

The shaping of an institutional choice: Weather shocks, the Great Leap Famine, and agricultural decollectivization in China ☆



Ying Bai, James Kai-sing Kung*

The Hong Kong University of Science and Technology, Hong Kong

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Abstract

By providing more public goods (irrigation), collective agriculture can deal with negative weather shocks more effectively. Yet, collective institutions are fraught with problems of work incentives, excessive grain procurement, and the like, which in one extreme historical instance had resulted in great tragedy—China's Great Leap Famine. By exploiting the variation in the pace of agricultural decollectivization among the Chinese provinces during 1978–1984, we test the respective effects of weather shocks, the lasting impact of the Great Leap Famine, and public goods provision on the villages' institutional choice between collective and family farming. We find that bad weather at the time of decollectivization had the likely effect of strengthening the collectives, but that effect reverses in provinces that had experienced greater famine severity or had enjoyed better public goods provision.

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1. Introduction

Institutions—with the effects they confer on incentives—matter for economic performance (e.g. Acemoglu et al., 2001, 2002, 2005; Banerjee et al., 2002; Engerman and Sokoloff, 2000; Goldstein and Udry, 2008;

Hall and Jones, 1999; La Porta et al., 1999; North, 1981; North and Thomas, 1973). From this vantage point, the key question underlying comparative historical institutional development concerns why under certain circumstances the institutions being chosen are suboptimal but still able to persist, before they change for the better (as they do in

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* Corresponding author at: Division of Social Science, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong. Fax: +852 2335 0014.

E-mail address: sojk@ust.hk (J.K. Kung).

some instances). This paper studies an important institutional change in economic history—the decollectivization of Chinese agriculture (circa 1978–84).¹

China collectivized its agriculture in the 1950s and decollectivized it approximately three decades later, completing a full circle of socialist agriculture in just over a quarter of a century. Agricultural decollectivization offers a unique opportunity for studying institutional change because, while virtually all provinces had eventually dismantled their communes, in the process they exhibited tremendous variations both across space and over time. To the extent that each institution has both advantages and disadvantages and that institutional change typically entails tradeoffs at the margin, differences in the timing across the Chinese provinces of abandoning collectivized agriculture may be interpreted as reflecting the variations in the degree of the problems they respectively faced with this particular institution. Going by this logic, those who abandoned collective agriculture the earliest may be regarded as likely having suffered from it the most.

Following North's (1981, 1990) analytical schema, we propose that the choice between individual and collective farming is fundamentally determined by a rational calculus by the actors concerned of the costs and benefits associated with these two different institutions. For reasons attributed to collective action, collective institutions are more conducive to providing public goods than is individual or family farming. This would appear to be especially the case in the historical context of China, where public goods or specifically irrigation was provided in an exceedingly labor-intensive manner through the mass mobilization of surplus farm laborers during slack agricultural winter seasons. While this particular feature of collective agriculture helps to reduce stochastic weather shocks on agriculture better than individual farming, the "team" nature of work organization renders the observation of individual work effort formidable, thereby giving rise to a level of effort lower than that under individual farming (Alchian and Demsetz, 1972).²

¹ Its importance goes beyond the incentive effects brought about by the reassignment of use and income rights to the farm households and the productivity and income effects this in turn had on the farm sector (McMillan et al., 1989; Lin, 1992). But more fundamentally by diverting a hundred million or so rural "surplus laborers" from the farms to work in the urban sector this institutional change has led to a thorough (possibly irreversible) overhaul of the Chinese economy.

² The argument that members of the agricultural commune were forbidden to leave after 1958, thereby resulting in a "one-shot game", leads to the same conclusion that effort equilibrium in collective agriculture is lower than that under individual or family farming (Lin, 1990). Empirical evidence to bear upon the existence of exit right before 1958 is however scant if not entirely unavailable (Kung, 1993; Kung and Putterman, 1997).

Poor work incentives are not the only negative feature of collective agriculture, however. Given that collectivization was conceived primarily to fuel China's Socialist Industrialization, a larger amount of farm surpluses was transferred from the countryside to the cities at sub-competitive prices (e.g., Li and Yang, 2005; Lin, 1994; Perkins, 1966). Some provinces responded zealously to this calling and remitted more grain than they could realistically afford to. For the country as a whole, this excessive procurement of grain during the Great Leap Forward of 1958–61 unwittingly resulted in the excess deaths of 30 million people—the worst famine ever recorded in history (e.g., Kung and Lin, 2003).³ We conjecture that this immeasurably tragic event had likely shattered people's beliefs about just how effective collective agriculture was against negative weather shocks.

The analytical issue arising from this simple comparison of collective and household farming is this: how did villagers and leaders alike decide on whether or not to abandon collective agriculture for family farming when bad weather struck? Did they carry on with collective agriculture because they continued to believe that the public goods having been accumulated in the collective era better enabled them to deal with the weather shocks, or did they quickly abandon it in favor of individualized farming because they no longer felt that collective farming better shielded them against negative weather shocks?

With the aid of a simple theoretical model that features the above tradeoffs between the two farming institutions we develop three hypotheses to empirically test this important institutional change in Chinese agriculture. First, we hypothesize that weather shocks at the time of decollectivization had the effect of strengthening the collective institution. But this initial belief that collective agriculture would be better able to deal with negative weather shocks was subsequently changed—specifically "reversed"—by the negative experiences of the Great Leap Famine, regardless of whether these experiences were rooted in poor work incentives or excessive grain procurement or some other aspects of collective agriculture (or a combination thereof). The hypothesized effect is that provinces (villages) severely afflicted by these negative experiences reacted strongly when faced with adverse weather post-1978 and tended to quickly abandon collective agriculture. Third, we hypothesize that more effectively irrigated acreage constructed during

³ Demographers define excess deaths as the difference between actual death rates and what would have occurred based on the linear trend of the 1950s. See, e.g., Ashton et al. (1984).

collectivization had the paradoxical effect of hastening a province's (village's) exit from collective agriculture when bad weather struck, simply because, once durable public goods were in place, there was less incentive to maintain collective agriculture in the face of negative weather shocks.⁴ In other words, the positive effect of public goods was subject to diminishing marginal returns.

The above simple model and the hypotheses developed from it are indeed highly consistent with the “stylized” historical facts. For example, an important goal behind Mao's mobilization of the surplus farm laborers to undertake irrigation projects during the slack winter months of 1957 was indeed to reduce the stochastic disturbances of negative weather shocks on agricultural output (e.g., Nolan, 1988). Conversely, the production team that tried to break away from the stranglehold of collective farming did so on the grounds that an individualized, family-based farming institution provided stronger incentives for them to plant the wheat into the arid soil (e.g. Yang and Liu, 1987).

Using a province level panel data set, we obtain robust empirical results to substantiate the hypotheses that bad weather at the time of decollectivization had the expected, significant effect of strengthening the collective institutions of agricultural production, but that effect was reversed by both famine severity and public goods (irrigation) provision. Our empirical results remain robust after controlling for a longer list of variables and correcting for the possible endogeneity bias of famine severity using the difference in the weather conditions between the 1958–61 period and the three-year period that immediately preceded it. We also confirm the province level results with nationwide evidence at the village level.

To further verify the hypothesis that before the onslaught of the Great Leap Famine the initial belief was indeed that collective agriculture was able to counteract the negative weather shocks much more effectively than family farming, we perform a placebo test. In this test, we regress the variation in the pace of collectivization across the Chinese provinces during 1950–54 on the historical famines of 1929–31, and find that, in a context predominated by family farms, variations in the above (pre-Leap) famine severity did significantly impact upon the establishment of “mutual-aid teams”—a precursor to the subsequent development of collective agricultural organizations. But this initial belief was thoroughly destroyed by the

negative experiences associated with the Great Leap Famine, as demonstrated by the opposite finding that provinces that had suffered disproportionately during the Great Leap period tended to abandon collective agriculture quickly during 1978–84 when bad weather struck.

Overall, our analysis contributes to the scant literature on the empirical analysis of institutional change.⁵ By focusing on the possible role of history—the Great Leap Famine in this instance—in shaping institutional choice, our study also sheds light on the path-dependent nature of institutional choice and institutional change. While many have examined the health and other welfare outcomes of China's Great Leap Famine (Almond et al., 2007; Chen and Zhou, 2007; Meng and Qian, 2009), no attempt has ever been made to reveal its possible impact on institutional choice. Our work may be regarded as making an important step in that direction.

The remainder of this article proceeds as follows. In Section 2, we provide a descriptive account of the institutional changes in Chinese agriculture for the entire period of 1950–1984. In Section 3, we develop our testable hypotheses based on a simple theoretical model that highlights the tradeoffs between collective and family farming in respect of public goods provision and work incentives. After laying out our empirical strategy and introducing our data set in Section 4, we discuss the empirical results in Section 5. Section 6 presents the logic and results of the placebo test. Section 7 concludes.

2. Institutional change in Chinese agriculture, 1950–1984

China collectivized its agriculture in the 1950s and decollectivized it some three decades later, completing a full circle of socialist agriculture in a little more than a quarter of a century. In what follows we provide a brief account of the history of agricultural collectivization in China—including the Great Leap Forward—to set the scene for our model and hypothesis development.

2.1. Agricultural collectivization in China

China began to collectivize its agriculture in a number of stages from around the early 1950s, upon the completion of a nationwide land reform. In a nutshell, the overriding goal of collectivizing agriculture was to

⁴ China succeeded in fully decollectivizing its agriculture only after more than two decades of intensive construction of rural public works within the framework of collective agriculture (Putterman, 1985).

⁵ Alston et al. (1996) remain to this day the only analysis on the subject matter.

pool together a farm surplus sizeable enough to fuel Socialist Industrialization based on state ownership.⁶ For this reason, collectivization, which initially was conducted in a voluntary and gradual manner, gained a new momentum, increasingly violating the farmers' private property rights—most evidently not only in land but also in labor in respect of control and residual income rights. We discuss in what follows the various forms of collective agricultural organizations as they had developed in a chronological order and their likely impact on work incentives in general and on the consequences of the Great Leap Famine more specifically, with implications leading to the setup of our hypotheses.

The mutual-aid teams (MATs), for instance, which began as a temporary measure to help farm households to ration the use of draft animals (the scarcest resource after land) more optimally, and to take advantage of the arrangement of team work on the seasonally pressing farm tasks such as plowing, sowing, and harvesting, had essentially left private property rights of the farm households intact.⁷ It was not until the MATs (after their brief existence) were being replaced by the elementary agricultural cooperatives (the EACs)—which consisted on average of 27 households—that farmers became compelled to work together as a team, even though this new setup not only deprived the farmers of their control rights over cropping decisions but also impacted their income rights negatively.⁸ Like their MAT counterparts, the EACs were similarly short-lived (roughly from 1953 to 55, depending on provinces). The advanced agricultural cooperatives (the AACs) which came to replace them were not only more sizeable—consisting of 250 households on average, but more importantly had private property rights in land completely removed from the farmers (Kung, 1993). Adding insult to injury was the modification that income had now to be earned entirely through work;

the land- and asset-based dividends, which still constituted a legitimate source of income under the EACs, were now completely abolished.

