 1959-1961 was the most devastating catastrophe in human history. It not only caused a death toll in the magnitude of sixteen to thirty million (Banister, 1987; Coals, 1981; Peng, 1987), but also inflicted long-term, negative health and economic consequences on millions of survivors (Chen and Zhou, 2007; Almond et al., 2007; Meng and Qian, 2009). The existing literature has proposed several explanations for the causes of the famine.<sup>1</sup> The first one, known as the "food availability hypothesis," attributed the famine to sharp declines in grain output caused by the massive collectivization of People's communes, which reduced peasant incentives (e.g., Lin, 1990). Li and Yang (2005) regard the sharp output declines as a failure of central planning, as Mao's wishful thinking had led to a drastic reallocation of economic resources from agriculture to industry. The second explanation focuses on entitlements to grain in the famine period (e.g., Lin and Yang, 2000). When food supply was in overall shortage, the government ensured the food supply for urban residents by sacrificing lives of peasants, which explains why deaths were heavily concentrated in rural areas.<sup>2</sup>

The third explanation traces the causes of the famine to China's institutional arrangements at the time. Meng, et al. (2015) argue that the rigidity of grain procurement quotas set by the central government was critical for understanding why rural mortality rates were positively correlated with per capita food production when average rural food retention was sufficient to prevent a severe famine. According to this argument, when grain output fell, the central government was still stuck with the previous high procurement quotas for different regions, which led to excessive grain procurement and, subsequently, grain shortages and famine in rural areas. Chen and Kung (2011) argue that career concerns of local officials also motivated them to submit excessive levels of grain to the central government in order to increase their likelihood of promotion.

Although the aforementioned explanations shed much light on our understanding of the causes of the Great Famine, there are still several unresolved puzzles. One particular salient feature of this famine was its long duration. There were early signs of famine in 1958 in some

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<sup>1</sup> See Yang (2008) for an extensive survey of the literature on China's Great Famine.

<sup>2</sup> Public dining halls in rural areas offering free meals to every peasant encouraged excessive food consumption and waste, which worsened the food shortage in rural areas (Chang and Wen, 1997; Yang, 1996).

areas, with estimated deaths of less than one million; in 1959, the famine erupted across the country with an estimated death toll of over four million. The death toll peaked in 1960 with over ten million people dying of hunger. When the central government started its nationwide relief efforts in early 1961, the death toll that year declined to about two million, which was much lower than in 1959, even though the average rural food retention in 1961 was the lowest during the period of 1958-1961. The effectiveness of the rescue efforts in 1961 motivates an important question: why did the central government react so slowly when over fifteen million people had already died of starvation in the previous two years?

An even more puzzling observation is that while grain output fell sharply in 1959 and 1960, the Chinese government increased its net grain exports to foreign countries in 1959 to a record high level for the entire decades of the 1950s and 1960s—4.16 million tons—that accounted for over 40 percent of the cross-province grain transfer in the same year. Even in 1960, the worst year of the famine, net grain exports were maintained at a high level of 2.66 million tons. Furthermore, the existing explanations for the causes of the famine cannot explain why the total area sown with grain decreased sharply by about 10 percent in 1959 just when the grain yield was also falling.

To fully understand these puzzling observations, it is important to account for the information distortion created by the political incentives of local officials to misreport local grain yield to cater to Mao's wishful thinking about the Great Leap Forward (GLF) movement. Mao had commanded unchallenged authority in the Chinese Communist Party (CCP) since the early 1950s, and his wishful thinking motivated him to implement the radical GLF policies, such as rapid urbanization and industrialization, starting in 1958. These policies immediately led to sharp declines in grain output across the country in 1958 and 1959, due to weakened incentives of peasants and the large migration of rural labor to urban areas, as emphasized by the literature. Despite the sharp declines in grain output, the widespread catering behavior of local officials in inflating local grain yields to miraculous levels (the so-called "launching agricultural sputniks") encouraged Mao to further increase the pace of the GLF, rather than cautioning him to correct these radical policies.

We hypothesize that because the central government was misguided by the inflated grain

output figures, it was largely unaware of the widespread famine across the country in 1959 and 1960. This severe information distortion explains the lack of any systematic famine relief effort by the central government in the two worst years of the famine. Instead of relieving the famine, the central government continued to procure high levels of grain from provinces with greater death tolls and sent it to provinces with fewer deaths, and even exported substantial amounts of grain to foreign countries. Even when faced with substantial drops in grain output and massive starvation, local officials reacted by covering up the famine and continuing to report high grain yields. Encouraged by the largely inflated grain output, the central government launched even more aggressive industrialization policies in 1959 and 1960 by migrating more rural labor to industry and further reducing areas sown with grain which exacerbated rather than mitigated the decrease in grain output and the famine.

It might seem shocking that a nationwide famine in the modern age could have remained unknown to the central government after it had already taken the lives of over fifteen million people over two years. In order to fully appreciate the possibility of such severe information distortion, it is important to note the organizational structure of the Chinese government at the time. First, China had a strict hierarchical government system; information was reported level by level from the lower echelons of the system to the upper echelons. In particular, the central government in Beijing exclusively relied on information reported from the provincial officials about many aspects of the local economy, including grain production, yield, and distribution. As the reported information also directly affected performance evaluations of these officials, career concerns created strong incentives to inflate grain output and even to compete in launching agricultural sputniks.

Second, there were no alternative channels that allowed the central government systematically to verify the information reported by provincial officials. As all private markets for grain were closed and prohibited at that time, grain prices did not reflect the scarcity of food supply. As part of the GLF propaganda, the media was fully controlled by the central government and was occupied by reporting all sorts of miraculous sputniks launched by both agricultural and industrial sectors in different regions. Although leaders from the central government had taken regular tours to inspect local areas, the tours were typically

staged by local officials and failed to serve the purpose of acquiring reliable information about local conditions. This environment provided the necessary ground for the disastrous famine to occur without even being noted by the central government. For this reason, we also believe that China's Great Famine provides an excellent laboratory for examining information distortion inside a large hierarchical organization.

The main challenge we face in testing our information distortion hypothesis is how to empirically identify the information gap between the central government and local officials during the famine. We, as researchers, did not observe the information set held by different levels of the government regarding the famine. By taking advantage of certain institutional features of China's grain procurement system during the GLF period, we are able to use a revealed knowledge approach to compare the information about the famine held by the central government and provincial officials. On one hand, the net grain transferred from each province was directly determined by the central government and thus revealed the central government's knowledge about famine severity in the province. On the other hand, redistribution of the procured grain to peasants in need (the "sell-back grain") was determined by provincial officials and provided a channel to infer the knowledge of provincial officials about grain shortages in rural areas in each year of the famine period. Furthermore, after the grain subcontract system was instituted in 1958, the information on sell-back grain was largely confined to provincial officials and not revealed to the central government.

Building on these institutional features, we examine how net grain transfers from a province and grain sell-back within a province were correlated with famine severity in the province in each year of the famine period. By using a province-level panel dataset from 1954 to 1966, we find that during the famine period, a significant and negative correlation between net grain transfer from a province and famine severity appeared no earlier than 1961. This pattern indicates that the central government did not provide any systematic famine relief to provinces more severely affected by the famine until 1961. In sharp contrast, the amount of sell-back grain exhibited a significant and positive correlation with famine severity in 1959 or even earlier. This pattern suggests that provincial officials had allocated more sell-back grain under their control to relieve the famine in rural areas, which in turn indicates

that they were already informed about the famine in 1959. Overall, we interpret these findings as evidence of an information gap between the central government and local officials regarding the famine.

As widely acknowledged by the literature, it is challenging to accurately measure the severity of the Great Famine due to the lack of reliable data for this period. We deal with this issue by using four alternative proxies. Three of the measures are commonly used in the literature: excess death rates, birth-cohort size, and grain output reductions. The fourth measure is new and based on excess death rates of children age one to six during the famine. This measure is calculated from a rare and unique survey on childbearing history of Chinese women taken in 1988. Our key results are robust to these different famine measures.

Taken together, our analysis highlights information distortion inside the government system as another important mechanism, in addition to the aforementioned mechanisms, to help fully explain China's Great Famine. By demonstrating the presence of severe information distortion in this catastrophic famine, our study also provides useful evidence supporting the importance of analyzing information transmission inside organizations. In particular, the organizational setting of our study is closely related to the model setting of Prendergast (1993), which analyzes information transmission from a worker to his supervisor when the worker is subject to subjective performance evaluations. The model shows that the worker has incentives to distort the transmitted information to conform to the opinion of his supervisor, leading to information loss in transmission. Our empirical results strongly support this type of conforming behavior. Prendergast's model also shows that as the supervisor rationally internalizes the information distortion caused by a worker's conforming behavior, the information distortion does not systematically bias the supervisor's decision making. Our empirical findings suggest that Mao might have failed to fully internalize the grain yield inflation by local officials, likely due to his own wishful thinking. Our analysis thus prompts the need to expand this line of theoretical modeling to further incorporate the interaction between information distortion induced by career concerns of subordinates and potential behavioral biases, such as wishful thinking, which might lead to failure by superiors to internalize the information distortion.

Also note that the severe information distortion we highlight during China's Great Famine, although extreme, may also be present in many other institutional settings. For example, severe information distortion caused by subordinates' career concerns might have contributed to the recent U.S. financial crisis. Shortly before its spectacular bankruptcy in September 2008, the CEO of Lehman Brothers, Richard Fuld, fired two dissenting chief risk managers, which might have acted as repeated warning signals and induced employees of Lehman Brothers to go along with his aggressive risk taking in mortgage markets. Consistent with this anecdotal argument, Cheng, Raina, and Xiong (2014) provide systematic evidence to show that at the peak of the U.S. housing bubble in the mid-2000s, most Wall Street employees in the securitization industry were surprisingly ignorant of the gigantic bubble and had been aggressively acquiring, rather than selling, homes for their personal accounts. Benabou (2013) further argues that conforming behavior and group think might have caused massive ignorance of warning signs by managers and traders of financial firms before the crisis.

The paper is organized as follows. Section I gives a detailed description of the institutional background about Mao's Great Leap Forward and the subsequent famine in the late 1950s. We discuss three widely held explanations for the Great Famine in Section II. Section III explains our identification strategy to measure the information gap between the central government and provincial officials. Section IV describes the data and defines the key variables. Section V presents the econometric specification and the main empirical results, followed by the conclusion in section VI.

## **I. Institutional Background**

### **A. Mao's Great Leap Forward**

Mao's radicalism appeared in as early as 1953 when he proposed that China should start massive industrialization and move to socialism in three years instead of fifteen years as originally planned. Agricultural collectivization sped up. Mao's radicalism towards rapid industrialization was initially unpopular and received strong resistance from other top leaders like Zhou Enlai and Chen Yun who were in charge of economic planning. There was even a

heated debate between Mao and Zhou in 1956 about the proper pace of China's industrialization.

In November 1957, Mao declared in Moscow that China would catch up with and overtake Great Britain in fifteen years, as a response to Khrushchev's claim that the Soviet Union would catch up with and overtake the United States in fifteen years. This proved to be a turning point in Mao's attitude towards his senior colleagues who cast doubt on his aggressive economic plans. He was increasingly impatient with the conservatism of his senior colleagues in the Party and started to fight back in a series of conferences held in Nanning, Chengdu, and Wuhan in 1958. Mao persistently criticized Zhou and Chen for their anti-radicalism positions and labeled them as "rightist conservatism." Under the increasing pressure from Mao, Zhou and Chen were forced to openly confess their mistakes in insisting on a conservative stance. Many local leaders, including some provincial leaders, such as Pan, Fusheng (the leader of Henan Province), were purged or ousted due to their cautious attitude about Mao's radical policies (Dikotter, 2010, page 21-24).

