There Will Be Killing: Collectivization and Death of Draft Animals

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Abstract

The deprivation of private property rights can wreak havoc on productive assets, as the owners can destroy them in order to keep some residual value. In China’s collectivization movement from 1955 to 1957, peasants slaughtered their draft animals instead of passing them to the collectives. By comparing 1,600 counties throughout China that launched the movement in different years, the difference-in-differences estimates suggest that the accumulative animal loss during the movement was 12 to 15 percent. Grain output dropped because of lower animal inputs and lower productivity.
"But a (ownership) conversion process that requires that the animals be killed in order to establish private rights must incur the larger social cost of depleting the stock of animals."

—Alchian and Demsetz (1973, p. 23)

1 Introduction

From 1955 to 1957, 96 percent of China’s 550 million peasants were organized into collectives and deprived of their private ownership of land and draft animals (National Bureau of Statistics, 1980). This was the largest movement from private to communal property rights in history. Collectivization set the stage for the Great Leap Forward movement in 1958, which in turn led to the Great Famine of 1959-61, the worst famine in history, which killed 17-45 million people (Meng, Qian, and Yared, 2015). Collective land ownership has shaped the lives of Chinese peasants over generations, and it lasts to today.

The collectivization movement is an ideal setting in which to examine how weakened private property rights affect agricultural productivity and peasants’ investment in productive assets. The sweeping movement was carried out relatively smoothly, and was not accompanied by major social unrest. In the collectives, called advanced cooperatives, all rent payments for land and draft animals were eliminated. Income was distributed only in the form of wages, according to the “work points” earned by each member. Members were required to turn over their land to the cooperative without compensation; and sell their draft animals to the cooperative, accepting a low payment in installments over three to five years. The principle of voluntary participation was largely ignored in practice, as officials rushed to finish the process. By the end of 1956, after only a year and a half, 88 percent of the rural population was organized into collectives. By 1957, the percentage had reached 96 percent (National Bureau of Statistics, 1957, 1980).

Peasants slaughtered their draft animals instead of passing them to the collective, observed in several provinces by historians (Shue, 1980; Hinton, 1983; and Friedman, Pickowicz, and Selden, 1991). Contemporary government reports and documents were full of anecdotal evidence of animal slaughter (Huang, 1992; Ye, 2006). This paper assesses the causal effect of collectivization on the draft animal inventory. We use a novel data set of yearly inventories of draft animals in 1,600 counties from 1952 to 1957, hand collected from a wide

1 The Great Leap Forward movement and the Great Famine have been studied intensively. See Lin (1990), Li and Yang (2005), Kung and Chen (2011), Meng, Qian, and Yared (2015), and references there.
2 For an introduction to collectives and China’s urban-rural divide, see Naughton (2007).
3 Contemporary government reports and documents frequently mentioned that unwilling peasants were forced to join the cooperatives (Huang, 1992; Ye, 2006).
variety of recently declassified government files. The sample covers 71 percent of all Chinese counties and 77 percent of the rural population. Since some counties started collectivizing in 1955 and others did so in 1956, we explore this variation in the timing to identify the effect of the movement. The difference-in-differences estimates show that collectivization lowered the growth rate of the animal inventory by 6 percentage points. In the first two years of the movement, the accumulative animal loss reached 12-15 percent, or 7.4-9.5 million head nationwide.

The dead animals were not replaced by tractors or other farming machines. Their loss cannot be explained by either the economy of scale or a shift in crop types related to collectivization. The timing of their immediate loss in the process of collectivization makes it unlikely that the deaths were due to the animals’ overuse or mistreatment in the collectives. Our hypothesis is that the deprivation of private property rights suppressed investments in draft animals. Faced with the prospect of losing their land and sharing any future revenue generated by the animals with other members of the collectives, peasants slaughtered them.

This hypothesis has two testable implications. First, animal owners would lose more if they had to join a large collective and thus share the revenue between more members. Indeed, we find that the animal inventory declined more sharply in counties with larger cooperatives. Second, collectivization would incur a larger loss of animals in counties in which property rights had been well protected prior to collectivization. We use the ratio of so-called “middle peasant” households in the rural population to measure the level of protection of private property. China finished a land reform program 3-4 years prior to collectivization, in which the properties of landlords and rich peasants were confiscated and given to poor peasants. Only the properties of the officially recognized middle peasants survived. This class of peasants had a long tradition of planting their own land and raising their own animals. Because they owned more land and draft animals than the others, they were unwilling - but forced to - join an advanced cooperative and share the output based only on labor input (Du, 2002; Ye, 2006). Again, the implication is supported by the data: we find that the animal inventory declined more in counties with more middle peasants.

When evaluating the effects of property rights on agricultural production, it is important to consider the effect on both inputs and productivity. Collectivization reduced the annual

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4As articulated in Coase (1960), Demsetz (1967), and Alchian and Demsetz (1973), the main allocative function of property rights is the internalization of externalities. When the products are shared, joint ownership of the productive asset may or may not dominate private ownership, depending on whether the output produced using the asset is a public or private good (Besley and Ghatak, 2010).

5Banerjee, Getler, and Ghatak (2002) discuss both effects in theory, but they are unable to separate them in their empirical analysis. Controlling for inputs, Lin (1990, 1992) documents the changes in China’s agricultural productivity related to the Great Leap Forward movement in 1958 and the Household-responsibility system in the 1980s.
grain output by 6.7 percent: 1.3 percent attributable to lower animal inputs and 5.4 percent to lower total factor productivity. Productivity was equally low in counties with larger cooperatives. These results do not support the hypothesis that the collectives managed to reduce the demand for draft animals by pooling resources and taking advantage of the economy of scale.

This paper joins the growing literature that discusses how the development of individualistic property rights affects investment. While most papers test how improving the protection of private property rights affects investment, the Chinese collectivization movement allows us to examine how the deprivation of private property rights destroys existing productive assets. But the phenomenon discussed in this paper is not a special case of China. Historians have documented similar mass animal slaughters during the Soviet collectivization movement of 1929-33, which was also followed by a severe famine (Jasny, 1949; Fitzpatrick, 1996). Unlike these records of national patterns, our county-level data allow us to identify the causal effects of collectivization on the animal inventory, explore heterogeneity across counties, and translate the animal loss into grain loss.

The rest of the paper is organized as follows. Section 2 introduces the institutional background. Section 3 describes the data. Section 4 estimates the effects of collectivization on the inventory of draft animals. Section 5 discusses how these effects are related to property rights. Section 6 estimates the effects on grain output. Section 7 concludes.

### 2 Background

Since the founding of the People’s Republic of China in 1949, the three-year land reform had redistributed land and draft animals from landlords to tenants and landless laborers. In 1952, the government adopted a Stalinist heavy-industry-oriented development strategy. To fund this rapid industrialization, the government must raise agricultural productivity and extract more resources from the agricultural sector (Lin, 1990; Li and Yang, 2005). Lack of new technology, the government resorted to changing the organizations of agricultural production and enhancing cooperation among peasants.