The chronology of the collectivization of Chinese agriculture is illustrated in Fig. 1 (Panel A), where the longest curve, which charts the changing degree of collectivization over time, represents the percentage share of households engaged in collective organizations for the entire 1950–1984 period regardless of the type of collective units to which a household belonged. The percentage of farm households engaged in collective farming increased steadily from a little over 10% in 1950 to more than 90% in 1956, when collective farming stabilized and remained constant for nearly a quarter of a century (circa. 1956–1979), before dropping to near zero in 1984. As befits our narrative, the MATs, which existed up until 1955 (the solid line marked by triangles), were indeed the embryo of China's collective agricultural organizations. Since then (actually from 1954 onwards) they were replaced first by the EACs (represented by the diamond-marked solid line), and shortly after by the AACs (represented by the square-marked solid line). By 1956, nearly all farm households in China (97.2%) became a member of either the EACs (62.6%) or AACs (29.1%), with the ratios reversed favoring the AACs in just a year's time. But it was the mammoth people's commune, made up of some 1800 farm households through the amalgamation of the AACs in the autumn of 1958, that became the mainstay of China's collective agricultural organization for the longest period (circa 1958–1979), and was the organization that was eventually dismantled in the wake of China's economic reforms beginning from the late 1970s/early 1980s.

Before we proceed to the episode of the Great Leap Forward it is important to point out the possible change in work incentives and productivity outcome in response to the institutional changes from family to collective farms. Intuitively, with private property rights abolished and with the collectives incapable of remunerating workers based on the “marginal product” rule,⁹ agricultural collectivization would result in productivity

⁶ The “development model” as it was conceived in China in the 1950s necessitated the industrial state-owned enterprises to generate “above-normal” profits with which to further generate and sustain industrial growth. This in turn required prices of farm and other inputs—most notably labor—to be kept artificially low. Collectivization facilitated this process because it was able to suppress the prices the state paid to the farmers for what they produced.

⁷ Typically, a mutual-aid team included four to five neighboring households who pooled their laborers, farm tools, and draft animals together during peak agricultural seasons for scale economies purpose.

⁸ In principle, a farm household was entitled to receive part of its income via dividends calculated on the basis of the land and other farm assets (e.g. draft animals) it brought into the cooperatives; the other part of its income was premised on the amount of labor (work) effort it contributed to agricultural production. See Shue (1980) and Kung (1993) for details.

⁹ It is a well-established premise that it is intrinsically hard to effectively observe effort within a “team context” (Alchian and Demsetz, 1972). Worse still is that in labor-intensive peasant agriculture the degree of specialization is so inherently low it lacks a well-delineated set of intermediate products for which to profitably adopt piece rates (which allegedly has the property of remunerating workers based upon the “marginal product” rule) and therefore managerial scrutiny—a problem further exacerbated by the spatial dispersion of agricultural production (Bradley and Clark, 1972; Lin, 1990; Nolan, 1988).

collapse. While that was certainly the case for the Soviet Union (Davies et al., 1994; Nove, 1992), curiously the same cannot be said for China. Quite the contrary, total factor productivity even edged up marginally in 1957—the year when the AACs became the predominant form of agricultural collectives in China.¹⁰ Total factor productivity did eventually decline, and declined precipitously during 1958–1961—a time coinciding with the establishment of the people’s commune within the larger institutional context of the Great Leap Forward.

2.2. The Great Leap Forward

The Great Leap Forward was essentially an unorthodox development strategy conceived to hasten the pace of the Chinese economy’s transformation from a predominantly agrarian one into a powerful industrial state. It was unorthodox because, being severely constrained by capital and backward in technology, the twin goals of increasing agricultural and industrial output by manifolds had to rely upon the disproportionate use of China’s abundant surplus rural workers instead of technical change. Specifically, the rural labor force was mobilized to engage in a variety of public projects—chief among them irrigation in agriculture and steel and iron production facilities in industry—through the restructuring of work and social organizations (of which the people’s commune played a key role). Mao was convinced that, by increasing the farm acreage served by irrigation, collectivization—on an ever-larger scale—would help to reduce the stochastic disturbances of weather on peasant agriculture, thereby raising agricultural productivity.¹¹ As shown in Panel B of Fig. 1, irrigated

land had indeed been expanded by leaps and bounds as a result of collectivization in general and under the communes in particular. Starting from a modest 18.5% in 1952, the percentage of irrigated land increased to 24.4% in 1957, and jumped to 33.5% in 1959, before reaching 45.3% in 1976, but remained stagnant in the ensuing years of decollectivization (circa 1978–1984).

While collectivization had strengthened China’s irrigation infrastructure, it failed to bring about a commensurate increase in agricultural output—at least not during the Great Leap Forward as it was expected to. Due to a number of policy mistakes, grain output in 1958, which originally was estimated euphorically at 375 million tons, turned out to be a mere 200 million tons—only 5 million tons more than that produced in the previous year (which was a record harvest year). Worse still was that grain output in the subsequent two years continued to slide—and slid precipitously—by a cumulative total of nearly 40% over 1958. By the time this downward trend was finally arrested in 1961, 30 million excess deaths had resulted—the largest famine ever recorded in history (Ashton et al., 1984; Banister, 1984).¹²

A number of reasons have been offered to account for this tragedy, not all of which, however, are subject to rigorous quantification. These explanations include three consecutive years of bad weather (the Chinese government’s official explanation), food availability decline (Li and Yang, 2005), an excessive procurement of grain from some provinces (Bernstein, 1984; Kung and Lin, 2003),¹³ huge waste in the preparation and consumption of food in the communal dining halls (Chang and Wen, 1997),¹⁴ a biased policy disfavoring the villagers in respect of grain entitlement (Lin and Yang, 2000), reduced acreage sown in grain under the misguided belief that China was awash with grain

¹⁰ Lin (1990) attributes this unexpected outcome to an “exit right” explanation. The crux of this thesis is that, prior to the establishment of the commune farmers were protected by constitution with the rights to withdraw from a collective, were they convinced that collective agriculture was not as efficient as private farming. This serves as a credible threat to those who have a tendency to shirk effort. Without such a right, which was the situation after 1958, however, the potential threat of exit by the diligent farmers is no longer credible. It follows that would-be shirkers would now supply a lower-than-optimal effort, and the diligent workers would retaliate by following suit. The result is a lower overall equilibrium level of effort. Kung and Putterman (1997) dispute this hypothesis by providing partial evidence that the absence of a productivity collapse in 1957 may instead be due to the de facto devolvement of farm operations and organization to the households.

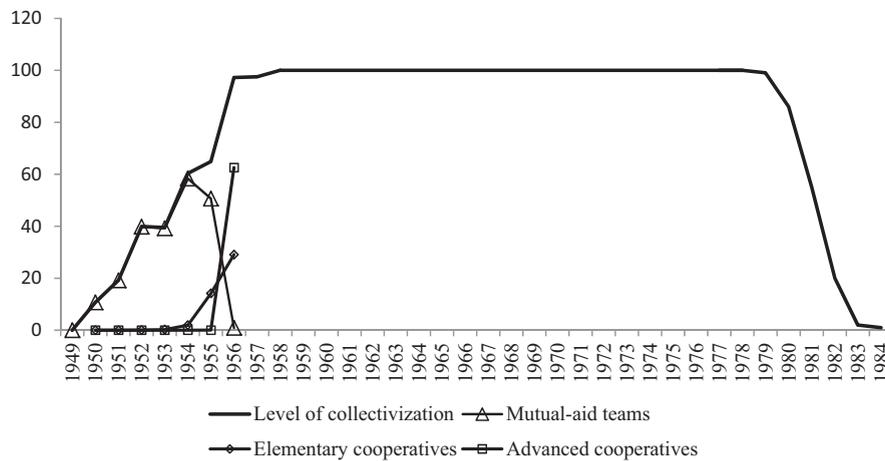
¹¹ Mao indeed saw a vastly decentralized agriculture as being un conducive to large-scale irrigation works, as public projects of this nature typically span large areas and thus require sizeable administrative units for efficacious management and coordination. For him, even the AACs were too small for that purpose. Mao thus believed that collectivization would vastly speed up the transfer of agricultural surplus from the countryside to the town.

¹² Recent figures have put the death toll at a startling 45 million (Yang, 2012). One of the salient features of the Great Leap Famine is that the government did not respond swiftly enough to it. A probable reason is that the authorities truly believed that China was awash with grain (Bernstein, 1984). Even if the regional (provincial) authorities were aware of how bad the situation was, the political and ideological climate of the day discouraged even those who genuinely wanted to speak the truth (Riskin, 1998); some even deliberately blocked the bad news from reaching the central government (Bernstein, 1984). This may explain why there was virtually no news coverage regarding the role conceivably played by transportation networks and storage in mitigating the dire consequences in the heavily afflicted areas, as one would expect in famine situations.

¹³ According to Li and Yang (2005), excessive grain procurement was the primary determinant of output decline—a massive 53%.

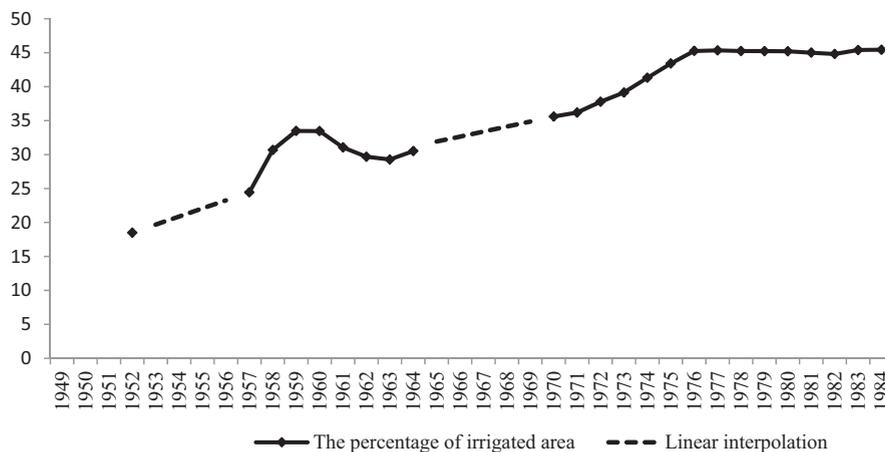
¹⁴ While Li and Yang (2005) find that radicalism associated with communal mess hall dining accounted for 17.5% of grain output decline, no significant effect has been found on excess deaths (Kung and Lin, 2003).

A: Share of Households in Various Collective Institutions, 1949–1984



Sources. 1950–1977: Huang, Yu, and Wang (1992); 1978–1982: Chung (2000); 1983–1984: Huang, Yu, and Wang (1992).

B: Irrigated Acreage as a Percentage of Total Sown acreage, 1949–1984



Source. Statistical Bureau of China, 1999.

Fig. 1. A history of agricultural collectivization in China.

(Walker, 1984),¹⁵ cultivation using techniques and tools ill-suited to some regions (Becker, 1996; Riskin, 1998),¹⁶ and not the least the elimination of work incentives—in particular the removal of “exit right”

after communalization (Lin, 1990).¹⁷ Regardless of the actual underlying causes, the important implication is that people’s choice of farming institutions was likely affected by what they experienced during the Great

¹⁵ Resource diversion from agricultural to industrial undertakings allegedly further reduced grain output by 28.6%, according to Li and Yang (2005).

¹⁶ Notable examples of such activities included “deep plowing” and “close planting”—allegedly “scientific” methods that Mao erroneously believed would raise yields (Becker, 1996).