Although cautious top and local leaders were criticized or punished, those who showed strong support for Mao received favorable treatment and were promoted by him. For instance, Ke Qingshi was promoted from the Party Central Committee to the Politburo Committee. Mao's preferential attitudes towards supporters and dissidents sent a strong signal to his colleagues in the Party that any deviation from his positions would invoke serious political consequences. Mao's attack on dissidents in 1958 marked a turnaround in the CCP; Mao became elevated over all others in the Party, and each member faced the choice of either following him closely or being punished (Bo, 1997).

After Mao was elevated to the only authority of the CCP in early 1958, the policies of Great Leap Forward (GLF) gained universal support. The core of the GLF policies was to achieve rapid economic growth, encourage regional competition, and create economic miracles. Prudent cautions were viewed as equivalent to rightist conservatism. Mao enthusiastically promoted yardstick competition on economic terms at provincial, county, and township levels. The keywords of local economic officials were "high speed" and "targets of economic growth." Under Mao's campaign, the Chinese economy exhibited a clear sign of



“great leap forward”: a large fraction of the rural population either engaged in off-farm activities or migrated to urban areas to increase industrial production. About 41 million agricultural workers, accounting for 21 percent of the agricultural labor force, left farming between 1957 and 1958 (Riskin, 1987). Among these workers, approximately 17 million worked in the iron, steel and other heavy industries in rural areas, while 16 million migrated into cities, working in state industrial sector (Yang, 2008). The massive migration caused the urban population as a ratio of the total population to increase from 22.5 percent in 1957 to over 26 percent in 1960 (see Figure 1). As a result of the rapid urbanization, the areas sown with grain markedly decreased from 134 million hectares in 1957 to 128 million hectares in 1958, and 116 million hectares in 1959, as shown in Figure 2.

## **B. Inflation of Grain Output**

An astonishing feature of the GLF was the feverish competition between local officials to launch “grain sputniks” by inflating the local grain output to please Mao. Village officials of a People’s commune in Henan Province triggered an intensive competition of sputnik-launching all over the country by claiming to have achieved a record high wheat yield of 2,015 *jin* per *mu* on June 8, 1958.<sup>3</sup> This record was quickly overshadowed by others: for example, 2,394 *jin* per *mu* on June 11, 4,353 in the Hubei Province on June 18, 5,103 in Hebei Province on June 30, and 8,585 in the Qinghai Province on September 22. A similar competitive record-setting pattern occurred in rice yield in 1958. The record of rice yield was initially set at 3,275 *jin* per *mu* in the Fujian Province on July 12, and then reached a breathtaking level of 60,437 in Guangdong on September 5.<sup>4</sup> The miraculous grain yield reported by local officials encouraged Mao’s radicalism, misguided the central government to set excessive procurement targets, promoted aggressive industrialization policies, increased grain exports, and decreased areas sown with grain. At some point, Mao and his senior leaders became seriously worried about how to deal with the unprecedented, excessive supply of grain. As a consequence, in 1958 Mao proposed reducing the area sown with grain for land fertility maintenance, and this proposal was quickly implemented in 1959.

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<sup>3</sup> One *jin* is equivalent to 500 grams. One *mu* equals approximately 0.067 hectares.

<sup>4</sup> See Yang (2008) for more details.

There is ample evidence of grain output inflation by local officials. Table 2 reports the inflation in reported grain output by twenty-two provinces to the central government in 1958. Each of the twenty-two provinces had a certain amount of output inflation. Shandong was on the top of the list, over-reporting by about 307.8 percent of its actual yield, followed by Yunnan, Gansu, Guangdong, Henan, Hebei, and Anhui. Sichuan, the largest province by population, inflated its output by 100 percent. Jilin, whose comparative advantage was heavy industry and not grain production, turned out to be the most “honest” province, but nevertheless had inflated its output by 13.4 percent.

In sharp contrast to the excessive supply of grain perceived by the top leaders in the central government (hereinafter, the “Center”) was the reality of a marked and continuous fall in grain output in 1959 and 1960 due to the free-rider problem created by a radical move to People’s Communes and massive migration of rural labor to cities. In 1959, local officials continued to report high yields despite the large yield reduction. This is perhaps a key reason why the grain procurement in 1959 did not decrease but increased by ten percent, as shown in Figure 4. In 1960, facing a second year of large grain output drops across the country, some local officials started to report modest reductions in output to the central government.<sup>5</sup> No local officials had voluntarily reported the massive famine. In response, the central government reduced procurement levels but provided no famine relief, let alone a reversal of the radical GLF policies.

This bottom-up information distortion was made even worse by the outright purge of the Defense Minister Peng, Dehuai, who boldly criticized Mao’s radicalism and the resulted output inflation during the Lushan meeting in November 1959.<sup>6</sup> Local officials were scared by Peng’s fate and continued to report high grain output levels despite the actual drops in output and to cover up the increasing death tolls caused by grain shortages across the country.

Notably, the information acquisition channels of the Center during the GLF period were

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<sup>5</sup> There were a few reports of grain shortage sent by local officials to the Center in 1959. The Center showed concern and requested that local officials seek solutions by themselves. Several months later, these local officials reported to the Center that the problem had been brought under control, although in reality the famine had worsened.

<sup>6</sup> During the Lushan meeting, Peng wrote a lengthy letter to Mao, criticizing his radicalism in the GLF and widespread false reporting of high yield. But there was no mention of any incidence of famine in the letter.

seriously impaired by the lack of free media at the time. In fact, the official media was fully occupied with reporting the agricultural sputniks launched in different areas and the great successes of the GLF. As a result, virtually all information related to local areas depended upon the self-report of local governments, which was strongly influenced by the political incentives of local officials.<sup>7</sup> In addition, the shutdown of private grain markets and the introduction of central planning prices also made it impossible for the Center to detect food shortages through any sharp rise in market prices.

### **C. The Great Famine**

The famine showed early signs in some areas with an estimated death toll of about one million, and erupted across the country in 1959 with an estimated death toll of 4.08 million. As we will describe in detail, the estimated death toll is based on the excess death rate in each of the years during the famine period relative to the average death rate during the prior three years of 1955-1957. The death toll peaked in 1960, reaching 10.12 million (see Figure 3). Despite the worsening famine in 1959 and 1960, the massive migration of rural labor to irrigation projects and to cities for industrial production (mainly iron and steel production) did not stop and, instead, increased (Kung and Lin, 2003; Li and Yang, 2005). Figure 1 shows that the urbanization rate, which is measured as a ratio of urban population over the total population, continued to increase in 1959 and 1960, and over twenty-three million rural laborers were reallocated to cities in those two years. As a result of these dramatic GLF policies, there was a remarkable decrease in the area sown with grain from 1956 to 1959 (Figure 2). Even though grain output dropped by 15 percent in 1959 relative to 1958, grain procurement increased by 14.5 percent. In 1960, although the procurement level was lowered slightly, the ratio of procurement actually rose (Figure 4).

Figure 5 shows the geographical distribution of the famine exposure during 1959-1961.

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<sup>7</sup> One would expect the statistical institutions of the government to have played a role during the GLF in collecting information for the central government. Unfortunately this was not the case. The National Bureau of Statistics did not have field offices at the local levels and relied almost entirely on local bureaus for information acquisition and provision. But during the GLF, local statistical bureaus were fully controlled by the local governments and thus yielded to the will of local officials. The former director of the National Bureau of Statistics, Xue Muqiao, actually advised provincial bureau directors to follow the order of provincial leaders to report whatever agricultural statistics that would please their provincial leaders, but in the meantime, to keep the genuine information for themselves just in case the central governmental requested it later (Xue, 1996, page 192).

The famine was widespread across the entire country. It also exhibited large variations across regions. Sichuan, Guizhou, and Anhui were among the most severely affected regions, with excess death rates of 5-10%. The close followers, in descending order of severity, include Shandong, Hunan, Henan, Guangxi, Gansu, and Qinghai, ranging from the relatively prosperous, coastal region to the poor, far western part of China. Some provinces, such as Inner Mongolia, Tibet, and Jilin, only experienced modest famine.

A salient feature of the famine was that most deaths happened in areas with relatively high per capita grain output, such as Sichuan, Henan, and Anhui, as pointed out by Meng, et al. (2015). This observation suggests that provinces that had supplied more grain to other areas before 1958 also had higher excess deaths during the famine. Figure 6 further shows that across different provinces the excess death rate is negatively associated with the changes in grain output from 1958 to 1961. In other words, the provinces that experienced larger reductions in grain output suffered higher death tolls during the famine. This fact suggests that the famine was concentrated in provinces that transferred larger quantities of grain to other areas before the famine and that also experienced more severe reductions in grain output during the famine.

Surprisingly, despite the grain output declines and the ongoing famine in 1959 and 1960, the GLF policies, such as high procurement of grain, rapid urbanization, and industrialization, remained and were even strengthened. The concentration of famine in grain-producing provinces is particularly intriguing and suggests that the sharp drops in grain output in regions with relatively high per capita grain output before the famine might have been somehow unknown to the Center. Our goal in this paper is to analyze that issue.

The rapid urbanization, industrialization, and high procurement of grain finally came to a halt in 1961, when the Center (especially Mao) acknowledged the widespread famine across the country and started nationwide famine relief in several ways, as reflected in Figures 4 and Table 1. First, after a modest downward adjustment in 1960, the absolute procurement level dropped again in 1961 even though the grain output started to rise. Second, China increased grain imports by 4.46 million tons in 1962, which was equivalent to an increase of 6.76 kilograms of grain for each person at that time. Third, millions of migrated workers were sent

back to their rural homes, and fourth, the area sown with grain increased. The reversal of the GLF policies continued after 1961.

## **II. Possible Explanations for the Delayed Famine Relief**

The literature has offered several alternative explanations for the central government's failure to respond to the nationwide famine in 1959-1960 and its increased procurement in those provinces experiencing sharp drops in grain output: 1) the central government was unable to provide any systematic relief due to a nationwide grain shortage, 2) Mao was aware of the famine but accepted the death toll of tens of million as a necessary cost of the GLF, and 3) the grain procurement system was too rigid to adjust to the decline in output. In this section, we argue that these explanations do not fully explain the delayed response.

### **A. Was the Central Government Short on Grain?**

Although the consecutive declines of grain output in 1959-1960 and the persistent high levels of procurement caused widespread food shortages in China, the central government still had the ability to aid most provinces in need. The grain stock in the granaries around the country amounted to 16.5 million tons in 1960, which could have saved millions of lives if it had been used for famine relief. More important, in 1959 and 1960, China exported the highest levels of net grain exports in the entire 1950s and 1960s. Table 1 reports China's grain imports and exports from 1954-1966. In 1959, China exported 4.16 million tons of grain, which turned out to be the largest amount exported during that period and accounted for over 40 percent of the aggregate net grain transfer in 1959. In 1960, high levels of grain exports continued (2.72 million tons), accounting for about 38 percent of the net grain transfer in that year. Grain imports in these two years were negligible compared to other years before and after the famine.<sup>8</sup> Additionally, as mentioned earlier, the area sown with grain declined sharply by about 10 percent in 1959 as a response to Mao's proposal for maintaining land fertility given the optimistic prospect of grain "surplus."