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From 1952 to 1955

In 1952, the government started to press for establishing Mutual Aid Teams (MAT) throughout China.\(^7\) An average MAT consisted of seven households (National Bureau of Statistics, 1957), which usually comprised relatives, friends, or neighbors. Within a MAT, draft animals were either jointly bought and owned, or rented from their owners to the other members in exchange of grain, fodder, or labor. The typical rent was that one day’s ox labor was equivalent to two days’ man labor (Shue, 1980). As shown in Figure 1, at the peak of the MAT movement in 1954, 58 percent of rural households were organized into about 10 million MATs.

The national movement from MATs towards elementary production cooperatives began in late 1953. In 1955, 59 percent of rural households joined 1.9 million elementary cooperatives. A typical elementary cooperative was larger than a MAT, and included 20 or more households (National Bureau of Statistics, 1957). In contrast to the occasional reciprocal aids in a MAT, members of an elementary cooperative put their land and other means of production at the disposal of the cooperative, and organized production under unified and planned management. Members’ income was based on rent payments for their land and wage payments for their labor. Members could sell their animals to the cooperative at the going price, or own and rear the animals themselves and rent them to the cooperative. Both ways were common. According to a survey of 26,733 elementary cooperatives throughout China (National Bureau of Statistics, 1956), 54 percent of draft animals were publicly owned whereas 46 percent were privately owned. The annual rent payment for a draft animal was about 40 RMB (in 2014 dollars, about $43). The annual rent for land was 4.9 RMB per mu (0.07 hectare), and the annual wage of a full labor (or an able-bodied man) was 86 RMB. As William Hinton (1983) observed in some elementary cooperatives, “A peasant who owned two good draft animals could get by without working at all.”

Participation was voluntary in both MATs and elementary cooperatives. This changed in the sweeping collectivization movement that started in the latter half of 1955.

Unexpected Collectivization and the Death of Draft Animals

The timing of the collectivization movement was unexpected. Before 1955, the leaders of the Communist Party of China (CPC), including Mao Zedong, followed the strategy of the Soviet Union. They believed that tractors and other modern agricultural equipment were

\(^7\)In December 1951, the Central Committee of the Communist Party of China issued the “First Draft Decision on Mutual Aid and Cooperation in Agriculture,” which launched the nationwide MAT movement. For a detailed discussion, see Ye (2006).
prerequisites for large collective farms, without which the economy of scale would not be realized. Thus collectivization should be a gradual process, accompanied by industrialization. In the spring of 1955, the central government called for a halt to the rapid development of elementary cooperatives, and the number of cooperatives stopped growing in the second quarter.\(^8\) That summer, however, Mao changed his mind and started to believe that rapid agricultural collectivization could boost agricultural productivity and supply more resources for industrialization. He condemned the conservative policy and pressed provincial leaders to accelerate the pace of collectivization. In a well-known speech, *On the Cooperative Transformation of Agriculture*, he said: “An upsurge in the new, socialist mass movement is imminent throughout the countryside. But some of our comrades, tottering along like a woman with bound feet, are complaining all the time, 'You’re going too fast, much too fast.'”\(^9\) Mao’s intervention settled the policy debate on the pace of collectivization. From August to October, all the other top party leaders criticized their own conservative attitudes and endorsed fast collectivization (Lin, 2009).\(^10\)

Subsequently, local cadres rushed to create more elementary cooperatives and started to establish new collectives of a fully socialist nature, called advanced cooperatives. According to the National Bureau of Statistics (1957), in the middle of 1955 there were only about 500 advanced cooperatives nationwide.\(^11\) Yet by the end of the year, this number surged to 17,000, covering 4 percent of all rural households. By 1956, 88 percent of all rural households had joined 312,000 advanced cooperatives; and by 1957, it was 96 percent. Within only two years, advanced cooperatives completely replaced elementary cooperatives, MATs, and independent households, and became the main organization of agricultural production. Collectivization developed much faster even than Mao’s expectation, who thought that most regions should start experimental advanced cooperatives in 1956 and 1957, and finish in 1960 (Huang, 1992). In such a fast and sweeping movement, the principle of voluntary participation in cooperatives was largely ignored in practice, and bureaucratic commandism and even violence against distressed peasants were not uncommon.\(^12\)

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\(^8\)The number of cooperatives increased from 96,000 in March 1954 to 633,000 in March 1955, with a quarterly growth rate of 140 percent. In June 1955, the number was 634,000, barely changed from March (National Bureau of Statistics, 1957).


\(^11\)Before 1955, there were a few voluntary experiments of advanced cooperatives. In 1953, there were only 15 advanced cooperatives nationwide; and in 1954, the number was about 200 (National Bureau of Statistics, 1957). We ignore these special cases in the following analysis.

\(^12\)For the reports on the bureaucratic commandism in contemporary government documents, see Huang (1992) and Ye (2006).
All the rent payments for land, draft animals, and tools were eliminated in advanced cooperatives. Income was distributed only in the form of wages, according to the “work points” earned by each member. Peasants were required to turn over their land to the cooperative without compensation, and sell their draft animals to the cooperative, accepting a payment in installments over 3 to 5 years. The prices set for the animals were usually very low. A high price would have been a burden for the majority of members, who were too poor to own a draft animal and had to pay off the installments with their labor. By accepting a low price, the animal owners were forced not only to subsidize other members, but also to take the risk that the installment payments might never come through. Unwilling to turn over their valuable animals in exchange for the mere one-third or even one-fifth cash payment from an already-too-low price, many peasants slaughtered their animals.

Anecdotal evidence of the animal slaughter was frequently mentioned in contemporary government reports and documents, and by historians. For example, in a chapter titled “Against Cooperation”, Friedman, Pickowicz, and Selden (1991, pp.191) report the “mysterious death of an ox” in a village in Hebei Province:

Village leaders explained that people would be compensated for draft animals, orchards, wells, and other items taken over by the collective. But villagers could see there was no money for such payments. Lu Zhenxing insisted on keeping his ox rather than see it pass to the collective... The matter of the Lu Zhenxing ox was settled within a few days when the beast mysteriously died. Throughout Hebei the numbers of draft animals dropped from 4.2 million in 1955 to 3.3 million one year later. Villagers ate their animals rather than have them appropriated.

According to statistics from the Ministry of Agriculture (1990), Figure 2A shows an abrupt decline in the national inventory of draft animals in 1955. The decline continued in 1956 and 1957, when more advanced cooperatives were established. By the end of 1957, the animal inventory had dropped by 3.6 million head from the 1954 level. The disappeared animals were indeed slaughtered. Figure 2B shows a spike in the trade volume of cowhides from 1955 to 1957. The accumulated abnormal increase in cowhides was higher than the accumulated loss of draft animals, as many calves, female animals, and even milk cows were slaughtered too.