¹⁷ It is indeed not necessary to explain incentive loss on the communal farms on account of “exit right” removal. The unwieldy size of the commune, the exceedingly narrow wage spread that came to dominate the compensation system, and more generally mismanagement would all have produced a demoralizing effect on work incentives (see, among others, Donnithorne, 1967; Perkins and Yusuf, 1984).

Leap Famine. Specifically, those who suffered worse during the Leap were more likely to have formed an unfavorable impression of collective agriculture's capability in dealing with weather calamities,¹⁸ as a corollary, they would choose to discontinue with this kind of institution when bad weather struck, and when given a chance to do so.

2.3. *The decollectivization of Chinese agriculture, 1978–84*

China began to decollectivize its agriculture soon after the demise of Mao and the downfall of the “Gang of Four” in 1976. The story of decollectivization apparently began as early as 1978, with a few farmers in a production team (*Xiaogang*) in central China (Anhui Province), who, driven by spells of prolonged droughts and prospects of hunger, secretly divided the land among themselves in their villages before it was even sanctioned by the authorities. That single action soon sparked a prairie fire across the nation that cannot be reversed. From that perspective the farmers were indeed the vanguard of this important institutional change (Kelliher, 1992; Zhou, 1996). While the central government did not endorse family farming straight away, Deng, whose overriding concerns were to raise farm incomes and agricultural output, allowed it to be “experimented” with in those areas of rural China (remote, poor, and mountainous) where failures could be easily contained without causing much political backlash.¹⁹ Meanwhile, he dispatched two reform-minded senior officials, Zhao Ziyang and Wan Li, to oversee and guide the rural reforms in two poverty- (and also famine)-stricken provinces, Sichuan and Anhui, while patiently waiting to see the results of what came

to be known as the Household Responsibility System (HRS).

Evidence suggests that the farmers' initial step toward decollectivization was timid, understandably so because of the uncertainty concerning whether household farming would be eventually sanctioned by the authorities. By the end of 1980, for instance, only less than a quarter of the production teams in China (23.5%) farmed on a household basis. This magnitude soared to two-thirds (64.6%) in less than a year (October 1981), by which time the central government had, with evidence of bountiful harvests reportedly produced on the household-farmed plots, moved swiftly to endorse household farming.²⁰ And by early 1983, with nearly 80 (78.7) percent of the production teams already effectively dismantled, the central government, which now preferred household farming to be the only organizational form, put pressure on the “recalcitrant” provinces to have them conform (Chung, 2000). In less than 12 months' time, another 20% yielded, with 99% of the households eventually farmed on an individualized basis (refer to the right-hand side of the main curve, Panel A of Fig. 1).

This brief account of the decollectivization process suggests that the provincial governments must have played a key role in determining *when* to switch over to household farming. In particular, given that the rural reforms were aimed at raising farm output, provincial officials must take this into account when deciding which of the two institutional choices would better serve this purpose. Indeed, the literature on agricultural decollectivization has hinted at the pivotal importance of economics in accounting for the temporal variations in decollectivization across provinces. For instance, in sharp contrast to the dire poor provinces, those who enjoyed higher levels of output and income, thanks to (rural) industrialization and (farm) mechanization, etc., were reluctant to make an immediate switch—presumably for fear of the high opportunity costs that potentially entailed (Chung, 2000; Zweig, 1983, 1985).²¹ Such a concern also likely reflects the fact that the provincial

¹⁸ Psychological research has richly demonstrated that a trauma, usually derived from an adverse historical experience, can impact negatively on the population at large. Moreover, historical shocks such as China's Great Leap Famine can create a sense of general helplessness, which in turn will reduce cooperation and accordingly the perceived ability to cope with future adverse events. The famous study that finds that before 1989 (the fall of the Berlin Wall) East Berliners systematically perceived a distinctly greater sense of helplessness than West Berliners is a case in point (Oettingen and Seligman, 1990). Premised on this reasoning, Guiso et al. (2013) find that self-governance in some Italian cities in the Middle Ages has had a lasting positive effect on “civic capital” (as measured by, e.g., the number of nonprofit organizations and organ donation organizations) in those cities today through the intergenerational transmission of positive, empowered attitudes and behavior.

¹⁹ As a matter of fact, neither of the two policy documents drafted and issued in 1979 and 1980 carried any hint of anti-collectivism (Chai, 1998; Kueh, 1985).

²⁰ In August 1981 the central government issued a directive to the provinces officially sanctioning household farming (People's Daily [the Party's mouthpiece], August 4th, 1981). Its legitimate status received further boost in January 1982 when the State Council issued Document No. 1 officially stating that “the HRS is the production responsibility system of the socialist economy”.

²¹ Other reasons include differences in cropping patterns, average size of the production teams, and so forth (see Johnson, 1982; Kelliher, 1992; Lin, 1987, 1992; O'Leary and Watson, 1982; Siu, 1989; Unger, 1985–86). Space limitations prevent us from adequately discussing this voluminous literature.

officials were accountable upwards to the central leaders rather than downwards to the farmers, as suggested by evidence that some provincial leaders had tried to stop farmers in their provinces (e.g., Anhui and Jiangsu) from decollectivizing (Kelliher, 1992; Zweig, 1985).

3. Hypotheses

3.1. A simple theoretical model

Our goal is to develop three empirically testable hypotheses with the aid of a formal model. In this model, we assume that a production team or village's goal is to maximize total revenue, which it can do by choosing an optimal farming institution. Specifically, we assume that the status quo is collectivized agriculture but they are given the choice to decollectivize it by carving up the land. Denote this choice by $c \in \{0, 1\}$, we define $c = 0$ as representing household farming and $c = 1$ collective farming, respectively.

Collective farming ($c = 1$) and household farming ($c = 0$) represent two radically different institutions in respect of indivisible public goods provision (I). In peasant agriculture, an obvious example is irrigation, which, by alleviating the negative effect of weather adversity has a potentially positive effect on agricultural production. We assume, realistically, that household farming is not conducive to providing the indivisible public goods.²² On the basis of this assumption public goods provision (I) can be written as $I = I_0 + c\delta$, in which I_0 represents the initial public goods provided; the condition $\delta > 0$ reflects the assumption that more public goods will be provided under collective than household farming.²³

We can now write the agricultural output (Q) function in terms of its relationship with public goods and weather adversity as

$$Q(I, w) = \alpha + \ln \frac{I}{I + w}$$

²² Historically, corvée or statute labor was the major force behind large-scale irrigation projects in China, for Mao believed that enlarging the scope of collectivization effectively overcame the institutional deficiency of a vastly decentralized small peasantry.

²³ This assumption is indeed borne out by the fact that the effectively irrigated area (EIA) had actually declined between 1979 and 1986 for as many as seven Chinese provinces, as opposed to having increased dramatically during the collective era (Stone, 1988), and that agricultural decollectivization, which rendered the commune defunct, had resulted in the ill maintenance of water conservancy facilities (Vermeer, 1998) and conflicts over water use (Li et al., 1983).

in which I stands for public goods provision and w stands for weather adversity. Where the weather is good ($w = 0$), agricultural output is equal to α .²⁴ Where there is adverse weather ($w > 0$), however, agricultural output increases with more public goods ($\partial Q / \partial I > 0$) but at diminishing marginal rates ($\partial^2 Q / \partial I^2 < 0$). Conversely, weather adversity will have a negative effect on agricultural production ($\partial Q / \partial w < 0$), but this effect can be alleviated as the supply of public goods increases ($\partial^2 Q / \partial w \partial I > 0$).

In addition to public goods the two types of farming institutions also differ in two other significant respects. More specifically, collective farming suffers from two particular “institutional” costs that household farming avoids. The first of these costs pertains to a possibly higher procurement rate of the farm surpluses due to the removal of control and income rights from the farm households under collective farming, which has been the case historically (Li and Yang, 2005; Lin, 1994; Perkins, 1966). A second distinct institutional cost of collective farming is the free rider problem inherent in “team production” (Alchian and Demsetz, 1972), with the corollary that collective farming is unable to provide powerful work incentives to the individual workers (Bradley and Clark, 1972; Lin, 1994; Nolan, 1988).

In light of the foregoing discussions we may further assume that there are possibly two types of collectives: the “bad” collectives ($B = 1$), which suffer from an institutional cost defined by $\kappa_0 + \kappa_1 w$, in which $\kappa_0 > 0$ and $\kappa_1 > 0$, and the “good” collectives, whose only cost is κ_0 . The corollary of this further assumption is that only those collectives suffering from weak incentives or the government's excessive grain procurement or some combination of the negative aspects (i.e. $B = 1$), would do worse when bad weather strikes.²⁵ As already rehearsed, family farming does not suffer from this institutional cost.

The crux of our model features the important assumption that prior beliefs regarding the two “types” of collectives are heavily shaped by historical events of lasting memory, denoted by $\Pr(B | \text{history})$. The Great Leap Famine ($F \in \{0, 1\}$), for instance, is a prominent example of this kind of historical event. Assuming that there is higher probability that the Great Leap Famine

²⁴ This assumption can be relaxed by assuming that $Q(I, w) = \alpha + \ln [I / (I + \theta + w)]$, in which $\theta > 0$.

²⁵ In reality, some villages (provinces) did suffer from higher procurement than others. This could be due to the stronger career incentives of some provincial officials (Kung and Chen, 2011) or to the institutional inflexibility of the procurement system (Meng et al., 2011).

will occur in a “bad” collective ($B = 1$, denoted by $m = \Pr(F = 1 | B = 1)$) than in a “good” collective ($B = 0$, denoted by $n = \Pr(F = 1 | B = 0)$), it follows that $m > n$. In other words, the “type” of collective can affect the probability of famine incidence. Denoting $\Pr(B = 1)$ by b , $\Pr(B | F)$ can be rewritten as

$$\begin{aligned} \Pr(B = 1 | F = 1) &= \frac{\Pr(F = 1 | B = 1) \Pr(B = 1)}{\Pr(F = 1 | B = 1) \Pr(B = 1) + \Pr(F = 1 | B = 0) \Pr(B = 0)} \\ &= \frac{mb}{mb + n(1-b)} \equiv P_1 \end{aligned}$$

$$\begin{aligned} \Pr(B = 1 | F = 0) &= \frac{\Pr(F = 0 | B = 1) \Pr(B = 1)}{\Pr(F = 0 | B = 1) \Pr(B = 1) + \Pr(F = 0 | B = 0) \Pr(B = 0)} \\ &= \frac{(1-m)b}{(1-m)b + (1-n)(1-b)} \equiv P_0. \end{aligned}$$

Since $m > n$, $P_1 > P_0$ implies that villagers in collectives afflicted with the negative experience of the Great Leap Famine ($F = 1$) are more inclined to believe that the collectives they are in belong to the “bad” type ($B = 1$).