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<sup>8</sup> The international prices for grain during 1959-1960 did not exhibit any significant increases to induce such a spike in grain exports. China did not suffer any serious trade deficit during that time either. China's foreign reserve during 1958-1961 was stable at about 100 million U.S. dollars, as the increase in exports was essentially matched by an increase in imports.

These facts convey two important messages. First, the central government kept a large stock of grain at its disposal in the worst famine years. The total amount of grain exports in these two years (6.87 million tons) were enough to save millions of people from starvation. Second, one could not justify the grain exports in 1959 and 1960 unless the central government had missed something about the grain output drops and the resulting famine. There was an increase of nearly one million tons in grain exports from 1957 to 1958, which could be justified by the increase in grain output in 1958, but the sharp rise of another 1.27 million tons of grain exports in 1959 occurred when the output fell by over 20 percent in that year. Grain output continued to decline in 1960, but China again exported a large amount of grain.

Grain imports finally increased dramatically from 66.3 thousand tons in 1960 to 5.81 million tons in 1961, presumably after Mao became informed of the famine in 1961. The high level of net grain imports continued in the following five years. It is particularly difficult to explain the marked reduction in areas sown with grain in 1959 by any factor other than the optimism of the Center (especially Mao) about the grain yield.<sup>9</sup>

## **B. Could Mao Accept the Famine as the Cost of the GLF?**

An alternative interpretation for the delayed response to the famine is that Mao was aware of the severity and extent of the famine but was willing to accept a death toll of millions as the cost of advancing the GLF. We find it difficult to establish the premise that Mao could accept the loss of the lives of millions of people as a cost of the GLF. First, different from Stalin, peasants were the constituent base of Mao and the CCP. Ignoring the massive death of peasants was politically suicidal. Repeated riots after widespread famines led to the eventual fall of several dynasties in Chinese history, which Mao knew by heart. Second, massive death would shake Mao's power base and threaten his leadership in the CCP. Indeed, in the aftermath of the famine, Mao faced unprecedented criticism from party members, which culminated in the Meeting of Seven Thousand People in 1962. Mao was

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<sup>9</sup> Public propaganda often claimed a key cause of the famine was the repayment through grain exports of a debt to the Soviet Union. However, the pressure of repaying the debt appeared only after 1961, and the CCP overreacted to the debt claim from the Soviet Union for political reasons, as argued by Yang (2008).

largely sidelined by Liu Shaoqi after this meeting, which planted the seed for Mao to initiate the Cultural Revolution in 1966 in order to remove Liu from power (MacFarquhar, 1999). Third, Mao did eventually react to the famine in late 1961 by reversing most of his GLF policies. Although the exact timing of his recognition of the severity and extent of the famine is arguable, the fact that he chose to reverse most of the GLF policies indicates that it was not his intention to ignore the death of millions.<sup>10</sup>

A more reasonable argument is that local officials who had better knowledge of the famine did not report accurately to Mao and other top leaders for fear of being viewed by Mao as dissidents of the GLF. After the Xinyang Accident broke out in late 1960,<sup>11</sup> Mao asked his colleagues in the Center to visit different regions of the country to collect information about the famine. Mao even asked his security guards to visit their home villages and report back to him what they saw there. This indicates that Mao might have been concerned that his colleagues in the Center were not telling him the truth, and he had to rely on his personal guards as trusted informants. Only after Liu Shaoqi (then the number-two ranked leader in the CCP) spent two months in early 1961 in his Hunan hometown did he (and subsequently other top leaders) realize the extent of the substantially inflated grain yield and the widespread famine. Subsequently, most GLF policies were reversed. The central government drastically increased grain imports and reduced procurement pressure on grain exporting regions.

Even though it is unlikely that Mao knew the extent of the widespread famine, some questions still remain. Having grown up in a peasant's family, how could Mao believe in the absurd growth in grain yield reported by local officials? Anecdotally, Mao and other top leaders recognized the inflation in the reported yields, but failed to fully appreciate the degree

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<sup>10</sup> The 1931-1933 famine in the former Soviet Union, which caused a death toll of several millions was regarded as a plot orchestrated by Stalin to revenge the nationalist aspiration of the Ukraine and peasant resistance to agricultural collectivization (Conquest, 1986). Imposing the famine as revenge cannot explain China's Great Famine since the famine death tolls were widespread across the entire country, with Mao's home province, Hunan, among the most suffered areas.

<sup>11</sup> Xinyang was a prefecture in the Henan Province, which suffered at least one million abnormal deaths from October 1959 to April 1960, due to local radicalism in procurement and cruel persecution of peasants who disobeyed the excessive procurement policies. When the large-scale famine broke out in Xinyang, local leaders tried everything to cover it up and prohibit migration of refugees. Mao was informed of the situation as late as October 24 1960. See Yang (2008) for more details.

of inflation.<sup>12</sup> To some extent, Mao believed that some degree of regional competition in launching sputniks helped boost the national morale for the GLF. Wishful thinking and group think thus might have prevented him and other top leaders from systematically internalizing the inflation and accurately accessing the realistic situation on the ground—grain yield across the country had substantial drops rather than growing at rates less than reported by local officials.

### **C. Was the Grain Procurement System Too Rigid?**

The literature has highlighted the rigidity of the procurement system during the GLF period as an important cause of the Great Famine (Meng et al., 2015). The institutional rigidity originated from the necessity of supplying a huge volume of grain to cities every year and the need to serve the rapid industrialization instituted by the GLF. To fulfill this need, the Center set up procurement targets for each province with production capacity, based on projected grain output (which was heavily influenced by the output in the previous years), the overall plan for industrialization, and the convenience of transporting grain to other areas (areas near railroads and major rivers faced particularly high procurement targets). The Center made fulfilling the procurement targets a key political task of local officials, which motivated them even to sacrifice the bare minimum required grain to feed local peasants.

Although there is no doubt about the rigidity and inefficiency of the procurement system, it is important to recognize that the rigidity we observed during the GLF was rooted not from institutional inertia or overriding necessity, but from the lack of knowledge by the Center regarding the actual grain output at the local level. In order to differentiate between system rigidity caused by inertia and the lack of knowledge, we simply examine the yearly responses of grain procurement to output fluctuations from 1954 to 1962. In Figure 7, we provide scatter plots of excessive grain procurements against the change in grain outputs for each year from 1954 to 1962. Excess gain procurement is defined as the current year's procurement

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<sup>12</sup> Mao's optimism about high grain yield was also confirmed by his close colleagues in the central government. On November 16, 1958, the vice premier Tan Zhenlin, who was in charge of agriculture, submitted a report to Mao about grain output in 1958. This report conservatively estimated the national grain output would be 425 million tons after explicitly taking into account output inflation at local levels, and guaranteed the output would be 375 million tons even in the worst case (Yang, 2008, page 939). The actual grain output in 1958 was only 200 million tons, according to a subsequent recalculation.



minus the average procurement during 1955-1957.

Interestingly, there was a significantly positive relationship between excessive procurement and grain output change in all years except 1959 and 1960, the two peak years of the famine. This positive relationship suggests that an output drop in one province was usually accompanied by a reduction in procurement amounts. For example, in 1954 when several provinces (e.g., Hunan, Hubei, and Anhui) near the Yangtze River and Huai River suffered unprecedented flooding and large grain output drops, the procurement levels for the affected areas did decrease substantially.<sup>13</sup> Specifically, the procurement levels for the Hubei Province, which was among the most affected regions, decreased from 1.95 million tons in 1953 to 1.5 million tons in 1954 (China Ministry of Agriculture, 1990). In fact, as a province that regularly transferred grain to other regions,<sup>14</sup> Hubei received 0.45 million tons of inbound transfer after the flood. China was again hit by a large flood in 1956, and the affected provinces (e.g., Anhui and Hebei) received assistance from the Center in terms of inbound grain transfers and lower procurement obligations (China Ministry of Agriculture, 1990).<sup>15</sup> When Mao and the central government realized the extent of the famine in 1961, the procurement targets for most provinces were significantly adjusted downward. These observations suggest that the grain procurement system was able to react to fluctuations of grain output in different regions both before and after the famine when the Center was informed of the grain output drops at the local level.

There was a sharp change in the relationship between excessive procurement and grain output change in 1959 and 1960. The relationship in 1959 was even negative, albeit insignificant—the provinces that had larger output drops faced higher rather than lower procurements. The relationship became flat in 1960, indicating the continued lack of systematic relief to provinces that suffered great output drops. The stark rigidity displayed by the procurement system just during these two years, although not before and after the Great

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<sup>13</sup> Bo (1997, page 193) mentions that due to the unprecedented flooding of the Yangtze and Huai Rivers in 1954, grain procurement increased by about 3.5 million tons for those unaffected regions in order to aid the affected regions.

<sup>14</sup> In 1953, Hubei transferred 0.37 million tons grain to other regions.

<sup>15</sup> Hebei's procurement level decreased from 1.65 million tons in 1955 to 1.25 million tons in 1956. The procurement level for Anhui decreased by 0.87 million tons from 1953 to 1954 and its outbound transfers by 0.34 million tons.

Famine, shows that there was a particular reason driving the observed rigidity of the procurement system in this period. As we have argued and will show more systematically, the reason is related to the lack knowledge by the Center about the famine.

### **III. Empirical Design**

Our central hypothesis is that information distortion in China's government hierarchy during the GLF was critical for causing the lack of knowledge by the Center about the grain output drops and the widespread famine across the country in 1959-1961. We argue that information distortion contributed to the famine in two ways. First, the inflated grain yield reported by local officials in 1958 and 1959 misguided Mao and the Center into believing that China had achieved an unprecedented high level of agricultural production, which fueled their optimism so as to raise the already-high targets for grain procurement, industrialization, and urbanization. Second, when the actual grain output fell sharply in 1959 and 1960 and the famine set in, the Center was unaware of the grave situation until the end of 1960. Different from the Center, local officials had better knowledge, but chose to hide the actual situation of output declines and ongoing famine from the Center. In the meantime, they took actions within their control to alleviate the catastrophic famine by increasing sell-back grain to rural areas. It is our objective to identify the information gap between the local officials and the Center in terms of their knowledge of the famine.

The key challenge for our empirical test is how to measure the information gap regarding the famine between the Center (especially Mao) and local officials. We do not have any direct observations about whether Mao knew what went on at the local levels in 1959 when over three million people quietly died of hunger. It is even harder to pin down the information set of local officials regarding the famine. To confront this challenge, we rely on indirect inferences based on information revealed through actions, taking advantage of the institutional features of the grain procurement system used at the time.

#### **A. Grain Procurement System**

As an agriculture-intensive country in early 1950s, China needed to extract as much

agricultural surplus as possible from peasants to speed up its industrialization. To achieve this goal, China instituted a system of “*unified procurement and sales*” (*tonggou tongxiao*) in 1953. Under this system, the state, as the sole buyer and seller of grain, controlled the production, distribution, and consumption of all grain. All private grain markets were closed, and any sales outside the state system were strictly prohibited. Figure 8 illustrates how the system of “*unified procurement and sales*” worked. When grain was produced and harvested, peasants kept rations for their own consumption, seeds, and animal feed, paid agricultural tax, and then sold the surplus output to the state at prices specified by the central government.