The slaughter of animals also reflects the fact that selling draft animals was difficult during collectivization. With the establishment of the centrally planned economy, the traditional

13 For examples of government reports, see Huang (1992) and Ye (2006). For observations from historians, in both the north and the south China, see Shue (1980), Hinton (1983), and Friedman, Pickowicz, and Selden (1991).
markets for draft animals were replaced by official exchanges and supply and marketing cooperatives prior to collectivization (State Council, 1955). These poorly managed institutes failed to organize animal trade, and the trade volume plunged. For example, in Anhui Province, the total trade volume of large livestock in 1956 was only 20,000 head, less than 1 percent of the provincial inventory of 2.83 million head (Anhui Local Chronicles Compilation Committee, 1997). In 1957, the State Council admitted that trade in draft animals had halted completely in most places, and marketing cooperatives failed to allocate draft animals to areas where the inventory declined (State Council, 1957).

While the trade in animals as production inputs shrank, the trade in animal as a source of meat did not. The government noted that peasants could sell their draft animals to butchers in response to collectivization. Banning such a practice, however, was unlikely to succeed, because there was no clear distinction between draft animals and meat animals. It was also common practice for peasants to sell retired or weak draft animals to butchers (State Council, 1955). In order to reduce the loss of draft cattle, the government lowered the purchase prices of both beef cattle and cowhide in 1955 and 1956, shown in Figure 2C. The prices were not raised until 1957, when collectivization was largely completed (State Council, 1957). Moreover, peasants were banned from slaughtering their draft animals in private. Compared to the sale to butchers, however, private slaughter was even harder to monitor. Animals could die of disease or go astray, and peasants could rightly slaughter an old, weak, sick, or injured animal, but these conditions were private information and easy to manipulate. Even for alleged or verified intentional slaughter, the government guideline for punishment was vague: the peasant should be “seriously criticized and educated” (State Council, 1955). Thus the potential risks of killing an animal in private depended on the local context, which is discussed in more detail in Section 5.

Despite these policies, mass slaughter occurred. The observed loss in the national inventory of draft animals (Figure 2A), however, could well underestimate the true loss caused by collectivization. Had the inventory kept growing at a normal rate without the disruption, it would have been much higher in 1957 than the observed 53.7 million head. The rest of the paper estimates the causal effect of collectivization on the loss of draft animals. We start by introducing our data.

3 Data

We assemble a novel data set of yearly inventories of draft animals, agricultural production, land use, and population in 1,720 counties from 1952 to 1957. The sample covers 77 percent
of Chinese counties and 80 percent of the rural population of 550 million.\textsuperscript{14} The sample counties are spread over every province except Shanghai and Tibet.\textsuperscript{15} The statistics are from a wide variety of official sources, including many declassified government files and recently released compilations of statistics. For a centrally planned economy in the 1950s, these county-level statistics were indispensable to the planning committees and governments. For the counties for which the official compilations of statistics are missing, we use information from individual county gazetteers. China has a thousand-year-long tradition of recording local history in gazetteers. The most recently composed county gazetteers were published in the late 1980s and 1990s. Every county gazetteer documents important agricultural policies and some official statistics related to agricultural production.\textsuperscript{16} Appendix I reports the data sources and documentation in detail.

Our identification strategy relies on the variation in the timing of introducing advanced cooperatives across counties. Figure 3 divides the counties into three groups based on the year in which an advanced cooperative was introduced: 1955, 1956, and later or never. The establishment of advanced cooperatives is well documented in all county gazetteers. By the end of 1956, while 1,600 counties had almost finished collectivization, 120 counties had not yet begun. We drop these 120 counties from the sample, since they were special cases. 62 of these counties were on the north or northwest pastureland in Inner Mongolia, Xinjiang, Qinghai, Sichuan, and Yunnan provinces. Most of the inhabitants of these counties in the 1950s were nomads. Without a fixed residence and grazing area, it was difficult to collectivize their livestock and establish an advanced cooperative; grazing livestock also played a different role than draft animals in farming. The other 58 counties dropped from the sample were mainly in the southwest mountains and the forests of Sichuan and Yunnan provinces. These counties did not finish the land reform until late 1956 or 1957.

Our final sample includes 1,600 counties that introduced advanced cooperatives either in 1955 (569 counties) or 1956 (1,031 counties). Counties that started the collectivization process in late 1955 or early 1956 are divided into two years, though the real gap in the timing was only a few months. This division matches the time structure of our data, in which all the main variables, including the inventory of draft animals and grain output, are from the year-end statistics. Table 1 shows that an average Chinese county is quite large,

\textsuperscript{14}In 1957, China had 2,247 counties and a rural population of 54.7 million (National Bureau of Statistics, 2010). According to the 1982 census, about 80 percent of rural residents lived in the counties included in our data.

\textsuperscript{15}As far as we know, annual county-level data of agricultural production in Tibet in the 1950s do not exist. As for the nine counties under the jurisdiction of Shanghai, we found no records of their yearly inventory of draft animals from 1952 to 1957.

\textsuperscript{16}Few gazetteers report the inventory of draft animals in the 1950s. For 252 counties, we find such statistics in gazetteers.
comprising 255,096 people and 56,250 hectares of arable land. The smallest county only has about 2,000 people, but some of the largest counties have over one million.

The key dependent variable is the year-end inventory of draft animals. In the north of China, these animals are mainly cattle, horses, donkeys, and mules. In the south, they are mainly cattle and water buffaloes. The data are complete for every year from 1952 to 1957 in all 1,600 counties, thus the number of observations is 9,600. Table 1 shows that, on average, each county has 35,816 draft animals. The total number of draft animals is somewhat larger than the national inventory shown in Figure 2A, because most counties only report the total number of large livestock, including females and calves. We use this broad category of draft animals to be consistent across counties. Since the number of animals first increases and then declines during our sample period, the average growth rate of the animal inventory is about zero.

The summary statistics are consistent with the statistics from the aggregate data used by other researchers. In our sample, the average number of draft animals per peasant is 0.152, the area of arable land per peasant is 0.217 hectare, and the grain output per peasant is 0.322 tons. Based on the national statistics reported in Table 1 of Li and Yang (2005), the three numbers are 0.159, 0.213, and 0.347, respectively.

Our analysis controls for the effects of floods and droughts on animal inventory and grain output. The historical local weather data are compiled by the State Meteorological Society (1981), recorded in 267 weather stations as well as in county gazetteers. We assign these station records to their closest counties, based on the algorithm of Thiessen polygons. The weather data use a discrete variable for rainfall: 1 for exceptional floods, 2 for limited floods, 3 for normal weather, 4 for limited droughts, and 5 for exceptional droughts. We define two separate binary indicators for exceptional floods and exceptional droughts. Table 1 shows that floods are more frequent than droughts in our sample, owing to the 1954 Yangtze River flood.

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17 We aggregate our data for all the counties, calculate the three statistics for each year, and report the mean of the six years here.