In deciding whether or not to adopt the HRS (i.e., moving from $c = 1$ to $c = 0$), a village or production team will base its choice on which institution better allows it to maximize total income, which can be expressed as

$$\begin{aligned} \max V(c) &= \alpha + \ln \frac{I_0 + c\delta}{I_0 + c\delta + w}^{-\kappa_0} - \Pr(B = 1 | F) \cdot c \cdot \kappa_1 w \\ &= \alpha + \ln \frac{I_0 + c\delta}{I_0 + c\delta + w}^{-\kappa_0} - [FP_1 + (1-F)P_0] \cdot c \cdot \kappa_1 w. \end{aligned}$$

The decision concerning institutional choice will thus depend on the difference between $V(c = 0)$ and $V(c = 1)$. If $\Delta V = V(c = 0) - V(c = 1) > 0$, a village will adopt the HRS ($Y = 1$); otherwise, the village would be better off by retaining the collective farming system ($Y = 0$). We denote the difference in cost between $V(c = 0)$ and $V(c = 1)$ by an unobserved variable (Y^*), such that

$$\begin{aligned} Y^* = \Delta V &= \ln \frac{I_0}{I_0 + w} - \ln \frac{I_0 + \delta}{I_0 + \delta + w} \\ &\quad + [FP_1 + (1-F)P_0] \cdot c \cdot \kappa_1 w. \end{aligned} \tag{1}$$

The net difference in the returns under the two institutions cannot be observed, however. What can be observed is whether a village has adopted the HRS. Eq. (2) is thus essentially what we observe:

$$Y = \begin{cases} 1 & Y^* > 0 \\ 0 & Y^* \leq 0 \end{cases} \tag{2}$$

3.2. Hypotheses for testing institutional choice

Given that we are interested in the effect of weather adversity on the relative returns to the two different institutions of agricultural production (Y^*), based on Eq. (1) we can formalize the above relationship as

$$\frac{\partial Y^*}{\partial w} = \frac{1}{I_0 + \delta + w} - \frac{1}{I_0 + w} + P_0 \kappa_1 + (P_1 - P_0) \kappa_1 F. \tag{3}$$

$\frac{1}{I_0 + \delta + w} - \frac{1}{I_0 + w}$ is negative because the level of public goods provision (δ) is higher under collective farming. Moreover, a village is unlikely to adopt the HRS if P_0 is very small and if it does not have a history of severe famine ($F = 0$). Thus, this kind of village tends to persevere with collective farming when bad weather strikes.

Conversely, the effect of weather adversity on Y^* will increase in the event that a village had suffered from the Great Leap Famine:

$$\left. \frac{\partial Y^*}{\partial w} \right|_{F=1} - \left. \frac{\partial Y^*}{\partial w} \right|_{F=0} = (P_1 - P_0) \kappa_1 > 0. \tag{4}$$

Eq. (4) implies that the interaction between past famine severity and present weather adversity is positively correlated with the probability of adopting the HRS; the positive sign of the Great Leap famine on the effect of weather adversity is the result of the difference in the conditional probabilities (P_1 versus P_0). The underlying rationale is that the traumatic famine experience serves to undermine the farmers’ (prior) belief that collective farming can effectively protect them from negative weather shocks. With respect to the effect of public goods, to the extent that the marginal effects of the newly constructed irrigation decrease with the prevailing levels of irrigation facilities, the deduced relationship between the initial irrigation condition and the effect of weather adversity is positive:

$$\frac{\partial^2 Y^*}{\partial w \partial I_0} = \frac{1}{(I_0 + w)^2} - \frac{1}{(I_0 + \delta + w)^2} > 0. \tag{5}$$

From Eqs. (3), (4), and (5), we can thus hypothesize that bad weather at the time of decollectivization had the likely effect of strengthening the collective agriculture, due to the belief that collectives typically provide more public goods than family farms do. This belief of the collectives being more capable of fighting natural disasters would be reversed (from P_0 to P_1), however, by the experience of the Great Leap Famine; or in villages with more “lumpy” public goods, viz. irrigation constructed during the collective era, under the assumption of

diminishing marginal returns to additional public goods provision. In other words, we propose to examine the effects of weather adversity on province i in year t , and of its interaction with famine severity (F_i) and initial irrigation condition (I_i), respectively, on the percentage of production teams (villages) in province i adopting the HRS in year t (denoted by y_{it}). We can now restate these hypotheses more specifically.

H1. In provinces struck by negative weather shocks, a lower percentage of production teams or villages tended to adopt the HRS if the provinces had not experienced the Great Leap Famine.

H2. Conversely, in provinces where the Great Leap Famine was particularly severe, negative weather shocks would predispose a higher percentage of villages to decollectivize.

H3. Negative weather shocks would similarly predispose those villages with more durable public goods provided under the auspices of collective agriculture to decollectivize.

The expected signs of H1 to H3 are as follows:

$$y_{it} = \beta_1 w_{it} + \beta_2 F_i w_{it} + \beta_3 I_i w_{it}. \quad (6)$$

$\begin{matrix} (-) & & (+) & & (+) \end{matrix}$

4. Estimation strategy

4.1. Definition of variables

Testing our proposed hypotheses requires measuring the varying pace of decollectivization across provinces during 1978–1984—our dependent variable. While a variety of household responsibility systems had been adopted during the shift from collective to household farming, which included the contracting of output responsibility to the group (smaller than the production team), to the household, and to only the laborers within a household, for the sake of consistency we employ in our estimations only that variant known as “contracting everything to the household” (*da baogan*).²⁶ We choose this particular variant because ultimately it became the standard or universal practice. Information on the pace of decollectivization comes primarily from two sources. Data for the initial 1978–82 period are meticulously compiled by Chung (2000), whereas those for the final two years are based upon the *Compendium on Agricultural Collectivization since the Founding of the*

People's Republic, edited by Huang et al. (1992). In Appendix A we tabulate the percentage of villages or production teams having adopted the HRS by province at the end of each year. And, by taking the first-difference, we can obtain the percentage of villages having adopted the HRS during the same year t (y_{it}). For data and other considerations we exclude the three directly controlled municipalities of Beijing, Shanghai, and Tianjin, and the provinces of Tibet, Qinghai, Xinjiang, Ningxia, and Inner Mongolia, and end up with a sample of 21 provinces, on which basis we construct a balanced panel for the analysis.²⁷

Our key explanatory variable is weather, whose indices are usefully provided in the *Report on China's Natural Disasters [Zhongguo Zaiqing Baogao]* (Ministry of Civil Affairs of People's Republic of China, 1995). According to this compendium, adverse weather is defined according to “the area physically struck by natural disasters” (*shouzai mianji*), specifically measured in terms of: 1) droughts; 2) floods; 3) gusts and hailstorms; and 4) frost and cold. By summing the total area of natural disasters caused by (1) to (4) above, we are able to generate a natural disaster index for each of the 21 Chinese provinces for the period 1978–1984. With d_{it} defined as the percentage of total arable land in province i physically struck by various climatic disasters in a given year t , adverse weather can be expressed as $AW_{it} = \left(d_{it} - \frac{1}{T} \sum_t d_{it} \right) / \left(\frac{1}{T} \sum_t d_{it} \right)$. Since we normalize AW_{it} by the average percentage of sown area physically struck by natural disasters in province i between 1978 and 1984, it can be interpreted as measuring the shock in a given year t in province i relative to the normal weather conditions. The pertinent variables, including definition and sources, are summarized in Table 1.

Our second key independent variable is the severity of the Great Leap Famine, for which we employ the excess death rates for the period of 1959–61 as the pertinent measure. Following Chen and Zhou (2007), we first calculate the annual excess death rate as the difference between the annual death rate (r_{it}) during the Famine period and the average death rate of 1956–1958 ($\bar{r}_i^{1956-58}$),

²⁶ See Chai (1998) for a discussion of these variants.

²⁷ In Appendix A, we introduce the data set in detail. The sampled provinces are presented in Fig. A1, and the data on the adoption of the HRS are given in Table A1. Moreover, to check the robustness of our results we repeated the regression exercises using all the provinces in an unbalanced panel (these excluding provinces for which much of the required data are missing). Presented in Appendix B (Table A2), the results are broadly similar.

Table 1
Definition of key variables and data sources.

Variable	Mean	S.D.	Proxy	Data source
(1) Percentage of production teams adopting the HRS during the year (Y_{it})	16.483	21.122	The percentage of production teams adopting the Household Responsibility System (HRS) in a given year	A
(2) Weather adversity (AW_{it})	-0.028	0.350	Based on droughts, floods, gusts and hailstorms, and frost and cold	B
(3) Severity of Great Leap Famine (r_i^{\max})	14.506	14.245	Maximum excess death rate, 1959–1961	C
(4) Initial irrigation condition (I_i^{78})	27.226	8.205	Irrigated acreage as a percentage of total arable acreage, 1978	D
(5) Average affected ratio of disasters	44.516	8.991	The average ratio of the areas actually affected by natural disasters to the areas physically struck by natural disasters, 1952–78	B
(6) “Distance to minimum subsistence”	616.423	478.824	Food availability per capita, 1959–61 (kg)	E
(7) Urban bias	18.864	17.094	The share of urban population, 1957	D
(8) Excessive grain procurement ratio	0.110	0.171	The ratio of excessive grain procurement (1959–61) to average grain procurement (1956–58)	E

Notes:

- A. (a) 1978–1982: Chung (2000); (b) 1983–1984: Huang et al. (1992); (c) China General Social Survey (2005).
 B. Ministry of Civil Affairs of People’s Republic of China (1995).
 C. Kung and Lin (2003).
 D. Statistical Bureau of China (1999).
 E. Department of Planning et al. (1983).

which can be expressed as $r_{it}^{\text{excess}} = r_{it} - \bar{r}_i^{1956-58}$. Second, we use the highest annual excess death rates during the 1959–61 period to proxy for famine severity. Our third key explanatory variable is provincial variations in initial irrigation condition (measured at the outset of decollectivization, circa 1978). More specifically, we are interested in measuring the effect of the interaction between adverse weather (AW_{it}) and the percentage of irrigated acreage in 1978 in our estimation (I_i^{78}), the latter of which we obtain from the *Comprehensive Statistical Data and Materials on 50 years of New China*.

4.2. Econometric method

We begin with a baseline model in which we measure the effects of weather adversity and of its interactions with famine severity and initial irrigation condition, respectively, on the percentage of production teams adopting the HRS in year t from the benchmark year 1978 through 1984, using the pertinent panel data which includes year-specific effects:

$$y_{it} = X_{it}\beta + \lambda_t + v_{it} \quad t = 1, 2, \dots, T \quad (7)$$

where y_{it} measures the percentage of households adopting the HRS during year t , X_{it} are the key explanatory variables of weather adversity (AW_{it}), famine death rate (r_i^{\max}), initial irrigation condition (I_i^{1978}), and the two pertinent interaction terms $AW_{it} * r_i^{\max}$ and $AW_{it} * I_i^{1978}$, by province; λ_t is the time-specific effect for year t and v_{it}

is the residual error term. We first estimate Eq. (1) using OLS, then control for the unobserved province-specific effect α_i as in

$$y_{it} = X_{it}\beta + \alpha_i + \lambda_t + v_{it} \quad t = 1, 2, \dots, T \quad (8)$$

in which we include $AW_{it} * I_i^{1978}$ in the regressions; the coefficient AW_{it} is the effect of weather adversity when I_i^{78} is equal to zero. To examine the coefficient of weather adversity at average levels of irrigation condition, we use $(I_i^{78} - \bar{I}^{78})$ instead of I_i^{78} , with \bar{I}^{78} standing for the mean percentage of irrigated acreage of all the provinces in 1978.²⁸

5. Empirical results

5.1. Baseline results

The results of our baseline model, which includes a total of eight specifications regressed on 126 observations, are presented in Table 2. We begin our analysis by including only weather adversity and year dummies as benchmark. Reported in column (1), the result shows that weather adversity does correlate negatively with the percentage of households adopting the HRS. For

²⁸ Despite this transformation, it does not affect the coefficient of the interaction term between weather adversity and initial irrigation condition (i.e., it is the same as $AW_{it} * I_i^{1978}$).