The procurement typically accounted for nearly 30 percent of the total grain output during 1953-1957. A significant part of the procured grain for grain-surplus provinces was transferred to other provinces with food shortages. We call this “grain transfer.” China also exported grain to overseas markets in exchange for machinery and equipment. After grain transfers and exports, the excess procured grain would be allocated to urban and rural areas within the province. The amount of grain allocated to urban areas depended upon the need in these areas driven by the pace of industrialization and urbanization. In any case, assuring the food supply to cities had been a top priority of the state grain policies.

The grain allocated back to rural areas, the “sell-back grain,” fed those peasants who lacked a food supply for a variety of reasons, such as planting cash crops, engaging in fishing, forestry, or animal husbandry according to the state plan, or suffering from poverty or natural disasters. The sell-back grain accounted for over 40 percent of the annual grain yield and covered about 200 million of the rural population in the late 1950s, incurring a heavy burden on the state (Yang, 2008; Bo, 1997). By employing and thus feeding more urban workers due to the push for rapid industrialization, the state tried to restrict the amount of sell-back grain to the minimum level. Absent an emergency, such as flood, drought, or over-procurement, sell-back grain would be kept at a relatively stable level. Therefore, large year-to-year variations in sell-back grain prior to the GLF were mainly driven by bad weather or over-procurement (Li, 1981; Bo, 1997).

Grain stock played an important role in buffering shocks to grain consumption, production, and distribution. Since the early 1950s, the state made great efforts in

constructing new granaries around the country. Although grain stored in the granaries was in principle subject to the control of the central government, daily management of all granaries dispersed across the country were delegated to local officials, and the central government did not have any directly managed granaries. Because it was difficult for the Center to closely monitor and track the daily flows of grain in and out of local granaries, local officials, acting as gatekeepers of the national granaries, had significant discretion over the stock of grain in their jurisdictions. Anecdotal evidence shows that during the GLF, without notifying the central government, local officials channeled part of the grain stock to aid hungry peasants in areas severely affected by the famine (Li, 1981). This was particularly the case during the GLF period when the grain output declined sharply after 1958 but the procurement burden remained extremely heavy.

The amount of procurement linked to grain output in a certain region was a critical issue in the unified procurement and sales system. In the early years of the regime, there was too much arbitrariness in setting the ratio of procurement by local governments, which resulted in widespread complaints from peasants. In order to encourage peasants to produce more grain, the central government instituted a policy of "three quotas" in 1955 to pre-specify grain output targets, procurements, and redistribution in a three-year period. According to this policy, for every piece of arable land, a regular grain output would be estimated based on the yield in previous years and fixed for the next three years. The amount of procurement would accordingly be fixed in proportion to the regular grain yield. If the actual output exceeded the regular yield, peasants did not need to sell more than the pre-specified amount to the state.

The policy of "three quotas" operated from 1955 to 1957, but it changed in 1958 due to the inception of the GLF. The amount of procurement would be based on the estimated grain output for the coming year, rather than a pre-specified regular grain output. As there was a spurt of inflation in grain targets at the local levels during the GLF, this policy shift implanted an institutional root for excessive procurement. Nevertheless, as we will show later, the procurement system was still able to respond to shocks to grain demand and supply, conditioned on the central government's being well informed of the shocks.

In 1958, as part of a large-scale decentralization wave in the GLF period, the previously

centralized grain management registered a drastic change, delegating more authority to local officials. Previously, the central government directly controlled levels of grain procurement, sell-back, and transfer for each province. In the “grain subcontract system,” the central government only requested provincial governments to be responsible for the *net* volume of grain procurement transferred to the central government and delegated the management of intra-province procurement and sell-back to provincial governments. For provinces that regularly needed grain transfers from the central government, the subcontract system implied a fixed amount of transfer committed by the central government, and unless some catastrophe occurred, these provinces had to rely on their own grain in the event of a food shortage. The net volumes of grain procurement and transfer were specified on the basis of the 1957 levels. The shift to the grain subcontracting system seriously undermined the ability of the central government to directly determine food availability and consumption at the local levels, which created an information gap about the severity of the famine.

## **B. Revealed Knowledge**

The institutional details described in previous sections provide important clues on measuring knowledge of the Center and local officials regarding the famine. Under China's procurement system in the 1950s, the procured grain was used for intra-province distribution (including distribution to urban residents and redistribution as sell-back grain to peasants in rural areas), inter-province transfer, and export to foreign countries. The leftover, if any, would be stored in the granaries managed by local officials on behalf of the central government. The control rights of the intra-province grain distribution, which were originally held by the Center prior to 1958, shifted to provincial governments during the GLF. However, the inter-province grain transfers and grain exports to foreign countries had been firmly controlled by the central government at all time, even under the grain subcontract regime during the GLF, under which the central government only cared about the net contribution of grain procurement from provinces to the central government. Although formal control over grain granaries formally belonged to the central government, local officials had *de facto* power as gatekeepers. The fact that the different uses of the procured grain were subject to control of the government at different levels helps us to infer information regarding the

famine held by the Center and local officials.

Our analysis builds on the premise that the Center would adjust grain procurement requirements of a province if it was sufficiently informed of an ongoing famine in the province. As we argued earlier, Mao and the Center could not ignore the deaths of millions even if the situation could help to advance the GLF. Indeed, as showed before, the Center had adjusted inter-province transfers in response to unfavorable grain production shocks in some regions, such as during the flooding in 1954 and 1956. Thus, the information held by the Center regarding the famine can be inferred from the response of the net grain transfer from a province to the severity of the famine.

It is reasonable to infer that the Center was unaware of the famine if the net grain transfer out of a province was not responsive to the severity of the famine in the province. For this inference to hold, we also need to assume that the Center was able to transport grain to areas in need in a timely manner during the GLF period. Otherwise, the lack of response to the famine was not due to the lack of information, but due to the lack of capacity to react to the famine. This assumption should easily hold given the fact that in 1958 China already had established a central-planning economy following the model of the Soviet Union, with at least five years of building and exercising its capacity to allocate and transport materials, industrial products, and grain across regions. Actually in 1961 when the government fully mobilized its capacity to relieve the famine, the excess death toll declined sharply from 10.12 million in 1960 to 2.12 million. This testifies to the capacity of the Chinese government to react to the famine when it became informed.

It is more challenging to infer the information held by local official regarding the famine. Our identification strategy builds on variations in the sell-back grain to rural areas chosen by officials of a province in response to the famine severity in the province. This strategy is motivated by the following considerations. First, as previously explained, due to China's industrialization strategy and an imbedded urban bias in grain distribution, the amount of sell-back grain to rural areas was restricted to the minimum level and was stable in the absence of catastrophe.<sup>16</sup> In other words, in normal circumstances, we would not expect any

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<sup>16</sup> In our subsequent analysis, we will control for provincial population size to capture the effect of increased

significant variation in sell-back grain, otherwise it would signal an abnormal situation in rural areas, such as severe grain shortage and famine.

Second, during the famine period, rural areas suffered from much more severe malnutrition than urban areas and endured most of the abnormal deaths across the country. If provincial officials wanted to relieve the famine, the most effective way to save lives was to distribute sell-back grain to the most affected rural areas.

Lastly, local officials had the control necessary to reallocate procured grain to aid rural areas. Note that prior to 1958, grain sell-back in each province was subject to the direct control of the central government, which left little room for provincial governments to respond to local emergencies. Instead, provincial officials needed to request permission from the central government in order to allocate more sell-back grain. The grain subcontract system instituted in 1958 granted provincial officials the *full* freedom to make their own decisions about the distribution of the residual grain, including reallocating sell-back grain to rural areas, *after* fulfilling the pre-specified contributions to the central government.<sup>17</sup>

Motivated by these observations, we argue that any significant variation in sell-back grain to rural areas could reveal critical information held by provincial officials regarding the severity of the famine in rural areas. Specifically, we examine whether there was a positive correlation between the amount of sell-back grain and the severity of famine across provinces in each of the years during the famine period, e.g., whether provinces that suffered more severe famine also provided more sell-back grain to rural areas. A positive correlation would indicate that provincial officials were aware of the famine and used allocation of sell-back grain under their control to relieve the famine in rural areas.

One might argue that although local officials could use their control to reallocate procured grain as sell-back grain to rural areas to relieve the ongoing famine, the Center would be able to observe the increased sell-back grain and thus detect the famine even if local officials did not directly report the famine to the Center. According to later comments

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rural population on the quantity of the sell-back grain.

<sup>17</sup> Those provinces that regularly needed grain transfers from the central government also had the freedom to distribute the grain received from the central government within the province. The only difference from pre-1958 was that those provinces could not request more from the center except under severe emergencies.

provided by Li Xiannian, who was the vice premier in charge of economic planning during the famine period, it was common for local officials to use grain stored in local granaries without notifying the central government (Li, 1981). This means that local officials misreported to the Center the grain stock in local granaries controlled by them. In doing so, local officials had to face potential penalty if the Center discovered the unreported allocation of sell-back grain and the misreported grain stock. As a consequence, the amount of sell-back grain privately allocated by local officials could not have been sufficient relative to the substantial need for grain in the most affected rural areas. Nevertheless, the detection of a statistically significant correlation between the amount of sell-back grain and famine severity would provide evidence for knowledge of local officials about the famine.

In sum, we examine whether there were different patterns in grain transfers and sell-back within provinces with respect to the severity of famine during the famine period. The difference in these patterns reflects different actions taken by the central and local governments during the period, which in turn reflects their knowledge of the severity of the famine across the provinces.

### **C. Data and Variable Definitions**

The Great Famine is still a politically sensitive issue in China, and therefore we face a well-known challenge in obtaining complete and reliable data on grain output, procurement, and population death rates during the famine period. Our general strategy is to use multiple measures constructed from different public sources. Thus, even if one is concerned by the data from some of the sources being potentially unreliable, the multiple measures allow us to cross-check them, and the overall results derived from these measures should be robust to such concerns.

Specifically, we collect data on provincial population, grain output, procurement, and distribution during 1954-1966 from the following sources. The data on provincial population come from the *China Statistical Yearbook* (1982) published by the National Bureau of Statistics (NBS); the data on total population and the ratio of urban population come from *A Compilation of Historical Statistical Data of Provinces, Autonomous Regions, and*



*Municipalities* (1949-1989) published by the NBS; the data on grain output, procurement, and stock and areas sown with grain come from *Agricultural Economic Data* (1984) published by the China Ministry of Agriculture in 1990.

We use four measures of famine severity. The first measure is the reduction in grain output in each year during the famine period of 1959-1961. This variable, denoted as “*excess grain output*,” equals the yearly grain output minus the average yearly output during the pre-GLF period of 1955-1957. It is important to bear in mind that the grain output data we use are based on actual output data corrected for reporting inflation after the GLF. According to Xue Muqiao, then-director of the National Bureau of Statistics, grain output data had been recalculated and adjusted in the aftermath of the famine (Xue, 1996, page 192). Thus, this grain output measure is not what the central government had observed during the famine period; otherwise, the ongoing famine would have been immediately detected.