18 They report national grain output and draft animals for each year from 1952 to 1957, and we divide these numbers by the national rural population, obtained from the same source as theirs (Ministry of Agriculture, 1989). They only report the area sown with grain, which is larger than the area of arable land because grain could be sown multiple times every year. The area sown with grain per peasant is 0.252 hectares, larger than the area of arable land per peasant. To compare with our data, we obtain data on the national area of arable land from the same source (Ministry of Agriculture, 1989).

19 This method creates a polygon around each weather station. These non-overlapping polygons cover all the counties. The counties closest to a station are the counties within the polygon of the station.

20 The variable is defined according to the descriptions in local gazetteers or the amount of precipitation, when available. Typical descriptions of events categorized as “exceptional floods” are “countless people and animals drowned in floods,” or “typhoons and heavy rains flood fields and houses,” etc. When the annual amount of precipitation is available, “exceptional floods” are the years in which the amount is higher than 1.17 standard deviation above the mean.
floods, some of the worst in 20th century China. The estimated effects of collectivization may vary with some county characteristics, listed in Panel B of Table 1. We explain these variables in Section 5.

4 The Declined Inventory of Draft Animals

Visual Evidence

The counties that introduced advanced cooperatives in 1955 saw an immediate loss of draft animals that year, as shown in Figure 4. The loss continued when more cooperatives were established in 1956 and 1957. By 1957, these counties had lost 11 percent of their 1954 inventory levels. For the other counties that started to establish advanced cooperatives in 1956, the animal inventory continued growing until 1956.

To highlight the year-on-year change in the animal inventory, Panel A of Figure 5 plots the growth rate of the inventory, i.e., the annual incremental change in the log of the inventory. For the counties that introduced advanced cooperatives in 1955, the growth rate dropped from about 4 percent to -3 percent. The rate stayed negative in the following years. For the other counties, the drop did not occur until in 1956 and 1957. As a comparison, panels B and C plot the growth rates of rural population and arable land, two other key inputs in agricultural production. The year-on-year changes in the two variables were much more modest, and the changes did not diverge in 1955 and 1956.

Had the animal growth rates in the two groups of counties followed the same trend in 1955, as they roughly did in 1953 and 1954, the growth rate in the counties that initiated collectivization in 1955 would have been 3 percent instead of -3 percent. Thus a visual comparison suggests that collectivization reduces the annual growth rate of draft animals by 6 percentage points. Now we turn to the regression analysis to estimate the causal effect.

The Difference-in-Differences Estimation

We use the following general difference-in-differences specification to estimate the effects of collectivization on the annual change in the inventory of draft animals. The first difference, $\Delta \log(\text{animal\_inventory})$, eliminates the inherent trend in the animal inventory.
\[ \Delta \log(\text{animal_inventory})_{it} = \beta \times \text{collectivization}_{it} + \text{year}_t + \text{county}_i \]
\[ + \ \Delta \log(\text{rural_population})_{it} + \Delta \log(\text{arable_land})_{it} \]
\[ + \ \text{drought}_{it} + \text{flood}_{it} + \varepsilon_{it} \quad (1) \]

For county \( i \) in year \( t \), \( \text{collectivization}_{it} \) is a dummy variable equal to 1 for the year that a county started to establish advanced cooperatives and for the years after. In most counties, collectivization was conducted village by village and was not finished until 1957, the last year in our sample. Thus \( \beta \), the coefficient of interest, captures the average difference in the animal growth rate during the collectivization process. Since counties start the process in different years, \( \beta \) is identified from the differences fixed over years and across counties, which are captured by a set of year dummies \( \text{year}_t \) and county dummies \( \text{county}_i \). \( \Delta \log(\text{animal_inventory})_{it} \) filters out the factors that affect the level of the animal inventory and do not vary over time, such as geography. But the change in the inventory may also vary across counties. For example, counties in northern China use more donkeys and mules, and those in the south use more water buffaloes. Different animals may also have different fertility rates. By adding the county dummies, \( \text{county}_i \), we further control for county-specific linear trends in the animal inventory. We also include the change rate of the rural population and of arable land, which may affect the demand for draft animals. Two separate indicators for exceptional floods and droughts allow for different effects of these calamities. We report robust standard errors clustered at the county level. Appendix Table 1 shows that other types of cluster errors do not change the inference of \( \hat{\beta} \).

Table 2 reports the results. In columns 1 and 2, instead of using county fixed effects, we divide all the counties into two groups according to when they began collectivizing: 1955 or 1956. A group indicator captures the average difference in \( \Delta \log(\text{animal_inventory})_{it} \) between the two groups. The magnitude of the difference is close to zero. The difference-in-differences estimates of \( \hat{\beta} \) suggest that the animal growth rate dropped by 6 percentage points during the collectivization process, close to the drop visualized in Panel A of Figure 5. In columns 3 and 4, we replace the group indicator with county fixed effects, and \( \hat{\beta} \)s change little. The estimates of \( \hat{\beta} \) are accurate, and all standard errors are close to zero. The estimates of \( \hat{\beta} \) are also stable with or without adding other control variables, because the collectivization status is not related to these variables. This is consistent with the patterns shown in Panels B and C in Figure 5. A placebo test, reported in Appendix Table 2, confirms that collectivization does not affect either \( \Delta \log(\text{rural_population})_{it} \) or \( \Delta \log(\text{arable_land})_{it} \).

\[ ^{21} \text{The calculation of two-way cluster error is based on Cameron, Gelbach, and Miller (2011).} \]
Table 2 shows that both the population and land growth rates are positively correlated to the animal growth rate. Exceptional floods and droughts reduce the animal growth rate by about 2 percentage points. The difference between the two calamities is not statistically significant. In terms of killing draft animals, collectivization is three times more effective than these calamities.

The Dynamic Effects and Internal Validity Checks

The coefficient $\beta$ in equation (1) summarizes the mean shift in $\Delta \log(\text{animal\_inventory})_{it}$ before and after the start of collectivization. As shown in Figures 4 and 5, the animal inventory keeps declining after the start, as advanced cooperatives spread to more villages and counties. To capture this dynamic, we estimate the year-on-year effects of collectivization. The coefficients of the years after collectivization could help calculate the accumulative effects of the movement, while the coefficients of the years before collectivization could help detect pre-trends. A downward pre-trend would suggest that the mean effect of collectivization might be overestimated, and an upward pre-trend would suggest that the mean effect might simply be mean reversion. Panel A of Figure 5 suggests there was no pre-trend prior to collectivization. Next we test this.

We replace $\text{collectivization}_{it}$ in equation (1) with a set of dummy variables $I(CY_{it} = k)$ that indicates the $k_{th}$ year of collectivization. $CY_{it} = 0$ indicates the year 1955 for counties that began collectivizing in 1955, and 1956 for those that started in 1956. $CY_{it} = 1$ is the second year in the movement, and $CY_{it} = -1$ is the year before the movement. Since our data of $\Delta \log(\text{animal\_inventory})_{it}$ are from 1953-57, we can estimate the coefficients of $I(CY_{it} = k)$ for $k = -1, 0, 1$, using $k = -2$ as the base group.