Table 2

Temporal variations in decollectivization across provinces, 1978–1984 (baseline results).

	Dependent variable: the share of production teams adopting household farming, by year							
	One-way fixed effect			Two-way fixed effect			Excluding outliers	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AW_{it}	-8.225 *	-24.961 ***	-24.922 ***	-8.636 *	-26.271 ***	-25.590 ***	-20.750 ***	-20.849 **
	(4.322)	(6.611)	(5.954)	(5.129)	(7.669)	(6.832)	(7.409)	(8.299)
r_i^{\max}		0.058	0.062				0.029	
		(0.083)	(0.079)				(0.168)	
$AW_{it} * r_i^{\max}$		1.214 ***	1.359 ***		1.279 ***	1.410 ***	1.097 **	1.105 **
		(0.303)	(0.287)		(0.357)	(0.355)	(0.495)	(0.543)
I_i^{78}			-0.015				-0.018	
			(0.188)				(0.189)	
$AW_{it} * (I_i^{78} - \bar{I}^{78})$			1.657 ***			1.724 **	1.958 ***	2.080 ***
			(0.558)			(0.683)	(0.544)	(0.678)
Provincial dummies	No	No	No	Yes	Yes	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	126	126	126	126	126	126	108	108
R-squared	0.46	0.52	0.55	0.46	0.52	0.55	0.59	0.60

Notes. The dependent variable is the share of production teams adopting household farming each year during 1978–1984; Constant term is included in the regressions but not reported. Robust standard errors in parentheses.

* Indicates $p < .1$.

** Indicates $p < .05$.

*** Indicates $p < .01$.

instance, if the area affected/struck by natural disasters (comprehensively defined) is twice the average (i.e., AW_{it} equals 1), the fraction of farm households adopting the HRS is approximately 8.225 percentage points lower (column (1)). Both the significance and magnitude of this benchmark estimate remain little changed after controlling for the provincial dummies (column (4)).

To examine the effect of weather adversity conditional upon the variation in famine severity, we include both the maximum excess death rate (r_i^{\max}) during the Great Leap Famine and its interaction with weather adversity in the regression (column (2)). Similar to that in column (1), the result in column (2) consistently shows that weather adversity correlates negatively with the percentage of households adopting the HRS, but with a magnitude that is three times larger (24.961%) in villages not afflicted by the Great Leap Famine, i.e., $r_i^{\max} = 0$.²⁹ These pieces of evidence lend support to our first hypothesis (H1).

Also supporting our second hypothesis (H2) is the positive correlation found between the interaction term of weather adversity and famine severity and the degree

of decollectivization. As hypothesized, the effect of adverse weather turns *positive* where the maximum excess death rate is higher than 20.56 thousandths (or 2.056%) in the One-way Fixed Effect model (column (2): 24.961/1.214), or 20.54 thousandths (or 2.054%) in the Two-way Fixed Effect model (column 5: 26.271/1.279). In column (5), the effect of weather adversity (when $r_i^{\max} = 0$) remains significantly negative even after controlling for the provincial fixed effects.

Moving on to testing Hypothesis 3, the pertinent estimation results show that provinces with proportionately larger irrigation acreage in 1978 tended to dismantle their communes significantly earlier when bad weather struck (columns (3) and (6)). For instance, if the area affected/struck by natural disasters is twice the average (i.e., AW_{it} equals 1), the fraction of farm households adopting the HRS is approximately 1.657% higher in the One-way Fixed Effect model (column (3)) or 1.724% higher in the Two-way Fixed Effect model (column (6)), for a one-percentage point increase in irrigation acreage. This supports H3. As with the case of famine severity, weather adversity remains negatively correlated with the percentage of households adopting the HRS when excess mortality is equal to zero and irrigation acreage is equal to the sample mean even after including both initial irrigation condition and its interaction with weather adversity in the regressions.

²⁹ We can interpret the coefficient of weather adversity as representing the sole effect of weather in the instance where the excess death rate equals zero, i.e., no famine.

Table 3

Temporal variations in decollectivization across provinces, 1978–1984 (the effect of lagged weather adversity).

	Dependent variable: the share of production teams adopting household farming each year							
	(1)	(2)	Excluding outliers		(5)	(6)	Excluding outliers	
			(3)	(4)			(7)	(8)
AW_{it}	−23.912 *** (5.745)	−24.597 *** (6.636)	−19.608 *** (7.283)	−19.841 ** (8.252)				
AW_{it-1}	−1.271 (5.628)	−1.656 (5.846)	3.018 (7.323)	2.516 (7.722)	2.123 (6.531)	2.184 (6.912)	6.349 (8.789)	6.444 (9.337)
r_i^{\max}	0.049 (0.069)		0.030 (0.167)		−0.008 (0.091)		0.015 (0.178)	
$AW_{it} * r_i^{\max}$	1.360 *** (0.286)	1.412 *** (0.359)	1.071 ** (0.494)	1.084 ** (0.542)				
$AW_{it-1} * r_i^{\max}$	0.383 (0.315)	0.397 (0.343)	−0.034 (0.534)	−0.011 (0.569)	0.349 (0.329)	0.350 (0.347)	−0.169 (0.592)	−0.173 (0.627)
I_i^{78}	0.001 (0.170)		−0.018 (0.178)		0.012 (0.215)		−0.005 (0.234)	
$AW_{it} * (I_i^{78} - \bar{I}^{78})$	1.600 *** (0.568)	1.666 ** (0.684)	1.987 *** (0.564)	2.101 *** (0.694)				
$AW_{it-1} * (I_i^{78} - \bar{I}^{78})$	−0.308 (0.593)	−0.278 (0.629)	0.014 (0.589)	0.043 (0.615)	−0.309 (0.727)	−0.305 (0.761)	0.029 (0.774)	0.040 (0.798)
Provincial dummies	No	Yes	No	Yes	No	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	126	126	108	108	126	126	108	108
R-squared	0.56	0.57	0.59	0.60	0.47	0.47	0.51	0.51

Notes. The dependent variable is the share of production teams adopting household farming each year during 1978–1984; Constant term is included in the regressions but not reported. Robust standard errors in parentheses.

* Indicates $p < .1$.

** Indicates $p < .05$.

*** Indicates $p < .01$.

To rule out the possibility that the results thus far may be driven by a few possible outlying provinces, namely provinces with extremely high famine mortality rates, we drop the three provinces with the highest mortality rates from our sample and repeat the same regressions based on the specifications of columns (3) and (6). These provinces are: Anhui, Sichuan and Guizhou, whose maximum excess death rate is: 56.7 thousandths, 38.1 thousandths and 35.4 thousandths, respectively.³⁰ As shown in columns (7) and (8) of Table 2, weather adversity and its interactions with respectively famine severity and initial irrigation

condition remain highly significant; these results reaffirm both of our hypotheses (H2 and H3).

5.2. Robustness check — the effect of lagged weather adversity

An immediate concern arising from our baseline estimations is whether contemporaneous weather shocks would actually trigger a response to decollectivization say at the end of the same year, or does the decision underlying the institutional change in question exhibit a lagged response, to the extent that it takes time to reach a collective decision? To address this concern we include the lagged independent variables in the regression as specified in Eq. (9):

$$y_{it} = X_{it}\beta + X_{it-1}\gamma + \alpha_i + \lambda_t + v_{it} \quad t = 1, 2, \dots, T. \quad (9)$$

The results of doing so are reported in Table 3. A striking finding is that the lagged explanatory variable

³⁰ An additional reason for dropping these provinces is that they had all adopted the HRS before it was sanctioned by the central government for nationwide implementation in April 1982. For instance, roughly 43%, 22.4%, and 61.8% of the households in, respectively, Anhui Province, Sichuan Province, and Guizhou Province had already switched to individual farming by the end of 1980.

has no significant effect whatsoever on the change in the degree of decollectivization both in the baseline regressions (columns (1)–(4)) and in those in which current weather adversity and its interaction with famine severity and initial irrigation condition are not controlled for (columns (5)–(8)). A possible explanation for this is that villages having experienced negative weather shocks in a given year would move swiftly to adopting the HRS during the slack winter months of the same year (e.g., December).³¹ What lends greater credence to our earlier estimates is that even with the inclusion of the lagged explanatory variables our baseline results remain unchanged; weather adversity is still negatively correlated with the percentage of households adopting the HRS when excess mortality is equal to zero and irrigation acreage is equal to the sample mean, and the two pertinent interaction terms continue to exhibit significantly positive effects on the dependent variable.

5.3. Robustness check — an inverse measure of public goods provision

Concern for measurement error may also exist with respect to employing only the irrigation condition (I_i) as the sole proxy for public goods provision. To check the robustness of our estimates based on a single measure of public goods provision, we employ an alternative measure, namely the average ratio of the area actually affected by natural disasters (a_{it}) [*chengzai mianji*] to the area physically struck by natural disasters (d_{it}) [*shouzai mianji*] during the entire period of collective agriculture, circa 1952–78. Not all areas physically struck by natural disasters eventually suffer from a loss of output. Presumably, a province with larger effective irrigated acreage is likely to be less affected when natural disasters strike, which explains why the area physically struck by natural disasters (*shouzai mianji*) is typically larger than the affected area. Consider the specification

$$\frac{a_{it}}{d_{it}} = \rho_0 + \rho_1 \tilde{I}_{it} + \varepsilon_{it}$$

in which ρ_0 is a constant term, \tilde{I}_{it} represents the level of public goods provision (including irrigation), and ε_{it} is

the error term absorbing the residual effects of, for instance, the unmeasured severity of a disaster. ρ_1 is negative, implying that a larger provision of public goods serves to reduce the affected ratio of natural disasters. To rule out the random factor (ε_{it}), we sum up the affected ratios of natural disasters during the entire period of collective agriculture up to the point of decollectivization:

$$\frac{a_i}{d_i} = \sum_t \frac{a_{it}}{d_{it}} = \rho_0 + \rho_1 \tilde{I}_i.$$

Note that the ratio (a_i/d_i) is actually an *inverse* measure of public goods provision and so the expected sign of this measure is negative instead. To check the reliability of this assumption, we plot a_i/d_i and average irrigation condition during 1952–78 in [Appendix B](#) and find that there is indeed a highly significant (at the 1% level) and negative correlation (−0.608) between the two.

Reported in [Table 4](#), the estimation results show that differences in the average affected ratio (a_i/d_i) do have a significantly negative effect on agricultural decollectivization in the presence of negative weather shocks (columns (1) and (2)). This effect remains robust in regressions in which the lagged effects of weather adversity are included (columns (3) and (4)) and where the outlying provinces (columns (5)–(8)) are excluded.

5.4. Robustness check — role of government

As remarked earlier ([Section 2.3](#)), the extent to which central and provincial governments were involved in the process of China's agricultural decollectivization has been a subject of heated debate. In light of the temporal variations among provinces in adopting the new farming institution, [Chung \(2000\)](#) suggests that provinces were afforded the discretion to experiment with various forms of non-collective farming in the first few years before it became universally sanctioned and preferred by the new leadership—an interpretation consistent with the experimentation-cum-evaluation approach adopted by the Chinese government ([Heilmann, 2008](#); [Rodrik, 2009](#); [Ravallion, 2009](#)).³² To ensure that our empirical

³¹ It is highly likely that villagers carved up their collective holdings during the slack winter month of December prior to the Chinese Spring Festival (which typically occurs in January and sometimes February).