The second measure is excess death rate, which equals the provincial excess death rate in each year during 1959-1961 relative to the average yearly death rate during 1955-1957. The calculation of this variable is based on the population data reported by the NBS in 1983. This measure, denoted as “*excess death rate (NBS)*,” has commonly been used as a proxy for famine severity in the existing literature, e.g., Lin (1990), Chen and Zhou (2007), Kung and Chen (2011). It is again useful to bear in mind that the population death rate data were compiled long after the famine and were not available to the central government during the famine.

The third measure is excess birth-cohort size in each year of 1959-1961 based on the *1990 China Population Census*. Meng et al. (2015) were the first study to use birth-cohort size during the famine as a measure of famine severity. Figure 9 shows the cohort size by birth year from 1950 to 1990, based on 1990 Population Census. It is clear that the cohort size shrank dramatically during the famine years compared with other years before or after the famine. We follow their study to construct excess birth-cohort size, which equals cohort size minus the average cohort size in 1955-1957. This measure, which we denote “*excess birth-cohort size*,” is highly correlated with the *excess death rate (NBS)*, with a correlation of -0.46 during the famine period.

The last measure is the excess death rate of children age one to six, which is calculated from a unique fertility survey on Chinese women taken in 1988. We denote this measure as “*excess death rate (Survey)*.” This survey sampled 0.2 percent of all married women born between 1931 and 1973—about 460,000 women. The survey asked each of these women to review her childbearing history up to 1988, including the information on the number of failed births and deceased children. In order to avoid the potential confounding factors, we will restrict the sample of excess death rate from the survey to the women experiencing their first birth no earlier than 1949, the year the People’s Republic of China was established. This implies the earliest year we can observe the death of six-year-old children in the sample is 1955. Therefore, the sample of excess death rate from the survey will start in 1955. We also include the ratio of CCP members over the total population in each province to measure provincial political radicalism. According to Yang (2001), the proportion of CCP members in a region is one of the determinants of political radicalism during the GLF. This variable is available only for 1956.

#### IV. Empirical Results

Following the empirical strategy outlined in Section III, we use the province-level panel data to examine how the net grain transfer, sell-back grain, and grain stock in local granaries responded to the famine severity during the famine years relative to non-famine years.

We adopt the following regression specification:

$$y_{it} = \alpha + \sum_{s=1954}^{1966} \beta_s \text{famine}_{it} \times I_s + \lambda X_{it} + \delta_i + \eta_t + \varepsilon_{it} \quad (1)$$

where  $y_{it}$  is the dependent variable of interest in province  $i$  in year  $t$ . The sample period is from 1954 to 1966 except for excess death rate (Survey) starting from 1955. We examine several dependent variables: the net grain transfer from a province, the sell-back grain to rural areas in a province, and the grain stock level in local granaries of a province. In order to capture the “abnormal” changes of these dependent variables during the famine period, we will construct excess levels of the grain transfer, sell-back to rural areas, and stock by subtracting their mean levels during 1955-1957. The independent variable  $\text{famine}_{it}$  represents

the famine severity measured by the aforementioned proxies;  $X_{it}$  is a set of control variables, such as the logarithm of provincial population, urbanization ratio, and the logarithm of grain procurement. We also control for the province and year fixed effects ( $\delta_i$  and  $\eta_t$ ). We are particularly interested in a set of interaction terms between the provincial famine severity measure  $famine_{it}$  and year dummies  $I_s$  ranging from 1954 to 1966, as their estimated coefficients indicate when and how the dependent variable, such as net grain transfer, sell-back grain to rural areas, and grain stock of a province, responded to the famine severity at the province level across years, especially in the famine years from 1959 to 1961.

Table 4 reports the regression results based on equation (1). The dependent variable is the excess grain transfer out of a province. We use the aforementioned four measures of famine severity as the independent variables: *excess grain output*, *excess death rate (NBS)*, *excess cohort size*, and *excess death rate (Survey)*. Because the magnitude of excess grain output and excess cohort size move in the opposite direction of famine severity, we multiply them by (-1) to facilitate our interpretation of the coefficients. We use the same normalization for these two variables throughout our analysis.

Columns (1) and (2) report the results using *excess grain output* as the measure for famine severity. The difference between these two columns is whether the impact of radical policy, which is measured by the interaction between the ratio of CCP members in 1956 and year dummies, is controlled or not. Several interesting findings emerge. First, Column (2) shows that in 1959, the more severely a province experienced a grain output drop, the more the central government demanded excess grain transfer from the province. This unusual relationship between grain transfer and output drop across provinces in 1959 is consistent with the plot in Panel (f) of Figure 7 and indicates the lack of knowledge by the central government regarding the grain output drop at the province level.

Second, the excess grain transfer does not respond in any significant way to the output drop in 1960 either, when the famine was most severe and ten million people died of hunger (Figure 3). Third, the significant response of excess grain transfer to famine severity shows up only after 1961: the provinces that experienced greater grain output drops transferred

significantly less grain to the central government, suggesting that the Center started to systematically respond to grain output drops and the famine across the country only in 1961.

Fourth, Columns (1) and (2) also show that the excess grain transfers significantly declined in response to output declines in 1954 and 1956. This result is consistent with our earlier discussion that during these two years, several provinces along the Yangtze River experienced severe flooding and grain output drops, and that the central government did react to the emergencies by reducing grain transfers from these affected provinces. The contrast between the significant responses in 1954 and 1956 in grain transfers to output drops, and the lack of response in 1959 and 1960 vividly demonstrates that the grain procurement system was flexible during the years before the GLF but became insensitive to local grain output drops during the GLF. This supports our key hypothesis that the misinformation of inflated grain outputs reported by local officials had prevented the Center from recognizing the severe grain shortage and the grave famine conditions at the province level.

Columns (1) and (2) also report the effects of population size, urbanization ratio, and procurement level on excess grain transfers. The estimated coefficient of the logarithm of population size is significantly negative, implying that all other things being equal, a more populous province transferred less grain to other provinces. The degree of urbanization seems not to have significantly affected the amount of excess grain transferred. The amount of procurement has a significant and positive effect on excess grain transfer, which is quite intuitive.

We also use three other measures of famine severity: *excess death rates (NBS)*, *excess cohort size (census)*, and *excess death rate (survey)*, to repeat the regression specified in equation (1). The results reported in columns (3) – (8) of Table 4 are qualitatively similar, and the key patterns in the response of *excess grain transfer* to the famine are robust across these different famine measures. First, for 1959, there is a positive correlation of *excess grain transfer* out of a province with the famine severity experienced by the province. Second, there is significant response from *excess grain transfer* to famine severity no earlier than 1961.

Table 5 reports the results from estimating equation (1) by using sell-back grain to rural

areas as the dependent variable. In contrast to the lack of response in cross-province grain transfers to famine severity, excess sell-back grain to rural areas, which was controlled by local officials, exhibited significant and positive responses to famine severity at least two years earlier than excess grain transfers. Regardless of the measure of famine severity used in the regression, we find a consistent pattern that *excess sell-back grain* to rural areas is positively correlated with famine severity across the provinces in both 1959 and 1960, and even as early as in 1958 if we use *excess grain output* as a measure of famine severity.

Specifically, Columns (1) and (2) of Table 5 show that there is a significantly positive correlation of sell-back grain to rural areas with the famine severity measure derived from *excess grain output* in the pre-GLF years of 1954 and 1956 and in each of the GLF years of 1958-1961. In these years, local officials increased sell-back grain to rural areas in provinces that suffered grain output drops. The consistency between the responses of sell-back grain before and during the GLF periods is particularly interesting and is in sharp contrast to the aforementioned drastic change in the responses of grain transfers before and during the GLF periods. This contrast highlights the information gap between local officials and the Center: local officials were reasonably informed of the grain shortage within their provinces during the famine years of 1959 and 1960 and had responded to the grain shortage by allocating more sell-back grain to rural areas, while the Center was largely unaware of the situation and eventually responded to the grain shortage by reducing grain transfers out of severely affected provinces only in 1961.

Columns (3) – (8) of Table 5 report results from using three other measures of famine severity: *excess death rates (NBS)*, *excess cohort size (census)*, and *excess death rate (survey)*. Note that these measures are all based on death tolls and that the famine caused a substantial increase in the death tolls across the country only in 1959 (Figure 1). Across these death-toll based measures, there are consistently and significantly positive responses from sell-back grain to the famine severity across the provinces in both 1959 and 1960.

Table 6 reports results from examining the response of grain stock stored in provincial granaries to the famine severity. As explained earlier, while local granaries were supposed to be controlled by the central government, local officials maintained significant *de facto* power

over them. If we interpret the positive correlation between sell-back grain and famine severity as a sign of the responses of local officials to the famine, we should observe that the local grain stock fell as the sell-back grain increased as a response to the famine. Although there seems to be a mechanical relationship between grain output drops (or famine driven by grain shortage) and reductions in grain stock level, it is important to note that during 1959 and 1960 when grain output declined sharply, most local officials nevertheless reported “record-setting” grain yield to the Center and consequently had to submit increased amounts of grain under the procurement system, some of which should have been stored in the local granaries.

From Table 6, we see that regions with more severe famine (e.g., larger reductions in grain output or lower cohort size) experienced a larger reduction in local grain stock in 1959 and 1960. Some measures of famine severity show a positive response starting from 1958, as shown in Columns (1) and (2) of Table 6. We argue that the reductions in grain stock were likely used by local officials for increasing sell-back grain to rural areas. This result is thus consistent with the aforementioned finding in grain sell-back, which lends further support to our hypothesis that local officials reacted in 1959 while the Center was unaware of the grave conditions at local levels until two years later.

Although we treat the four measures of famine severity equally in Tables 4-6, there is a subtle difference between them in terms of information content and government response. We find from Tables 5 and 6 that both sell-back grain to rural areas and grain stock levels were more responsive to the grain output changes than to excess death rates no matter how they are measured. This is reasonable because grain output was more volatile than death tolls, and when the output fell, local officials would have observed it and followed up with timely local rescue efforts. Excess deaths were likely delayed. They were typically triggered by food shortages, albeit with a delay depending on various factors, such as household storage of grain and government relief efforts. The information on grain output and excess deaths was equally hard for the Center to obtain from local officials. This is why in Table 4 we find a lack of response from the Center to grain output declines and excess death rates during 1959 and 1960, even though local officials had started to aid rural areas most severely affected by

the famine.

## V. Conclusion

This paper uses China's Great Famine in 1959-1961 as a laboratory to study information distortion in hierarchical organizations. Although the literature has attributed the famine to sharp declines in grain output caused by reduced peasant incentives and excessive grain procurement, we provide evidence to further connect these failures to information distortion inside the government system. In particular, we show that massive inflation of local grain yield by local officials caused the central government to fail to realize the widespread famine in 1959 and 1960. This finding helps to resolve several previously unanswered questions: 1) why was there a delay of two years in the central government's famine relief efforts; 2) why did China substantially increase its grain exports to foreign countries during the two worst years of the famine; and 3) why did China substantially reduce the area sown with grain in 1959 when grain yield declined sharply? Overall, our analysis highlights severe consequences of information distortion induced by subordinates' incentives to cater to their superior's wishful thinking.