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\Delta \log(\text{animal\_inventory})_{it} = \sum_k \beta_k \times I(CY_{it} = k) + \text{year}_t + \text{county}_i
+ \Delta \log(\text{rural\_population})_{it} + \Delta \log(\text{arable\_land})_{it}
+ \text{drought}_{it} + \text{flood}_{it} + e_{it} \quad (2)
$$

Figure 6 shows the estimated $\hat{\beta}_k$ for $k = -1, 0, 1$, and the 95 percent confidence intervals. Appendix Table 3 reports the estimated coefficients. Compared with $k = -2$, $\hat{\beta}_{-1}$ is close to zero. In the two years prior to collectivization, there is no pre-trend in the dependent variable, and the two groups of counties follow a common trend. In the first two years after collectivization, however, $\hat{\beta}_0$ and $\hat{\beta}_1$ show that $\Delta \log(\text{animal\_inventory})_{it}$ drops by 0.07 and 0.08, respectively. In other words, the two-year accumulative loss in animal inventory caused
by collectivization is approximately 15 percent. The lower bound of our estimates is about 12 percent.

The accumulative loss is clear in Figure 4. For counties that started collectivization in 1955, without collectivization, the log of the animal inventory would have increased to about 10.57 in 1956, instead of the actual 10.43. Compared with this counterfactual (10.57), the accumulative two-year change caused by collectivization is -0.14 log points, or 14 percent of the animal inventory. If we take 54 million head as the national inventory of draft animals after two years of collectivization, as shown in Figure 2A, our estimates suggest that the two-year accumulative animal loss was about 7.4-9.5 million head.

For some counties, we have data back to 1949, when the People’s Republic of China was founded. With this sample of unbalanced panel data, Appendix Figure 2 extends Figure 6 to the five years \((k = -5)\) before collectivization. It again shows no pre-trend in \(\Delta \log(\text{animal\_inventory})_{it}\), as well as a common trend in the two groups of counties prior to collectivization. Appendix Table 3 reports the estimates of \(\beta_k\)s. \(\hat{\beta}_0\) and \(\hat{\beta}_1\) barely change.

### 5 Interpretations

The backward economy of China in the 1950s precludes the possibility that agricultural machinery replaced draft animals. In 1957, the last year in our sample, the entire country had only 14,674 tractors, 1,789 combine harvesters, and 4,084 trucks for agricultural use, which were shared among 550 million peasants. Only 2.4 percent of the tilled areas were tilled by machines (National Bureau of Statistics, 1980). By comparison, the Soviet Union had 924,000 tractors, 483,000 combine harvesters, and 660,000 trucks for agricultural use in 1957, for only 110 million peasants, and 98 percent of their collective farms were tilled by machines (Li, 1981). Using statistics from the National Bureau of Statistics (1980), we split our sample into two groups. In one group of 24 provinces, the percentages of areas tilled by machines were all lower than 4 percent. In another group of five provinces, the percentages ranged from 10 to 21 percent. We re-estimated equation (1) in each group of provinces. Appendix Table 4 shows that the effects of collectivization on the animal inventory are almost identical between the two groups. The use of farming machinery could not explain our results.

Cooperatives could reduce the demand for draft animals for other two reasons. The economy of scale might reduce the use of draft animals. Or cooperatives may plant more grain instead of cash crops such as cotton, or vice versa, which might also change the demand for draft animal power. These two hypotheses will be falsified in Section 6 when we discuss grain output. In fact, the government repeatedly emphasized that the development of agriculture,
particularly after collectivization, required more and stronger draft animals (State Council, 1955 and 1957).

Our interpretation of the decline in draft animals is that weakened private property rights suppressed investment in maintaining the animals. Since peasants could not claim most of the future revenue generated by the animals, they tended to slaughter the animals to either sell or consume the meat and other animal products (such as hides). This interpretation has two testable implications. First, collectivization should incur greater losses of animal in counties in which private property rights had been better established prior to collectivization. Second, animal owners would lose more if they have to join a large collective and share the revenue generated by the animals with more members. Thus in counties in which the average cooperative is larger, more draft animals should be slaughtered.

Property Rights Prior to Collectivization

Prior to collectivization in 1955 and 1956, private property rights were better established in some counties than in others. In 1951 and 1952, China just finished a land reform. In this program of “land to the tiller”, the property of millions of landlords and rich peasants, including land, draft animals, houses, farm implements, and other valuables, was confiscated and given to poor peasants and landless laborers. According to the National Bureau of Statistics (1980), landlords and rich peasants owned 53 percent of all land before the reform. This number dropped to 8.6 percent after the reform, shown in Panel A of Figure 7. Prior to collectivization, the rights to most of the properties of landlords and rich peasants had been compromised, while the windfall gains for poor peasants and landless laborers were perhaps too new to be justified as their own properties.

The properties of so-called “middle peasants” survived the reform, as they were too poor to be labeled as rich peasants. This class of peasants, about one-third of the rural population, had a long tradition of planting their own lands and raising their own animals. The CPC believed that a firm alliance with the middle peasants was the key to success in the revolution and the reform. The land reform policies towards the middle peasants were unequivocal: under no circumstances were their lands or their interests to be harmed (Hinton, 1966). Thus the ratio of middle peasant households in a county, shown in Panel B of Figure 7, is indicative of how established private property rights had been prior to

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22 The classical references to the land reform are Hinton (1966) and Shue (1980).
23 Historians have documented that some poor peasants returned their newly assigned valuables to the original owners (Hinton, 1966; Shue, 1980).
24 The official CPC definition of middle peasants was “Those who have land, plow animals, and farm implements, who labor themselves and do not exploit others, or do so only slightly—these are the middle peasants.” (Hinton, 1966, pp. 27).
collectivization. \(^{25}\)

Middle peasants were unwilling to join advanced cooperatives because they owned more land and animals than the other classes, but they were forced to do so (Du, 2002; Ye, 2006). By pooling all capital together in an advanced cooperative and sharing the output based only on labor input, middle peasants would be worse off. Figure 7 shows that middle peasants accounted for 37 percent of all rural households prior to collectivization, but they owned 44 percent of the land and 52 percent of the draft animals.

In 895 county gazetteers, we find records of the class distribution during the land reform. The ratio of middle peasant households varies from 0.07 to 0.89 across counties, with a mean of 0.32, as shown in Panel B of Table 1. Using the median of the ratio, we divide the counties into two groups. For each group, Panel A of Figure 8 plots the mean change in \(\Delta \log(\text{animal}_{\text{inventory}})\), after collectivization. Regardless of the ratio of middle peasants, most counties see a decline of \(\Delta \log(\text{animal}_{\text{inventory}})\) after collectivization. For counties with more middle peasant households, however, the decline is even more salient.