³² A distinct feature of China's economic reforms after Mao is the willingness of the new leadership to embrace a gradual, experimental approach, whereby new policies were tried out in certain localities first before they were implemented nationwide upon proven successful (see [Heilmann, 2008](#); [Rodrik, 2009](#); [Ravallion, 2009](#); [Xu, 2011](#)).

Table 4
Temporal variations in decollectivization across provinces — an alternative measure of public goods.

	Dependent variable: the share of production teams adopting household farming each year							
	(1)	(2)	(3)	(4)	Excluding outliers			
	(5)	(6)	(7)	(8)				
AW_{it}	−24.745 *** (6.071)	−26.083 *** (7.103)	−24.096 *** (5.900)	−25.462 *** (6.832)	−24.062 *** (8.277)	−25.327 ** (9.660)	−23.735 *** (8.178)	−25.058 *** (9.433)
r_i^{\max}	0.055 (0.079)		0.039 (0.070)		0.021 (0.179)		0.022 (0.176)	
$AW_{it} * r_i^{\max}$	1.066 *** (0.280)	1.128 *** (0.328)	1.088 *** (0.273)	1.151 *** (0.329)	1.206 ** (0.539)	1.257 ** (0.608)	1.202 ** (0.535)	1.251 ** (0.599)
I_i^{78}	−0.002 (0.148)		−0.003 (0.147)		0.001 (0.149)		0.002 (0.151)	
$AW_{it} * (I_i^{78} - \bar{I}^{78})$	−0.732 * (0.379)	−0.758 * (0.398)	−0.683 * (0.395)	−0.711 * (0.411)	−0.760 ** (0.369)	−0.782 ** (0.384)	−0.762 * (0.395)	−0.790 * (0.408)
AW_{it-1}			−3.238 (5.808)	−3.403 (5.987)			0.773 (8.138)	0.571 (8.316)
$AW_{it-1} * r_i^{\max}$			0.485 (0.303)	0.486 (0.338)			0.009 (0.583)	0.008 (0.611)
$AW_{it-1} * (I_i^{78} - \bar{I}^{78})$			0.043 (0.418)	0.028 (0.445)			−0.036 (0.438)	−0.058 (0.461)
Provincial dummies	No	Yes	No	Yes	No	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	126	126	126	126	108	108	108	108
R-squared	0.53	0.53	0.54	0.55	0.56	0.57	0.56	0.57

Notes. The dependent variable is the share of production teams adopting household farming each year during 1978–1984; Constant term is included in the regressions but not reported. Robust standard errors in parentheses.

* Indicates $p < .1$.

** Indicates $p < .05$.

*** Indicates $p < .01$.

results are not biased by the *omission* of the possible role of the central and provincial governments in controlling which provinces were to be decollectivized first, we control for the role of the government (or rather “provincial spontaneity”) by generating a dummy variable (S_i), which includes those provinces with more than 50% of the households having adopted the HRS by April 1982—a time when the new farming institution had proven superior in productivity terms and on which basis the central government decided to push for its implementation nationwide (Chung, 2000).³³

According to this reasoning all provinces are divided into two groups: those having already adopted the new farming institution prior to its becoming sanctioned by the central government ($S_i = 1$), and those instructed to implement it only after universal laws and regulations

were drafted to see to that effect ($S_i = 0$). As with the other two earlier robustness checks, we also include an interaction term between “provincial spontaneity” and weather adversity ($S_i * AW_{it}$). Reported in Table 5, the results of these estimations show that permission by the central government to experiment with the alternative of household farming does have the expected effect of accelerating agricultural decollectivization (columns (1) and (4)). Once we include the interactions between weather adversity and respectively famine severity and initial irrigation condition, however, the significance of the tested term disappears, suggesting that the so-called “provincial spontaneity” is endogenous to both famine history and initial public goods provisions.

5.5. Robustness check — role of food availability, “urban bias”, grain procurement, and subsistence

To ensure that the relationship between excess deaths of the Great Leap Famine and agricultural decollectivization does not suffer from the possible

³³ Data limitations however require us to use year-end 1981 as the cut-off point.

Table 5
Temporal variations in decollectivization across provinces — controlling for the role of government.

	Dependent variable: the share of production teams adopting household farming each year						Inverse measure of public goods provision	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AW_{it}	-12.452 ** (5.223)	-24.652 *** (6.651)	-23.998 *** (5.963)	-13.092 ** (6.001)	-25.888 *** (7.705)	-24.492 *** (6.713)	-23.972 *** (5.950)	-25.249 *** (6.949)
r_i^{\max}		0.067 (0.090)	0.062 (0.083)				0.053 (0.087)	
$AW_{it} * r_i^{\max}$		1.131 *** (0.332)	1.137 *** (0.332)		1.184 *** (0.387)	1.162 *** (0.370)	0.860 *** (0.317)	0.907 ** (0.361)
I_i^{78}			-0.018 (0.189)				-0.002 (0.150)	
$AW_{it} * (I_i^{78} - \bar{I}^{78})$			1.788 *** (0.562)			1.873 *** (0.697)	-0.818 * (0.416)	-0.848 * (0.437)
S_i	0.663 (3.429)	-0.871 (3.894)	-0.692 (3.844)				-0.447 (3.837)	
$AW_{it} * S_i$	24.938 *** (9.286)	5.264 (10.105)	13.894 (10.449)	25.779 ** (10.800)	5.401 (11.332)	14.663 (11.546)	11.136 (11.113)	11.455 (12.268)
Provincial dummies	No	No	No	Yes	Yes	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	126	126	126	126	126	126	126	126
R-squared	0.49	0.52	0.56	0.49	0.52	0.56	0.53	0.53

Notes. The dependent variable is the share of production teams adopting household farming each year during 1978–1984; Constant term is included in the regressions but not reported. Robust standard errors in parentheses.

* Indicates $p < .1$.

** Indicates $p < .05$.

*** Indicates $p < .01$.

omission of other confounding variables we expand our control to include other possible determinants of famine severity. We can think of three such variables based on the famine literature. The first concerns food availability decline (FAD), the second food “entitlements”, and the third grain procurement. To the extent that the pace of decollectivization is correlated in part with the standard of living on the eve of decollectivization, and that the latter is correlated with food availability during the Great Leap Famine, it is necessary to control for per capita food availability during 1958–61, which is estimated using data on provincial grain output and procurement.³⁴

Second, to the extent that famine severity is correlated with systemic differences in grain entitlement based on one’s origin of residence—with the urban population being guaranteed a fixed amount of grain, it is necessary

to control also for this “urban bias” (Lin and Yang, 2000), or specifically the share of urban population in a province in 1957. Moreover, we control also for the provincial variations in the excessive increase in grain procurement during the Great Leap, in light of the finding that such variations impacted significantly (negatively) on famine severity (Kung and Chen, 2011; Kung and Lin, 2003). Denoting grain procurement in province i by P_{it} , we first calculate the change in procurement between 1956–58 (P_i^{56-58}) and 1959–61 (P_i^{59-61}), denoted by ΔP_i , and normalize the difference based on average procurement during the former period to measure the excessive increase in procurement during the Great Leap ($p_i = \Delta P_i / P_i^{56-58}$).

Reported in Table 6, differences in food availability do not have any significant effect on the temporal variations in decollectivization in the presence of negative weather shocks (columns (1) and (5)). The same can be said of “urban bias” and excessive grain procurement (columns (2), (3), (6) and (7)). Most encouraging is that expanding our list of control variables does not change our previous

³⁴ We obtain this variable from Materials of Agricultural Economy [Nongye Jingji Ziliao] (Department of Planning, Ministry of Agriculture, Animal Husbandry and Fisheries, 1983).

Table 6

Temporal variations in decollectivization across provinces — controlling for factors correlated with the Great Leap Famine.

	Dependent variable: the share of production teams adopting household farming each year							
	(1)	(2)	(3)	(4)	Inverse measure of public goods provision			
					(5)	(6)	(7)	(8)
AW_{it}	—	—	—	—	—	—	—	—
	25.153 *** (6.823)	26.628 *** (6.776)	26.601 *** (6.982)	24.510 *** (6.876)	25.240 *** (6.999)	27.045 *** (6.849)	27.079 *** (6.921)	27.690 *** (7.124)
$AW_{it} * r_i^{\max}$	1.355 *** (0.373)	1.560 *** (0.364)	1.546 *** (0.376)	1.449 *** (0.366)	1.034 *** (0.338)	1.212 *** (0.297)	1.170 *** (0.308)	1.196 *** (0.318)
$AW_{it} * (I_i^{78} - \bar{I}^{78})$	1.668 ** (0.706)	2.112 *** (0.773)	2.160 *** (0.789)	2.246 *** (0.803)	-0.758 * (0.400)	-0.799 * (0.459)	-0.943 * (0.499)	-1.004 * (0.508)
$AW_{it} * \text{food availability}$	-6.366 (15.647)		-16.155 (16.496)	-17.081 (16.409)	-11.700 (14.874)		-19.341 (17.385)	-19.728 (17.471)
$AW_{it} * \text{urban ratio}$		0.430 (0.308)	0.671 (0.422)	0.742 * (0.404)		0.105 (0.346)	0.418 (0.467)	0.433 (0.470)
$AW_{it} * \text{excessive procurement}$		12.175 (27.438)	12.097 (27.397)	5.886 (28.398)		-6.693 (28.000)	-6.307 (28.106)	-3.907 (30.442)
$AW_{it} * \text{rural income (per capita in log-term)}$				-14.093 (13.153)				2.997 (12.287)
Provincial dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	126	126	126	126	126	126	126	126
R-squared	0.56	0.56	0.57	0.57	0.54	0.53	0.54	0.54

Notes. The dependent variable is the share of production teams adopting household farming each year during 1978–1984; Constant term is included in the regressions but not reported. Robust standard errors in parentheses. For the additional control variables (Z_i), namely food availability, urban ratio, and excessive grain procurement of 1958–61, we use deviation from the sample mean (denoted by $(Z_i - \bar{Z})$).

* Indicates $p < .1$.

** Indicates $p < .05$.

*** Indicates $p < .01$.

results—our key explanatory variables and therefore hypotheses remain consistently robust.

It may, however, be contended that the institutional choice in question was dependent on how close households were to minimum subsistence, with the assumption that the further away they were from it the more likely collective institutions were to persist in the event of an adverse weather shock at the time of decollectivization. If the provinces that experienced severe famine were much poorer on the eve of decollectivization, our famine severity measure might capture the effect of household income. To rule out such possibility, we include an interaction term between weather adversity and “per capita rural income” (1978, in logarithm). Reported in columns (4) and (8) of Table 6, the pertinent results show that differences in per capita rural income do not have any significant effect on the choice of institutions in the presence of an exogenous weather shock, but the effects of our key explanatory variables remain stable.

5.6. Robustness check — instrumenting famine severity by deviated weather shocks

Although we have expanded our list of control variables and obtained the same robust results, it is still incumbent upon us to deal with the endogenous famine severity variable in a more rigorous manner. We thus resort to instrumenting famine severity by the Great Leap’s weather adversity, measured by the deviation in climate during 1959–1961 from that in the three-year period immediately preceding the Great Leap, denoted by $(a_i^{59-61} - a_i^{56-58}) / a_i^{56-58}$. The choice of this instrumental variable is motivated by the consideration that the adverse weather deviation during the Leap is correlated with the excess death rate in the same period but has otherwise no direct effect on the pace of decollectivization except through the indirect effect of famine severity.