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**Table 1: China's Grain Imports and Exports (10,000 tons) in 1954-1966**

Year	Grain Imports	Grain Exports	Net Imports	Ratio to Grain Transfer
1954	3	171	-168	-20.92%
1955	18.22	223	-205	-24.69%
1956	14.92	265	-250	-32.29%
1957	16.68	209	-192.5	-24.58%
1958	22.35	288.5	-266	-31.33%
1959	0.20	415.5	-415.5	40.60%
1960	6.63	272	-265.5	37.67%
1961	581	135.5	445.5	206.68%
1962	492.3	103	389	187.15%
1963	595.2	149	446	122.26%
1964	657	182	475	90.48%
1965	640.5	241.5	399	84.29%
1966	643.8	288.5	355.5	69.26%

Data Source: *China Statistical Yearbook (1981)*, National Bureau of Statistics.

**Table 2: Output Inflation by Local Officials in 1958 (10,000 tons)**

Province	Inflated Output	Real Output	Inflation Rate
Shandong	5000	1226	307.83
Yunan	1700	540	214.81
Gansu	1000	339	194.99
Guangdong	3000	1027	192.11
Henan	3510	1265	177.47
Hebei	2250	837.6	168.62
Anhui	2250	885	154.24
Hubei	2250	987	127.96
Zhejiang	1600	789	102.79
Jiangsu	2250	1110	102.70
Sichuan	4500	2246	100.36
Fujian	885	445.5	98.65
Guangxi	2290	1170	95.73
Ningxia	135.06	69.5	94.33
Qinghai	110	58.6	87.71
Hunan	4500	2455	83.30
Guizhou	900	525	71.43
Shanxi	750	462	62.34
Jiangxi	1000	662.5	50.94
Inner Mongolia	590	423	39.48
Shhanxi	672.66	513.5	31.00
Jilin	600	529	13.42

Data Source: Li (2001), *Thirty Years of Yunnan, Ningxia, Jiangxi, Shandong, Jilin, Shhanxi, Guangdong*.

**Table 3: Summary Statistics**

Variables	Obs.	Mean	Std. Dev.	Min	Max
Grain Export (10 000 tons)	371	2.847	60.943	-169.3	291.95
Grain Sales to Rural Areas	364	48.243	41.149	1.2	219.45
Grain Stock (March)	364	88.717	68.373	4.95	494.8
Grain Output	364	612.665	428.860	39	2245.5
Excess Grain Export (10 000 tons)	364	-8.039	38.429	-234.683	113.467
Excess Grain Sales to Rural Areas	364	3.201	21.917	-81.667	151.217
Excess Grain Stock (March)	364	-21.635	46.662	-348.017	118.15
Excess Grain Output	364	-31.603	141.609	-927.333	465.333
Excess Death Rate by NBS (%)	364	1.048	6.187	-6.13	56.86
Excess Cohort Size by the Census	377	295.674	2079.756	-8406.33	9670.67
Excess Death Rate by the Survey (%)	336	-3.332	8.005	-34.708	34.513
Log Population (10,000 people)	364	7.467	0.874	5.066	8.905
Urbanization	364	0.250	0.214	0.063	0.945
Log Procurement	364	4.610	1.053	1.209	6.399
Ranking of Central Committee of Party	364	1.038	0.923	0	3
Log Predicted Output (10,000 tons)	347	6.700	1.184	4.224	10.202
Ratio of CCP members in 1956 (%)	312	1.339	0.630	0.71	3.14

**Table 4: Excess Grain Transfer and Famine Severity**

Dependent variable: Excess Grain Transfer (in 10,000 tons)								
Measures for Famine Severity	Excess Grain Output ×(-1)		Excess Death Rate (NBS)		Excess Cohort Size (Census) ×(-1)		Excess Death Rate (Survey)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Famine *1954	-0.272*** (0.058)	-0.242*** (0.070)	-0.454 (1.934)	-1.129 (1.899)	0.009 (0.011)	0.001 (0.011)		
Famine *1955	-0.022 (0.094)	-0.007 (0.099)	2.562 (4.936)	2.915 (4.797)	-0.030** (0.014)	-0.029** (0.014)	-0.229 (1.580)	0.650 (1.630)
Famine *1956	-0.289*** (0.090)	-0.311*** (0.096)	-7.034 (4.752)	-6.534 (4.683)	0.051* (0.029)	0.058* (0.031)	-1.632 (1.541)	-2.627 (1.654)
Famine *1957	-0.152 (0.099)	-0.093 (0.109)	14.020*** (4.803)	22.449*** (4.986)	0.042*** (0.015)	0.047*** (0.015)	1.785 (1.523)	3.363** (1.595)
Famine *1958	-0.033 (0.075)	-0.037 (0.081)	2.356* (1.308)	2.588** (1.301)	0.016*** (0.005)	0.016*** (0.005)	1.326* (0.794)	1.825* (0.954)
Famine *1959	0.041 (0.036)	0.067* (0.040)	2.754*** (0.737)	3.208*** (0.748)	0.008*** (0.003)	0.009*** (0.003)	1.357** (0.589)	2.086*** (0.669)
Famine *1960	-0.041 (0.028)	-0.033 (0.031)	-0.285 (0.325)	-0.307 (0.355)	-0.001 (0.003)	-0.002 (0.003)	0.110 (0.574)	0.230 (0.623)
Famine *1961	-0.119*** (0.023)	-0.109*** (0.026)	-2.825*** (1.023)	-2.949*** (0.988)	-0.005* (0.003)	-0.005* (0.003)	-1.676* (0.999)	-1.562 (1.058)
Famine *1962	-0.182*** (0.032)	-0.173*** (0.035)	-9.449*** (2.356)	-11.787*** (2.347)	-0.005 (0.004)	-0.013*** (0.004)	-2.756** (1.150)	-3.152*** (1.213)
Famine *1963	-0.175*** (0.034)	-0.166*** (0.037)	-1.974 (2.748)	-2.240 (2.719)	0.006** (0.002)	0.008*** (0.003)	-1.153 (1.153)	-1.105 (1.348)
Famine *1964	-0.199*** (0.041)	-0.184*** (0.045)	0.259 (1.891)	0.302 (1.872)	0.006 (0.004)	0.011** (0.004)	-1.130 (0.971)	-0.529 (1.126)
Famine *1965	-0.160*** (0.046)	-0.156*** (0.049)	-1.407 (2.750)	-0.687 (2.668)	0.003 (0.003)	0.008** (0.004)	-1.860** (0.846)	-1.704* (0.967)
Famine *1966	-0.100*** (0.036)	-0.084** (0.040)	-2.411 (2.660)	-0.408 (2.614)	0.004* (0.002)	0.007** (0.003)	-0.285 (0.736)	-0.243 (0.841)
Log Population	-73.324*** (23.652)	-121.73*** (32.089)	-55.995** (24.362)	-143.38*** (30.93)	-92.392*** (27.212)	-195.714*** (34.188)	-37.397 (28.035)	-118.653*** (37.943)
Urbanization	27.486 (4.412)	47.22 (31.398)	33.192 (23.979)	52.427* (30.839)	13.585 (24.061)	28.087 (30.665)	5.708 (28.507)	-13.906 (36.573)
Log Procurement	37.486*** (6.920)	57.034*** (10.979)	64.124*** (7.200)	105.574*** (9.911)	52.802*** (7.136)	87.884*** (9.669)	56.979*** (7.669)	93.125*** (11.214)
Radical Policy	No	Yes	No	Yes	No	Yes	No	Yes
Within R-sq.	0.499	0.559	0.410	0.557	0.404	0.550	0.344	0.461
# of Provinces	28	24	28	24	28	24	28	24
Observations	364	312	364	312	364	312	336	288

Notes: Standard errors in parentheses. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. The radical policy is the provincial ratio of CCP members in 1956 multiplied by a set of year dummies. All regressions have controlled for province fixed effects and year dummies.

**Table 5: Excess Grain Sell-Back to Rural Areas and Famine Severity**

Dependent variable: Excess Grain Sell-back to Rural Areas (in 10,000 tons)								
Measures for Famine Severity	Excess Grain Output		Excess Death Rate		Excess Cohort Size		Excess Death Rate	
	×(-1)		(NBS)		(Census) ×(-1)		(Survey)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Famine *1954	0.226*** (0.038)	0.226*** (0.046)	2.593** (1.289)	2.577* (1.385)	-0.015** (0.007)	-0.008 (0.008)		
Famine *1955	-0.019 (0.060)	-0.006 (0.065)	4.565 (3.290)	4.540 (3.498)	0.022** (0.009)	0.022** (0.009)	-0.225 (0.988)	-0.287 (1.067)
Famine *1956	0.259*** (0.058)	0.307*** (0.063)	5.027 (3.167)	7.085** (3.415)	-0.052*** (0.018)	-0.049** (0.021)	0.227 (0.964)	1.494 (1.082)
Famine *1957	0.037 (0.064)	0.036 (0.071)	-5.559* (3.201)	-7.970** (3.636)	-0.009 (0.009)	-0.011 (0.010)	-0.687 (0.952)	-1.360 (1.044)
Famine *1958	0.127*** (0.048)	0.145*** (0.053)	-1.792** (0.872)	-1.949** (0.949)	0.002 (0.003)	0.002 (0.004)	-0.264 (0.497)	-0.651 (0.624)
Famine *1959	0.148*** (0.023)	0.150*** (0.026)	0.870* (0.491)	0.546 (0.545)	0.010*** (0.002)	0.010*** (0.002)	1.699*** (0.368)	1.903*** (0.438)
Famine *1960	0.111*** (0.018)	0.114*** (0.021)	0.706*** (0.217)	0.574** (0.259)	0.007*** (0.002)	0.007*** (0.002)	0.891** (0.359)	0.623 (0.408)
Famine *1961	0.048*** (0.015)	0.052*** (0.017)	2.448*** (0.682)	2.419*** (0.721)	0.002 (0.002)	0.003 (0.002)	-0.364 (0.625)	-0.657 (0.692)
Famine *1962	0.001 (0.020)	0.007 (0.023)	2.520 (1.570)	2.797 (1.711)	0.007*** (0.002)	0.010*** (0.003)	-0.431 (0.719)	-0.747 (0.794)
Famine *1963	0.062*** (0.022)	0.071*** (0.024)	1.040 (1.832)	0.712 (1.983)	-0.002 (0.002)	-0.003* (0.002)	0.080 (0.721)	-0.526 (0.882)
Famine *1964	0.063** (0.027)	0.075** (0.029)	-0.258 (1.260)	-0.484 (1.365)	-0.002 (0.002)	-0.005* (0.003)	0.016 (0.607)	-0.392 (0.737)
Famine *1965	0.039 (0.030)	0.049 (0.032)	1.519 (1.833)	1.220 (1.946)	-0.000 (0.002)	-0.001 (0.003)	-0.019 (0.529)	-0.138 (0.633)
Famine *1966	0.055** (0.023)	0.060** (0.026)	1.119 (1.773)	0.631 (1.906)	-0.001 (0.002)	-0.001 (0.002)	-0.340 (0.460)	-0.441 (0.550)
Log Population	9.047 (15.203)	3.397 (21.006)	26.867* (16.236)	51.921** (22.555)	29.473* (17.081)	62.013*** (23.444)	-11.111 (17.535)	31.846 (24.828)
Urbanization	6.503 (14.180)	4.605 (20.554)	4.319 (15.981)	-19.800 (22.489)	-9.723 (15.103)	-26.474 (21.028)	-35.715** (17.831)	-72.297*** (23.932)
Log Procurement	12.329*** (4.448)	20.903*** (7.188)	-1.100 (4.799)	-7.618 (7.227)	0.886 (4.479)	-2.404 (6.630)	3.161 (4.797)	-0.449 (7.338)
Radical Policy	No	Yes	No	Yes	No	Yes	No	Yes
Within R-sq.	0.430	0.493	0.280	0.368	0.356	0.432	0.248	0.339
# of Provinces	28	24	28	24	28	24	28	24
Observations	364	312	364	312	364	312	336	288

Notes: Standard errors in parentheses. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. The radical policy is the provincial ratio of CCP members in 1956 multiplied by a set of year dummies. All regressions have controlled for province fixed effects and year dummies.