This heterogeneous effect could be incorporated in equation (1), by adding an interaction term between the collectivization indicator and the ratio of middle peasant households. We demean the ratio and report the results in column 1 of Table 3. In counties that have the mean ratio of middle peasant households, 0.32, collectivization reduces the animal growth rate by 4 percentage points. If the ratio increases by 0.1, the animal growth rate further declines by 0.9 percentage points.

**The Size of an Advanced Cooperative**

Animal loss should be more severe in counties with larger cooperatives, as animal owners had to share the future revenue generated by their animals with more members. In 1,276 county gazetteers, we find the number of advanced cooperatives at the time when collectivization was finished, in either 1956 or 1957. We divide the rural population by the number of cooperatives to calculate the average size of a cooperative. Table 1 shows that an average cooperative includes 1,154 people or about 250 households. These numbers are close to a survey of 289,268 advanced cooperatives across 24 provinces, conducted in 1956 by the National Bureau of Statistics (1957b), which found that an average advanced cooperative included 246 households and 1,082 people.

Panel B of Figure 8 divides the counties into two groups according to the median of the

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\(^{25}\)There are some slight changes in this ratio before and after the land reform. There were typically two or three waves of reform in the same county, with each wave addressing any issues of mis-classification in the previous wave. As a result, the ratio of classes was adjusted a bit in each wave. In the following analysis, we use the last reported ratio in county gazetteers.
size and plots the mean change in $\Delta \log(\text{animal\_inventory})$ after collectivization. Among the counties with larger cooperatives, $\Delta \log(\text{animal\_inventory})$ declines more. In equation (1), we add an interaction term between the collectivization indicator and the size of the cooperative. Column 2 of Table 3 shows that collectivization reduces the animal growth rate by 5.4 percentage points when the size of the cooperative is at its mean value. Doubling the size (or an increase of about 0.7 log points) would further decrease the growth rate by 1.8 percentage points.

Column 3 of Table 3 shows that both the ratio of middle peasants and the size of advanced cooperatives significantly enhance the effects of collectivization. Unlike the ratio of middle peasant households, which was pre-determined prior to collectivization, the size of the advanced cooperatives could be affected by the local animal growth rate. In fact, to mitigate the impact of collectivization and the challenges of managing large cooperatives, many local governments downsized their cooperatives in 1957 (Ye, 2006). If the cooperatives shrunk in order to reduce animal loss, then the effects of cooperative size on animal loss would be underestimated.

**Political Influence and Ethnic Minorities**

Both private slaughter and sales to butchers were regulated, but they were difficult to monitor and prevent, as discussed in Section 2. Without a clear national guideline, dealing with suspected violations was left to the discretion of local officials. Yet the officials were busy establishing more advanced cooperatives to meet the target number before the deadline. It is unclear how much effort they made to identify and punish intentional animal slaughter. It is also unclear how peasants would perceive the risk of retribution. Here we try to evaluate some local characteristics that would affect the hide and seek game.

For each county, we first calculate the distance to the provincial capital because political zeal might fade far from the political center, and local officials might be more likely to turn a blind eye to the animal slaughter. Column 4 of Table 3 shows that in counties further from the provincial capital, collectivization incurred a greater loss of draft animals.

In counties with a revolutionary legacy, local officials might also be more tolerant, because local people had been longtime supporters of the CPC and had sacrificed a lot in the revolution. Therefore we create an indicator for counties that are officially recognized as a “revolutionary base,” about 10 percent of the counties in our sample, based on a list from the Ministry of Agriculture (1989). Column 4 of Table 3 shows that this indicator does not

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26For some examples of the target numbers and deadlines, announced by the provincial governments, see Chapter 3 of Lin (2009).
alter the effect of collectivization across counties, perhaps because peasants in revolutionary counties might be more supportive of the movement.

In counties with a large population of ethnic minorities, officials could be more tolerant to avoid ethnic conflicts. These counties were also more likely to receive subsidies or enjoy favorable policies from the government (Huang, 1992). In addition, some minority groups, such as the Li ethnic group in Hainan province, had been practicing collective farming (*Hemu* system) long before collectivization (Ma, 1993). These differences could all affect the ways in which peasants responded to collectivization. For each county, we calculate the ratio of ethnic minorities in the population using data from the 1982 census, the earliest census available. Table 1 shows that the average ratio of ethnic minorities is 0.12. Half of the counties in our sample have no ethnic minorities, and 10 percent have more than 50 percent minorities in their populations. Column 4 of Table 3 shows that the effect of collectivization on animal loss was mitigated in counties with more ethnic minorities.

Finally, column 5 of Table 3 shows that after controlling for these additional county characteristics, the effects of middle peasants and the size of cooperatives are robust. The effects of the geographic location and the proportion of ethnic minorities, however, became insignificant in this sub-sample, for which the data of both the middle peasants and the size of cooperatives are available.\(^{27}\)

The Tragedy of the Commons

The estimated effects of collectivization were likely to be the consequences of two types of behavior, both of which are related to weak private property rights: owners could either slaughter the animals, or the animals could die of overuse and mistreatment in the collective - the well-known tragedy of the commons. This tragedy could happen only after the collectives took charge of the animals. The effects of overuse and mistreatment are also likely to be more gradual than immediate slaughter.

Thus, at the time that advanced cooperatives were introduced, the immediate decline in the number of animals was more likely to be the result of slaughter. To highlight this immediate effect, we drop the observations in 1956 and 1957 for counties that started collectivizing in 1955, and drop the observations in 1957 for counties that started in 1956. Table 4 re-estimates the main specifications with this truncated sample, and the results are similar to the previous estimates. On average, collectivization reduced the animal growth rate by 4 to 5 percentage points, and this effect is larger in counties that have more middle peasants or larger advanced cooperatives.

\(^{27}\)In this sub-sample of 667 counties, even without controlling for middle peasants and the size of cooperatives, the effects of the geographic location and the proportion of ethnic minorities are still insignificant.
6 Grain Output

The main goal of collectivization was to take advantage of the economy of scale and boost agricultural productivity. From elementary production cooperatives to advanced cooperatives, the average size of a cooperative increased from 20 households to 250 households (National Bureau of Statistics, 1957b). Collectivization and larger cooperatives could lead to lower productivity, however, for at least two reasons (Lin, 1990). First, the work incentives could be lower in such a large collective because of the weak connection between individual effort and final outcome, while supervising work effort in agricultural production is difficult. Second, poor management and administrative capacity could result in mistakes in production plans and the misallocation of resources. In fact, in 1956 and 1957, the average total factor productivity in Chinese agricultural production dropped, according to Wen (1993) and other estimates listed in Lin (1990).