The second-stage of the instrumented results is presented in Table 7. We begin the regression by including only weather adversity and its interaction with

Table 7

Temporal variations in decollectivization across provinces — instrumented evidence.

	Dependent variable: the share of production teams adopting household farming each year						
	(1)	(2)	(3)	(4)	Inverse measure of public goods provision		
					(5)	(6)	(7)
AW_{it}	–	–	–	–	–	–	–
	28.214 *** (9.471)	29.587 *** (8.922)	30.860 *** (7.733)	31.942 *** (9.967)	28.103 *** (9.113)	29.266 *** (8.005)	29.754 *** (10.124)
$AW_{it} * r_i^{\max}$	1.420 *** (0.514)	1.707 *** (0.557)	1.751 *** (0.497)	2.029 *** (0.701)	1.283 ** (0.524)	1.313 *** (0.476)	1.354 ** (0.613)
$AW_{it} * (I_i^{78} - I_i^{78})$		1.787 ** (0.707)	1.858 *** (0.691)	2.391 *** (0.855)	–0.713 * (0.421)	–0.714 * (0.423)	–0.994 * (0.505)
$AW_{it} * S_i$			4.468 (12.610)			4.262 (12.837)	
$AW_{it} * \text{food availability}$				–16.433 (16.328)			–19.448 (17.134)
$AW_{it} * \text{urban ratio}$				0.886 * (0.473)			0.459 (0.492)
$AW_{it} * \text{excessive procurement}$				–3.916 (32.843)			–7.215 (35.216)
$AW_{it} * \text{rural income (per capita in log-term)}$				–10.569 (12.398)			3.938 (12.001)
Provincial dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	126	126	126	126	126	126	126
R-squared	0.52	0.55	0.55	0.56	0.53	0.53	0.54

Notes. The dependent variable is the share of production teams adopting household farming each year during 1978–1984; Constant term is included in the regressions but not reported. Robust standard errors in parentheses.

* Indicates $p < .1$.

** Indicates $p < .05$.

*** Indicates $p < .01$.

famine severity (column (1)). Consistent with our earlier results, the effect of weather adversity when $r_i^{\max} = 0$ remains significantly negative, but turns positive when the maximum excess death rate exceeds 19.87 thousandths (column (1): 28.214/1.420). In column (2) we include the initial irrigation condition and its interaction with weather adversity and the results are still consistent with our earlier findings. We continue to obtain the same results where we include the interaction between “provincial spontaneity” and weather adversity ($S_i * AW_{it}$) (column (3)), or that between weather adversity and the three factors that are seemingly correlated with the Great Leap Famine (column (4)), once again leading to the implication that provinces that had suffered from more severe famine tended to decollectivize faster when bad weather struck. In columns (5)–(7) we replicate the exercises in columns (2)–(4) using our alternative measure of public goods provision, namely (a_i/d_i), and obtain similar results.

5.7. Robustness check — system GMM

Since the changes in the degree of collectivization exhibit strong time-dependent properties, and the degree of collectivization is bounded by 100%, it is necessary that we include the lagged degree of collectivization and employ the following dynamic panel model with unobserved specific effects:

$$y_{it} = Y_{it} - Y_{it-1} = \rho Y_{it-1} + X_{it}\beta + \alpha_i + \lambda_t + v_{it} \quad (10)$$

where Y_{it-1} is the lagged degree of collectivization and ρ is the parameter associated with it. To estimate all the pertinent parameters consistently, we account for the dynamic structure of the model as well as control for the unobserved province-specific and year-specific effects. Eq. (10) can be estimated using the “system GMM” (Arellano and Bover, 1995; Blundell and Bond, 1998).

Table 8
Temporal variations in decollectivization across provinces — system GMM.

	Dependent variable: the share of production teams adopting household farming each year					
				Instrumented famine severity		
	(1)	(2)	(3)	(4)	(5)	(6)
AW_{it}	−17.081 *** (6.194)	−16.716 *** (6.436)	−17.138 ** (8.216)	−22.944 *** (6.952)	−21.319 *** (5.619)	−25.326 *** (6.274)
$AW_{it} * r_i^{\max}$	0.919 *** (0.321)	0.824 * (0.445)	1.023 ** (0.455)	1.403 *** (0.467)	1.242 *** (0.407)	1.410 *** (0.542)
$AW_{it} * (I_i^{78} - \bar{I}^{78})$	1.723 *** (0.483)	1.780 *** (0.479)	1.961 *** (0.640)	1.880 *** (0.490)	1.850 *** (0.506)	2.073 *** (0.680)
y_{it-1}	−0.488 *** (0.092)	−0.488 *** (0.089)	−0.487 *** (0.081)	−0.457 *** (0.093)	−0.464 *** (0.088)	−0.470 *** (0.101)
$AW_{it} * S_i$		5.937 (12.465)			0.282 (13.676)	
$AW_{it} * \text{food availability}$			1.753 (17.076)			4.137 (23.766)
$AW_{it} * \text{urban ratio}$			0.318 (0.390)			0.313 (0.477)
$AW_{it} * \text{excessive procurement}$			−28.770 (20.453)			−22.997 (27.721)
$AW_{it} * \text{rural income}$			−12.794 (13.379)			−1.074 (11.923)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	126	126	124	126	126	124
Number of Prov.	21	21	21	21	21	21
m_1	−2.50 **	−2.51 **	−2.49 **	−2.52 **	−2.52 **	−2.40 **
m_2	−0.52	−0.49	−0.42	−0.56	−0.52	−0.39
Hansen test (over-identifying restriction)	0.198	0.205	0.283	0.208	0.206	0.152
Number of instruments	18	19	22	18	19	22

Notes. A constant term is included in the regressions but not reported. The two-step GMM estimators are reported. Windmeijer-corrected (2005) standard errors are reported in parentheses. m_1 and m_2 are test statistics for the first-order and second-order serial correlation of the first-differenced residuals (Bond, 2002). The Hansen (1982) test (p-value), which ensures the instruments are exogenous, is reported.

* Indicates significance at the 10% level.

** Indicates significance at the 5% level.

*** Indicates significance at the 1% level.

Reported in Table 8, the results show that: 1) the lagged degree of decollectivization is negatively correlated with the change in the degree of decollectivization, 2) the effect of weather adversity remains negative and significant, and 3) the interaction term between famine severity and adverse weather remains positive and significant. Moreover, provinces with better irrigation infrastructure tended to dismantle their communes faster when struck by bad weather (column (1)). As with the OLS model we include also interaction terms between weather adversity and the role of government, food availability, urban bias, grain procurement and per capita rural income, and find that the results remain broadly the same (columns (2)–(3)). We then instrument famine severity by deviated weather shocks. The results thus obtained clearly substantiate our hypotheses (columns (4)–(6)).

5.8. Robustness check based on village-level evidence

Given that the decision making unit in our theoretical model is the village or production team, we would like to check the robustness of our empirical results which are based on provincial level data, by analyzing a village level data set. Fortunately for us the China General Social Survey (CGSS, 2005), a national survey, contains a question asking the village leaders when decollectivization occurred in their villages.³⁵ Similarly, with i representing a

³⁵ The CGSS (2005) surveyed 392 villages across the 21 provinces we employ in the empirical analysis. The villages were selected on the basis of a multi-stage stratified random sampling method whereby 125 counties were initially selected from 2798 county or county-level districts, and 3–4 villages were then selected from each of these sample counties.

Table 9
Temporal variations in decollectivization across villages, 1980–83.

	Dependent variable (dummy): whether a village adopts household farming this year							
	Baseline results						Instrumented results	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AW_{it}	-0.063 (0.036)* [0.037]	-0.150 (0.057)*** [0.061]++	-0.078 (0.040)* [0.043] ⁺	-0.176 (0.063)*** [0.067]++	-0.078 (0.045)* [0.043] ⁺	-0.176 (0.072)** [0.067]++	-0.300 (0.090)*** [0.098]+++	-0.300 (0.102)*** [0.098]+++
r_i^{\max}		0.000 (0.001) [0.000]						
$AW_{it} * r_i^{\max}$		0.005 (0.003)* [0.003] ⁺		0.006 (0.003)** [0.003] ⁺		0.006 (0.003)* [0.003] ⁺	0.014 (0.005)*** [0.005]++	0.014 (0.006)** [0.005]++
I_i^{78}		-0.001 (0.001) [0.001]						
$AW_{it} * (I_i^{78} - \bar{I}^{78})$		0.012 (0.006)** [0.006] ⁺		0.013 (0.006)** [0.007] ⁺		0.013 (0.007)* [0.007] ⁺	0.018 (0.007)*** [0.007]++	0.018 (0.008)** [0.007]++
Provincial dummies	No	No	Yes	Yes	No	No	Yes	No
Village dummies	No	No	No	No	Yes	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1536	1536	1536	1536	1536	1536	1536	1536
R-squared	0.02	0.03	0.03	0.03	0.05	0.06	0.03	0.05

Notes. Robust standard errors in parentheses. The two-level clustering standard errors nested at the province and village levels in brackets.

* Indicates $p < .1$.

** Indicates $p < .05$.

*** Indicates $p < .01$.

⁺ Indicates $p < .1$.

++ Indicates $p < .05$.

+++ Indicates $p < .01$.

village in province j adopting the HRS in year t , we can test the hypothesized effects of weather adversity (AW_{it}), famine severity (r_i), and initial irrigation condition (I_i) on the probability that villages will adopt household farming as in:

$$Y_{ijt} = X_{it}\beta + \alpha_{ij} + \lambda_t + v_{ijt} \quad t = 1, 2, \dots, T. \quad (11)$$

We perform eight regressions on 1536 observations and report the results in Table 9. Initially we exclude the provincial and village dummies (columns (1) and (2)) but later include them (provincial dummies in columns (3) and (4) and village dummies in columns (5) and (6)). We also employ the deviation in weather shocks between 1958–61 and 1956–58 to instrument famine severity and report the results in columns (7) and (8). Given that this is a village-level panel data but with the key explanatory variables constructed at the province level, we cluster our standard errors and nested them at

both the province and village levels. While these clustering error terms are slightly less significant than the heterogeneity-consistent standard errors, they remain robust and are thus supportive of all three of our hypotheses. Foremost is that weather adversity correlates negatively with the probability that a village will adopt the HRS. Also consistent are the findings that villages in the province with either higher death rates during the Great Leap Famine or better initial irrigation condition tended to adopt household farming faster when struck by negative weather shocks. In terms of magnitude, if the area affected/struck by natural disasters is twice the average (i.e., AW_{it} equals 1), the probability that a village will adopt the HRS is approximately 30% lower (column 8) than if there was no famine during 1959–61, i.e. $r_i^{\max} = 0$ —a magnitude strikingly similar to that based on the province level analysis (29.587%, column (2) of Table 7).

Table 10
Comparing collectivization with decollectivization.