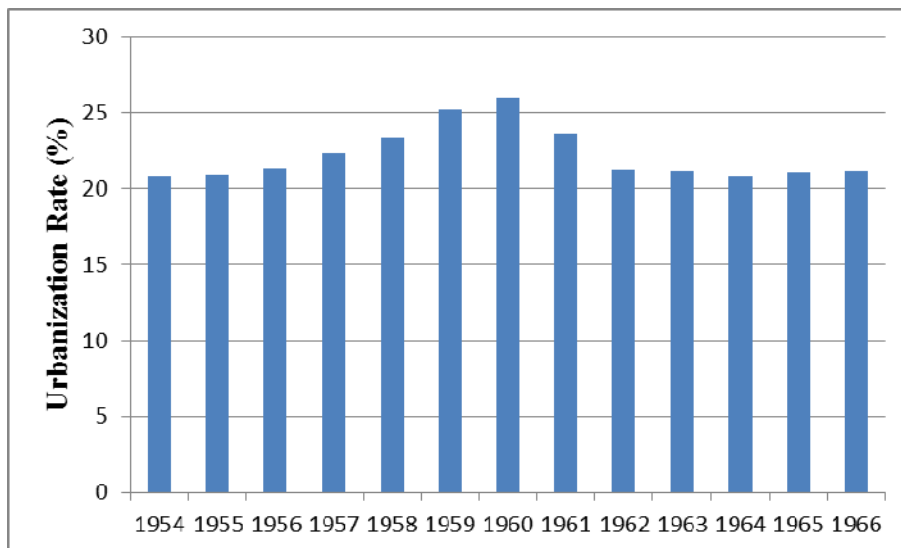
**Table 6: Excess Grain Stock (March) and Famine Severity**

Dependent variable: Excess Grain Stock (March) (in 10,000 tons)								
Measures for Famine Severity	Excess Grain Output ×(-1)		Excess Death Rate (NBS)		Excess Cohort Size (Census) ×(-1)		Excess Death Rate (Survey)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Famine *1954	-0.102*	-0.083	-2.570	-1.591	-0.007	-0.013		
	(0.056)	(0.066)	(2.063)	(2.191)	(0.011)	(0.012)		
Famine *1955	0.131	0.165*	-15.260***	-15.727***	-0.070***	-0.066***	2.345	2.204
	(0.089)	(0.094)	(5.263)	(5.535)	(0.014)	(0.014)	(1.616)	(1.747)
Famine *1956	-0.122	-0.170*	6.543	6.515	0.048*	0.060*	-4.362***	-4.762***
	(0.086)	(0.092)	(5.067)	(5.403)	(0.028)	(0.033)	(1.576)	(1.773)
Famine *1957	-0.190**	-0.170	2.147	7.217	0.049***	0.048***	1.746	2.481
	(0.095)	(0.104)	(5.121)	(5.753)	(0.014)	(0.015)	(1.558)	(1.709)
Famine *1958	-0.315***	-0.331***	3.052**	3.020**	0.011**	0.009	0.667	1.083
	(0.072)	(0.077)	(1.395)	(1.501)	(0.005)	(0.006)	(0.812)	(1.022)
Famine *1959	-0.135***	-0.168***	-0.323	-0.609	-0.004	-0.006*	-1.124*	-0.659
	(0.034)	(0.039)	(0.786)	(0.863)	(0.003)	(0.003)	(0.603)	(0.717)
Famine *1960	-0.207***	-0.214***	-0.853**	-0.890**	-0.012***	-0.012***	-1.653***	-1.557**
	(0.027)	(0.030)	(0.347)	(0.409)	(0.003)	(0.003)	(0.587)	(0.668)
Famine *1961	-0.215***	-0.224***	-5.398***	-5.415***	-0.017***	-0.018***	-2.907***	-2.829**
	(0.022)	(0.025)	(1.091)	(1.140)	(0.003)	(0.003)	(1.022)	(1.134)
Famine *1962	-0.237***	-0.240***	-8.699***	-9.968***	-0.003	-0.007*	-3.502***	-3.839***
	(0.030)	(0.033)	(2.512)	(2.708)	(0.004)	(0.004)	(1.177)	(1.300)
Famine *1963	-0.186***	-0.184***	-4.091	-3.917	0.008***	0.010***	-1.123	-1.123
	(0.032)	(0.035)	(2.931)	(3.137)	(0.002)	(0.003)	(1.179)	(1.445)
Famine *1964	-0.205***	-0.194***	-0.233	-0.652	0.008**	0.012***	-1.144	-0.911
	(0.040)	(0.043)	(2.016)	(2.160)	(0.004)	(0.005)	(0.993)	(1.207)
Famine *1965	-0.141***	-0.133***	-2.854	-2.375	0.004	0.007*	-0.471	-0.145
	(0.044)	(0.047)	(2.933)	(3.079)	(0.003)	(0.004)	(0.865)	(1.037)
Famine *1966	-0.150***	-0.154***	-3.269	-1.356	0.003	0.006*	0.333	0.841
	(0.034)	(0.038)	(2.837)	(3.017)	(0.002)	(0.003)	(0.753)	(0.901)
Log Population	56.182**	124.663***	94.875***	117.289***	38.805	52.397	139.303***	147.398***
	(22.570)	(30.673)	(25.977)	(35.687)	(26.855)	(35.866)	(28.680)	(40.668)
Urbanization	32.086	-47.553	32.006	-35.519	29.595	-31.909	55.636*	-3.383
	(21.052)	(30.014)	(25.569)	(35.582)	(23.746)	(32.170)	(29.164)	(39.200)
Log Procurement	12.171*	14.718	35.935***	64.781***	27.334***	46.929***	33.342***	56.126***
	(6.604)	(10.496)	(7.678)	(11.435)	(7.042)	(10.144)	(7.845)	(12.020)
Radical Policy	No	Yes	No	Yes	No	Yes	No	Yes
Within R-sq.	0.654	0.694	0.491	0.551	0.560	0.623	0.496	0.546
# of Provinces	28	24	28	24	28	24	28	24
Observations	364	312	364	321	364	312	336	288

Notes: Standard errors in parentheses. \* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1%. The radical policy is the provincial ratio of CCP members in 1956 multiplied by a set of year dummies. All regressions have controlled for province fixed effects and year dummies.

**Figure 1: The Urbanization Ratio during 1954-1966**

Data Source: *A Compilation of Historical Statistical Data of Provinces, Autonomous Regions, and Municipalities, 1949-1989*, NBS (1990)



**Figure 2: Areas Sown with Grain in 1954-1966**

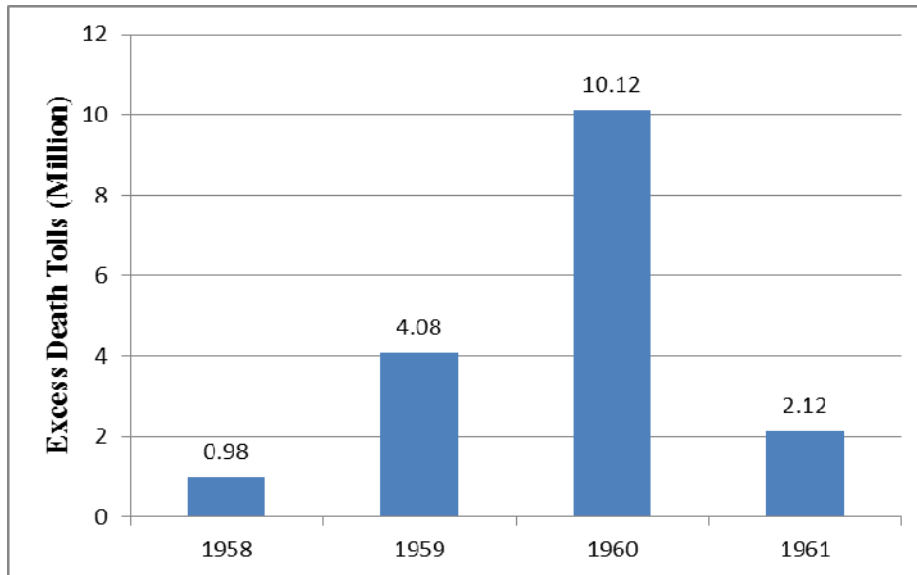
Data Source: *Agricultural Economic Data (1984)*, China Ministry of Agriculture





**Figure 3: Total Excess Death Tolls during the Famine**

Data source: *China Statistical Yearbook, 1982*, National Bureau of Statistics



**Figure 4: Grain Output and Procurement (million tons) in 1954-1966**

Data Source: *Agricultural Economic Data (1984)*, China Ministry of Agriculture

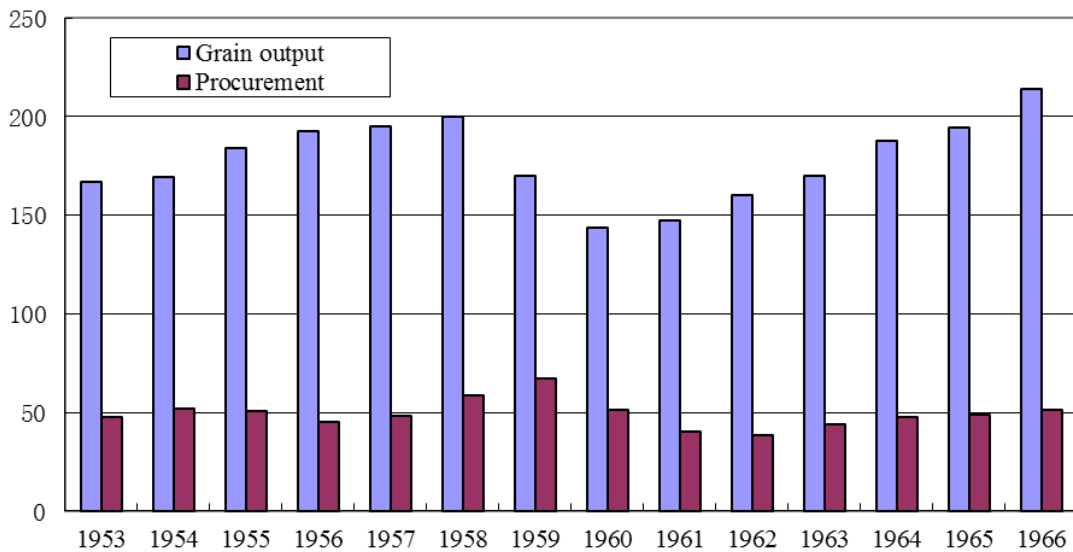


Figure 5: Excess Death Rates across China during the Famine (unit: ‰)