Not all of the effects of collectivization can be captured in productivity. Collectivization also reduced the inventory of draft animals, a key input in grain production. The overall effect of collectivization on grain output should be larger than its effect on productivity. To see this, we estimate the following simple Cobb-Douglas grain production function. The inputs are land, rural population, and draft animals.

\[
\log(\text{grain\_output})_{it} = \gamma_{\text{collectivization}_{it-1}} + \beta_l \log(\text{arable\_land})_{it} + \beta_p \log(\text{rural\_population})_{it} \\
+ \beta_a \log(\text{animal\_inventory})_{it} + \text{year}_t + \text{county}_i + \text{flood}_{it} \\
+ \text{drought}_{it} + \epsilon_{it} \quad (3)
\]

\(\gamma_{\text{collectivization}_{it-1}}\) is a dummy equal to 1 for the years after the first year that advanced cooperatives were introduced. The national collectivization movement started in the fall of 1955, and most counties started in the winter to avoid disrupting the harvest. For counties that started in 1956, many waited until the summer harvest was finished.\(^{28}\) Thus, we allow for a one-year lag in the effect of collectivization on grain output. A set of year dummies \(\text{year}_t\) and two calamity indicators capture the general shocks to grain production. County dummies, \(\text{county}_i\), capture the average difference in grain output across counties, perhaps due to the differences in land quality.

Without including the three production inputs, \(\hat{\gamma}\) summarizes the overall causal effect of

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\(^{28}\)For example, according to the People’s Daily on October 28, 1956 (Huang, 1992), only 40 percent of rural households in Guangdong province had joined an advanced cooperative. The number was 31 percent in Sichuan province, 28 percent in Yunnan province, and 50 percent in Guizhou province. But by the end of 1956, almost all counties in these provinces finished collectivization.
collectivization on grain output. We expect \( \hat{\gamma} \) to be negative. Adding \( \log(\text{arable land})_{it} \) and \( \log(\text{rural population})_{it} \) would not change \( \hat{\gamma} \), since the timing difference in collectivization across counties is not related to the amount of land or the rural population, as shown in both Figure 5 and Appendix Table 2. Adding \( \log(\text{animal inventory})_{it} \), however, would attenuate \( \hat{\gamma} \), since collectivization reduces the inventory of draft animals. The attenuated \( \hat{\gamma} \), after controlling for all the production inputs, could be interpreted as the change in total factor productivity caused by collectivization.

Table 5 reports the estimates. Overall, collectivization reduces annual grain output by 6.7 percent (columns 1 and 2). Adding \( \log(\text{animal inventory})_{it} \) in column 3 attenuates \( \hat{\gamma} \) to 5.4 percent, which is significantly different from the estimate in column 2, suggested by a Hausman test. Thus the total loss in grain output caused by collectivization, 6.7 percent, could be attributed to lower productivity (5.4 percent) and the loss of draft animals (1.3 percent). The decline in productivity suggests that the collectives failed to use the pooled resources more efficiently. The sum of \( \hat{\beta}_l, \hat{\beta}_p, \) and \( \hat{\beta}_a \) is 0.99, statistically indistinguishable from one. We cannot reject the null hypothesis of constant returns to scale in grain production, which is consistent with the estimates from provincial-level data in Li and Yang (2005). Moreover, column 4 shows that in counties in which the average size of a cooperative was larger, productivity was equally low and the economy of scale was still not realized.

Draft animals play an important role in grain production. The estimated \( \hat{\beta}_a = 0.277 \) is remarkably close to 0.245, the estimate from Li and Yang (2005).\(^{29}\) Using provincial-level data from 1952 to 1977, Li and Yang (2005) argue that the allocation of production inputs at the provincial level was decided by the central planner. These decisions were based on past observations, and hardly reflected the up-to-date idiosyncratic shock. Thus the effects of contemporary inputs on contemporary grain output could be consistently estimated. If we take their number, 0.245, and multiply it by -0.06 (the lower bound of the estimated annual change in the animal inventory caused by collectivization), we conclude that through the channel of the killing of draft animals, collectivization reduced grain output by 1.5 percent, which is similar to the breakdown in the last paragraph.

An alternative explanation of the reduced grain output is that the collectives allocated more resources to other types of crops instead of grain, such as cotton and other cash crops. Appendix Figure 3 shows that this hypothesis is unlikely to explain our results. From 1950 to

\(^{29}\)See the coefficient of \( \ln(\text{farm capital}) \) in column 1 of Table 5 in Li and Yang (2005, pp 863). They construct the variable to measure in equivalent power units (millions of horsepower) the sum of farm machines and draft animals. The number of farm machines from 1952 to 1957 is negligible, as shown in Section 5 in this paper and Table 2 in their paper. Their estimated coefficients on land and labor are different from ours. They use the area sown with grain and the amount of rural labor. The county-level data of the two variables are not available. Instead, we use the area of arable land and the rural population.
1957, among all the sown land, the ratio allocated to grain was continuously decreasing. The accumulative decline in the eight years, however, was modest, from 0.89 to 0.85. The decline was neither accelerated nor reversed in the years following collectivization. The changes in this ratio allocated to grain after collectivization were modest in all provinces, ranging from -0.04 to 0.01 (National Bureau of Statistics, 2010). Column 5 of Table 5 shows that the effect of collectivization does not change with the ratio.

7 Conclusions

This study shows how property rights shape people’s incentives and behavior. In China’s collectivization movement from 1955 to 1957, peasants slaughtered their draft animals rather than gave them to the collectives. By comparing 1,600 counties throughout China that began collectivization in different years, the difference-in-differences estimates suggest that the accumulative animal loss during the movement was 12-15 percent. More animals were slaughtered in counties where private property rights had been more established prior to collectivization, or where agricultural output had to be shared in larger collectives with more members. Collectivization reduced annual grain output by 6.7 percent: 1.3 percent could be attributed to the loss of draft animals and 5.4 percent to lower total factor productivity.

References


\(^{30}\)For each province and each year, we calculate the ratio of the area sown with grain to the area sown with all types of crops. We calculate the change at the time of collectivization as the average ratio in 1956 and 1957 minus the average ratio in 1954 and 1955. The data in Hainan province and Tianjin municipality are not available.


**Appendix: Data Sources**

Our data sources include 20 declassified government files, 15 government reports (both internal and public), seven published compilations of statistics, and 1,720 county gazetteers. Appendix Figure 1 shows some pictures of these declassified files. We collected these materials from the National Library of China, university libraries in both mainland China and Hong Kong, the search engine Duxiu with full-text Chinese books for subscribers, and the Kongfuzi website, the largest online market in China for used or antique books and documents. We hired a company to digitize the thousands of pages of statistics.

For 1,323 counties in 20 provinces, we found complete agricultural statistics compiled by the provincial bureaus of statistics or agriculture. For a centrally planned economy in the 1950s, these statistics were indispensable to the planning committees and governments. There are three main waves of provincial compilations of such statistics. The first wave was in 1958, which summarizes the first five-year plan (1953-57). The second wave was 1978-83, which reviews the first three decades of the People’s Republic of China since its founding in 1949. The third wave was compiled to celebrate the 60th anniversary of the republic in 2009. Many provinces displayed their achievements over the past six decades by publishing volumes of statistics, usually aggregated at the provincial or prefectural level. Some provinces, such as Jilin and Yunan, reported county statistics as well.