	Dependent variable: change in the degree of collectivization							
	1950–54						1979–84	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AW_{it}	6.949 ** (3.143)	6.672 ** (3.193)	6.624 ** (3.159)	6.682 ** (3.003)	6.351 ** (3.059)	6.321 ** (3.019)	7.840 ** (3.926)	8.239 * (4.683)
Famine during 1929–31		0.018 (0.075)	0.016 (0.075)				0.003 (0.011)	
AW_{it} * famine during 1929–31		0.278 *** (0.093)	0.293 *** (0.094)		0.294 *** (0.087)	0.305 *** (0.092)	–0.013 (0.025)	–0.013 (0.027)
r_i^{\max}			0.014 (0.104)				–0.059 (0.077)	
AW_{it} * r_i^{\max}			–0.069 (0.202)			–0.053 (0.207)	–1.148 *** (0.286)	–1.205 *** (0.337)
Provincial dummies	No	No	No	Yes	Yes	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	86	86	86	86	86	86	126	126
R-squared	0.34	0.38	0.38	0.43	0.47	0.47	0.52	0.52

Notes. Constant term is included in the regressions but not reported. Robust standard errors in parentheses.

* Indicates $p < .1$.

** Indicates $p < .05$.

*** Indicates $p < .01$.

As with the province level analysis, the effect of adverse weather turns positive where the maximum excess death rate exceeds 21.4 thousandths (column 8: 0.300/0.014). Likewise, the probability that a village will adopt household farming is approximately 1.8% higher in provinces where the area affected/struck by natural disasters is twice the average (i.e., AW_{it} equals 1), and where the effective irrigation acreage is 1% above the sample mean. The village level results are highly consistent with those of the province level and lend great confidence to our analyses based on the latter.

6. Placebo test: comparing collectivization with decollectivization

Our main thesis that history plays a crucial role in affecting collective beliefs and institutional choice can be further tested by analyzing the process of collectivization. Up to this point of the analysis we have demonstrated with rich empirical evidence that the Great Leap Famine had altered the (prior) belief that collective institutions—with their edge in public goods provision—are better able to cope with weather adversity than is individualized household farming. To verify this point we can test the converse situation

whereby households having experienced severe famine around the 1930s when individualized farming was the order of the day may be more incentivized to establish the collective organization, assuming that they held the belief that individualized farming was unable to cope as well as collective farming (or, equivalently, that collective farming can better shield them against negative weather shocks through greater public goods provision). By focusing on the period 1950–54—a time when the collective institutions the Chinese government advocated of establishing were confined to the less coercive MATs, we can test this prediction using the droughts that occurred in north China during 1929–31 and the floods in south China in 1931 as the pertinent famine measure, as together they wiped out 5.26% of the then population. Specifically, we employ the decline in population during 1928–31 (the population in 1928 minus that in 1931) as a proxy for famine severity to test the hypothesis that, in provinces afflicted by severe famine the individually farmed households tended to join the MATs when bad weather struck.

We do so by regressing the share of farm households joining the MATs in each year (\tilde{Y}_{it}) on weather adversity (AW_{it}). The results are reported in Table 10. First, and in contrast to the finding for decollectivization, weather

adversity has the significant effect of predisposing the individually farmed households toward adopting a collective framework for organizing agricultural production (columns (1) and (4)). For instance, if the area affected/struck by natural disasters is twice the average (i.e., AW_{it} equals 1), the share of villages establishing the mutual aid cooperatives increases by 6.949 percentage points. Also in contrast to the decollectivization finding, the effect of the interaction between past famine severity and negative weather shock is significantly positive (columns (2) and (5)), implying that in provinces afflicted by more severe famines, villages have a stronger urge to participate in collective farming. To see if we may obtain the same result using the severity of the Great Leap Famine and its interaction with weather adversity as a placebo test, we include this interaction term in the regression but find no significant effect of this particular famine on the villagers' proclivity for collective farming organization during the early-to-mid 1950s (columns (3) and (6)).

How may weather adversity and the history of famine during the 1920s and 1930s affect agricultural decollectivization? We can answer that question using the change in the share of collective farming during 1978–84 as the dependent variable. The results are reported in columns (7) and (8). Consistent with the previous findings, the results indicate that provinces struck by adverse weather during 1978–84 tend to carry on with collective agriculture.³⁶ But in provinces badly struck by the Great Leap Famine, the villagers' tendency was to discontinue with collective farming, as evidenced by the negative and significant sign of the interaction term between famine severity during 1959–61 and weather adversity (although the interaction term between famine severity during 1929–31 and weather adversity is insignificant). These results are consistent with the interpretation that, whereas bad weather tends to instill the belief that collective action in respect of agricultural public goods provision would help to offset weather shocks, such belief was shattered by the Great Leap Famine.

7. Conclusion

By providing more public goods, particularly irrigation, collective agriculture can offer better security against negative weather shocks. Yet, collective institutions are fraught with problems of work incentives, excessive grain

procurement, and the like, which in one extreme historical instance had led to a deadly famine (as was the case during China's Great Leap Forward). Marked by the varying pace at which provinces in China switched to the new institution of household farming, the decollectivization of agriculture in China provides us with an excellent social laboratory to empirically examine the tradeoffs between the two farming institutions from which farmers and officials alike were allowed to choose. Our pertinent research question is thus how actors—villages and provinces alike—made the critical decision on whether to switch over to the new farming institution when bad weather struck.

Our foremost finding is that negative weather shocks actually had a sustaining effect on the Chinese communes, a result that may be explained by the belief that collective agriculture could provide more public goods to cope with the negative weather shocks. Historically, this helps to make sense of the fact that a primary goal of collectivization in China was to facilitate the construction of irrigation for counteracting the negative weather shocks.

But it is our second and third findings that are more revealing of the interrelationships between exogenous weather shocks, a history that bears upon institutional choice, the tradeoffs between two different institutions, and the resulting institutional choice. By employing provincial variations in initial irrigation condition as a proxy for public goods provision and excess mortality rate as a proxy for the severity of the Great Leap Famine, we found that provinces having suffered more from the Great Leap Famine tended to decollectivize faster when struck by bad weather at the time of decollectivization, a result suggesting a *reverse* in the belief that collective agriculture can better deal with negative weather shocks. This interesting finding helps to explain why the first province to drop collective agriculture, Anhui, was also among the provinces to have suffered disproportionately from the Great Leap Famine. The same unwitting finding applies to provinces better served with irrigation: the more successful a province had developed its irrigation facilities under collective agriculture the more ready it was to abandon it. These findings remain robust to a wide array of checks and controls, including corroborating evidence at the micro-village level, all of which serve to reinforce our conviction that the variations in institutional change in Chinese agriculture that the provinces exhibited were importantly and jointly determined by nature (weather shocks), history, and institutions.

³⁶ The sign is positive here because the dependent variable measures the percentage of farm households remaining in the communes.

Appendix A. Data



Fig. A1. The Geographic Distribution of Sample Provinces.

Table A1
The Share (%) of Production Teams Having Implemented the Household Responsibility System, by Year.

	1979 ^a	1980 ^a	1981 ^a	1982 ^a	1983 ^b	1984 ^b
Hebei	0.00	7.50	45.90	96.00	98.99	100.00
Shanxi	0.00	9.50	58.40	92.59 ^c	98.36	98.36
Liaoning	0.00	0.00	34.41 ^c	64.52	92.08	93.48
Jilin	0.00	0.00	4.00	30.00	95.71	100.00
Heilongjiang	0.00	0.00	0.70	12.00	86.36	100.00
Jiangsu	0.00	21.15 ^c	48.90 ^c	74.45 ^c	98.26	98.84
Zhejiang	0.00	14.00	20.63	90.00	94.17	98.62
Anhui	10.00	43.00	69.30	95.50	99.72	99.71
Fujian	0.00	0.00	33.10	91.00	94.12	93.49
Jiangxi	0.00	10.96 ^c	90.41 ^c	94.10	98.72	99.51
Shandong	0.30	13.50	25.50	82.80	98.79	100.00
Henan	0.00	13.00	33.20	93.10	99.05	99.28
Hubei	0.00	0.00	47.03 ^c	75.00	100.00	100.00

(continued on next page)

Table A1 (continued)

	1979 ^a	1980 ^a	1981 ^a	1982 ^a	1983 ^b	1984 ^b
Hunan	0.00	10.00	11.20	98.10	98.08	100.00
Guangong	0.00	25.00	41.80	91.80	97.22	97.28
Guangxi	0.00	21.40	47.00	96.30	99.31	98.94
Sichuan	0.00	22.40	67.12	89.20	99.67	100.00
Guizhou	0.00	61.80	95.00	99.70	100.00	100.00
Yunnan	0.00	9.40	35.50	91.70	99.48	100.00
Shannxi	0.00	0.00	16.28 ^c	90.00	99.38	99.38
Gansu	0.00	32.00	72.20	99.00	100.00	100.00
Sub-total	0.49	14.98	42.74	83.18	97.50	98.90
Beijing	0.00				46.15	75.00
Tianjin	0.00				88.89	88.24
Shanghai	0.00				76.67	86.67
Neimenggu	0.00	0.00	40.10	90.00	98.48	100.00
Qinghai	0.00			92.00	100.00	100.00
Ningxia	0.00	24.00	51.60		100.00	100.00
Xinjiang	0.00		33.30	71.00	85.71	100.00
Xizang	0.00		39.20		80.00	100.00
Sub-total	0.00	12.00	41.05	84.33	84.49	93.74
Total	0.36	14.72	42.47	83.33	93.91	97.48

Data sources: (a) 1978–1982: Chung (2000); (b) 1983–1984: Huang et al. (1992); (c) China General Social Survey (2005).

Appendix B. Additional Results

Table A2

Temporal Variations in Decollectivization across Provinces, 1978 – 1984 (Unbalanced Panel).

	Dependent Variable: the share of production teams adopting household farming each year							
	One-way Fixed Effect			Two-way Fixed Effect			Excluding Outliers	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AW_{it}	-6.328*	-17.134***	-14.698***	-7.165	-20.976***	-13.736**	-11.813**	-8.201
	(3.463)	(5.089)	(4.629)	(4.392)	(6.370)	(5.658)	(5.584)	(6.408)
I_i^{\max}		0.035	0.037				-0.043	
		(0.077)	(0.075)				(0.140)	
$AW_{it}^* I_i^{\max}$		0.947***	1.240***		1.108***	1.266***	1.061**	0.929*
		(0.246)	(0.269)		(0.313)	(0.339)	(0.425)	(0.483)
\bar{I}_i^{78}			0.053				0.067	
			(0.157)				(0.157)	
$AW_{it}^* (\bar{I}_i^{78} - \bar{I}^{78})$			1.456***			1.623***	1.546***	1.870***
			(0.409)			(0.558)	(0.420)	(0.547)
Provincial dummies	No	No	No	Yes	Yes	Yes	No	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	145	145	139	145	145	139	121	121
R-squared	0.48	0.52	0.55	0.49	0.53	0.56	0.59	0.60

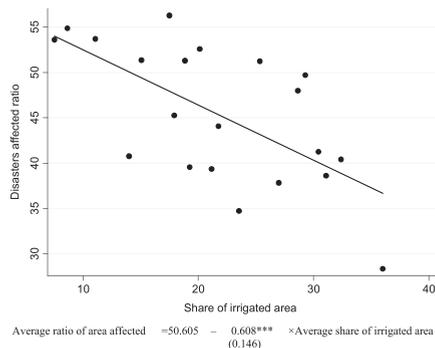
Notes. The dependent variable is the share of production teams adopting household farming each year during 1978–1984; Constant term is included in the regressions but not reported. Robust standard errors in parentheses.

* $p < .1$.

** $p < .05$.

*** $p < .01$.

Appendix C. The Relationship between Average Affected Ratio of Disasters and Average Share of Irrigated Area



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