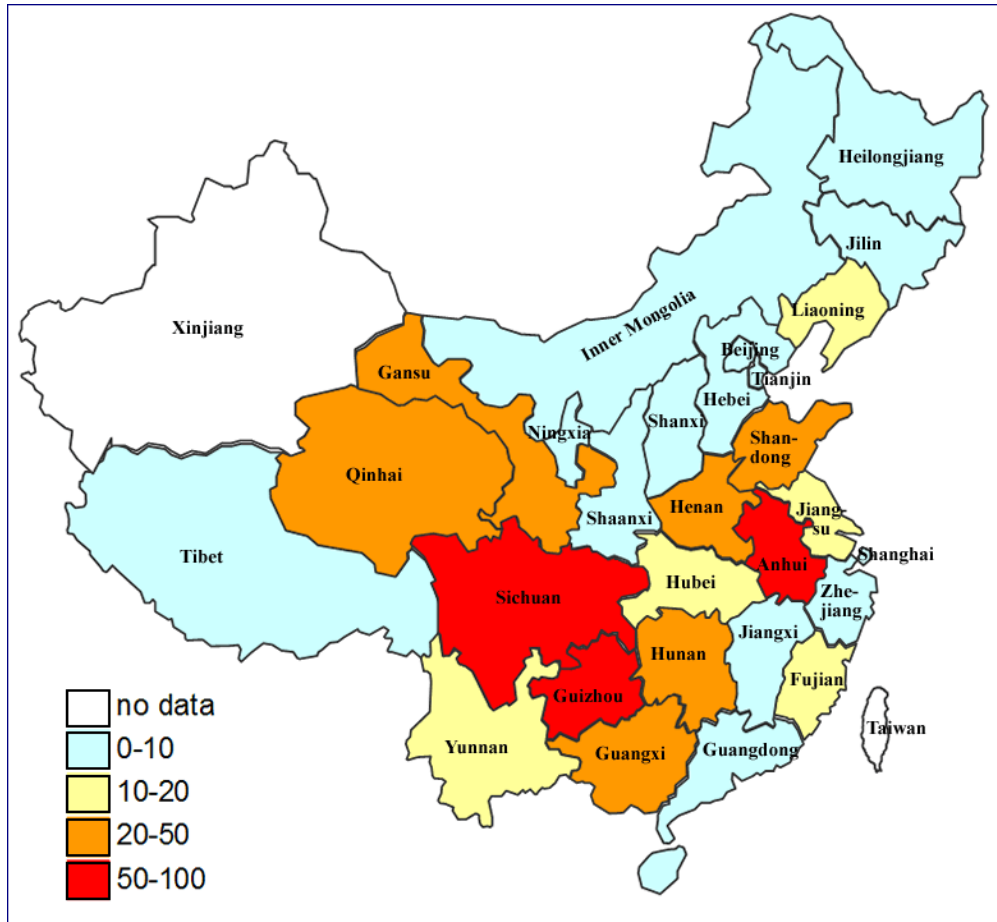
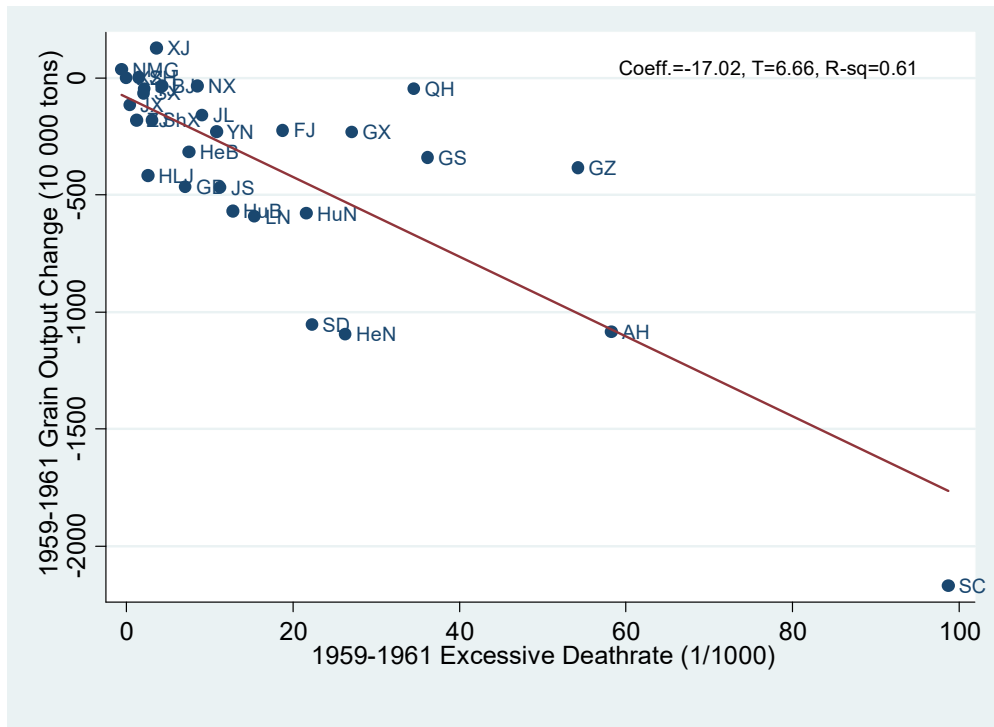
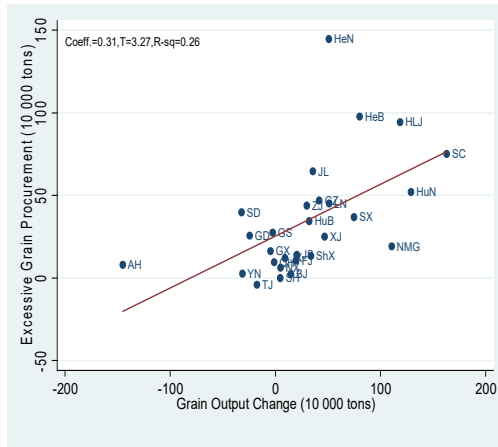


Figure 6: Excess Death Rates and Grain Output Changes during the Famine

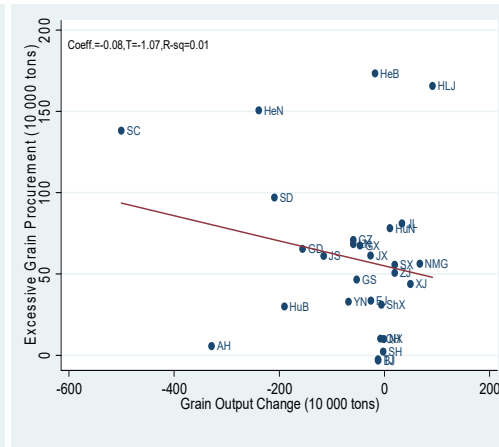




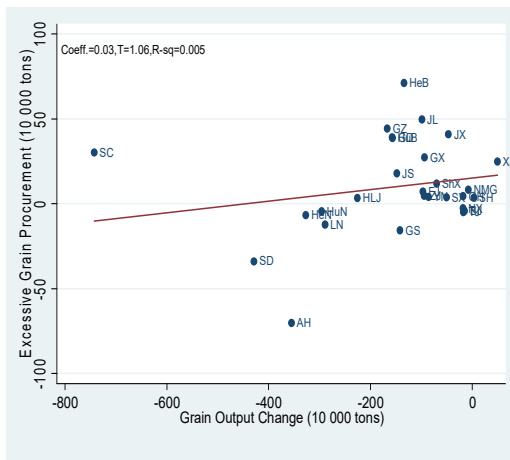
(e) 1958



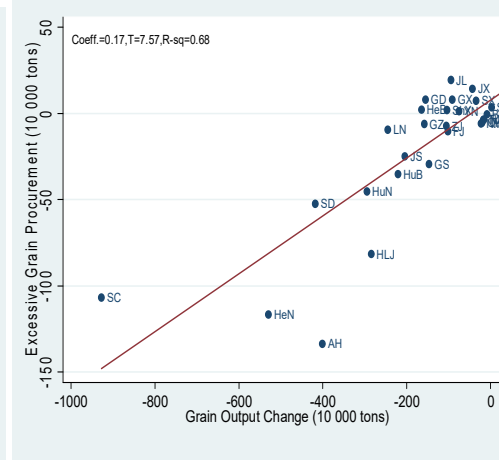
(f) 1959



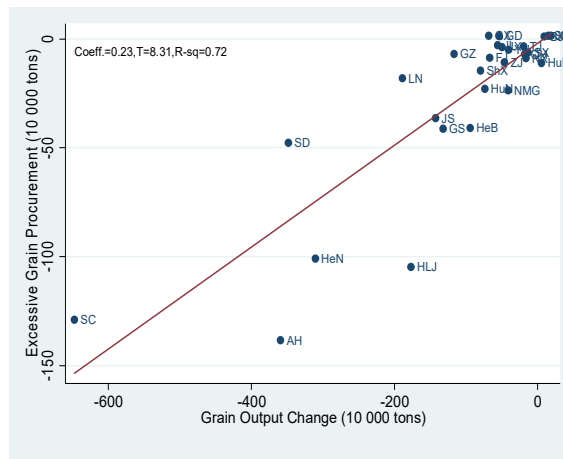
(g) 1960



(h) 1961



(i) 1962



**Figure 8: Grain Procurement, Sales and Consumption**

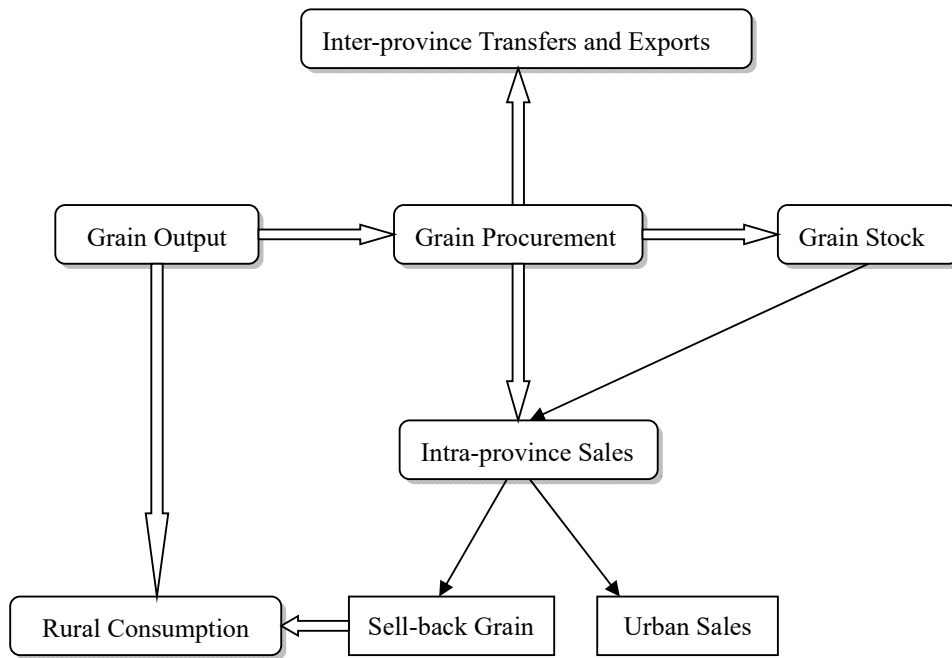


Figure 9: The Cohort Size by Birth Year Based on 1990 Population Census