Where provincial compilations were unavailable, we used prefectural compilations of county statistics. A prefecture is an administrative division under a province, and each prefecture consists of several counties. We managed to find 19 prefectural compilations of statistics of 155 counties. When neither provincial nor prefectural compilations were available, we used individual county gazetteers. China has a thousand-year-long tradition of
recording local history in gazetteers. The most recent gazetteers were published in the late 1980s and 1990s. Every county gazetteer has a section on agriculture that documents relevant policies and some official statistics of agricultural production. Few gazetteers, however, report the inventory of draft animals in the 1950s. We found such statistics in 252 county gazetteers.

Below are the data sources, all in Chinese, ordered by provincial administrative division code.

11 Beijing Municipality [the number of counties included in our sample: 4]
The statistics are from county gazetteers.

12 Tianjin Municipality [11 counties]
Other statistics of agricultural production and population are from county gazetteers.

13 Hebei Province [91 counties]
*Historical Agricultural Statistics in Chengde Prefecture: 1949-1978*, the Agricultural Bureau of Hebei Province, the Agricultural Bureau of Chengde Prefecture, 1979
The statistics of other counties are from county gazetteers.

14 Shanxi Province [107 counties]
*Shanxi’s Economy: Cities and Counties*, Shanxi Economy Press, 1992

15 Nei Mongol Autonomous Region [67 counties]

21 Liaoning Province [33 counties]
*One Decade of Economic Achievements of Jinzhou Prefecture 1949-1958*, the Statistics Bureau of Jinzhou Prefecture, 1959
The statistics of other counties are from county gazetteers.

22 Jilin Province [36 counties]

23 Heilongjiang Province [59 counties]

32 Jiangsu Province [58 counties]
*Agricultural Statistics in Jiangsu Province: 1949-1975*, Volumes I and II, the Agricultural Bureau of the Revolutionary Committee in Jiangsu Province, 1976

33 Zhejiang Province [45 counties]
*Agricultural Statistics in Hangzhou Prefecture (1949-1973)*, the Agricultural Bureau of Huzhou Prefecture, 1974
*Progressive Huzhou Prefecture: Thirty-five Years of Economic Statistics (1949-1984)*, the Statistic Bureau of Huzhou Prefecture, 1985
*Four Decades of Zhoushan Prefecture (1949-1988)*, the Statistic Bureau of Zhoushan Prefecture, 1989

The statistics of other counties are from county gazetteers.

34 Anhui Province [16 counties]
The statistics are from county gazetteers.

35 Fujian Province [61 counties]
*Fujian Compendium of Statistics (the Agricultural Sector): 1950-1957*, the Planning Committed of Fujian Province, the Agricultural Bureau of Fujian Province, and the Statistic Bureau of Fujian Province, 1958

36 Jiangxi Province [80 counties]

37 Shandong Province [100 counties]
41 Henan Province [112 counties]

42 Hubei Province [72 counties]
* Agricultural Statistics in Hubei Province: 1949-1975, Volume II, the Agricultural Bureau of the Revolutionary Committee in Hubei Province, 1979
* Agricultural Statistics in Hubei: 1949-1978, the Agricultural Bureau of Hubei Province, 1980

43 Hunan Province [67 counties]
* Economic Statistics in Hunan Province (Section 2: Agriculture): 1949-1975, Volumes 3-5, the Statistics Bureau of Hunan Province, 1978

44 Guangdong Province [77 counties]
* Agricultural Statistics in Guangdong Province (1949-1981, by Cities and Counties), Statistics Bureau of Guangdong Province, 1982

45 Guangxi Zhuang Autonomous Region [78 counties]

46 Hainan Province [17 counties]
* Agricultural Statistics in Guangdong Province (1949-1981, by Cities and Counties), Statistics Bureau of Guangdong Province, 1982

In 1982, Hainan was still a part of Guangdong province.

50/51 Chongqing Municipality and Sichuan Province [95 counties]
* Agricultural Statistics in Wenjiang Prefecture of Sichuan Province: 1949-1979, the Statistic Bureau of Wenjiang Prefecture, 1980
* Historical Agricultural Statistics in Leshan Prefecture: 1949-1986, the Agricultural Bureau of Leshan Prefecture, 1988

The statistics of other counties are from county gazetteers.

52 Guizhou Province [63 counties]
* Fifty Years of Tongren Prefecture: 1949-2009, the Editorial Committee of the Book, 1999
The statistics of other counties are from county gazetteers.

53 Yunan Province [117 counties]
Glorious Sixty Years of Yunan Province, Volumes of Economic Achievements, the Statistics Bureau of Yunnan Province, Yunnan Press Corporation, Yunnan People Press, 2010

61 Shaanxi Province [55 counties]
Forty Years in Yulin Prefecture: 1949-1988, the Statistics Bureau of Yulin Prefecture, 1989
Forty Years in Weinan Prefecture: 1949-1988, the Statistics Bureau of Weinan Prefecture, 1989
The statistics of other counties are from county gazetteers.

62 Gansu Province [73 counties]

63 Qinghai Province [33 counties]

64 Ningxia Hui Autonomous Region [18 counties]

65 Xinjiang Uygur Autonomous Region [80 counties]
The statistics of population are from county gazetteers.
This figure shows the percentages of rural households included in mutually exclusive organizations. From 1950 to 1953, the percentages were recorded in the middle of the year; from 1954 to 1957, at the end of the year. For 1955, only the total percentage of independent peasants and mutual aid teams was available.
Figure 2A National Inventory of Draft Animals (million head)

Figure 2B Quantity of Cowhides Sold Nationwide (million piece)

Figure 2C Price Indices of Beef Cow and Cowhide (1952=100)

Source: Ministry of Agriculture (1990)
Note: In our sample of 1,720 counties, 569 started to establish advanced cooperatives in 1955; 1,031 counties started in 1956, while 120 counties started later, or never established an advanced cooperative. The majority of these counties are located in the pasturelands of China.

The upper line is the Yellow River, and the lower line is the Yangtze River. The east side of Hu’s line includes 43 percent of mainland China’s territory but 94 percent of its population.

Source: County gazetteers.
Figure 4 Log of the Average Inventory of Draft Animals, by Year of Introduction of Advanced Cooperatives (1955 or 1956)
Figure 5 Average Growth Rates, by Year of Introduction of Advanced Cooperatives (1955 or 1956)
This figure shows that collectivization, started at year 0, changes the growth rate of the animal inventory. We regress $\Delta \log$ (draft animals) on the normalized year dummies and plot the coefficients. The dotted lines indicate the 95 percent confidence intervals. The reported coefficients in $\{-1,0,1\}$ reflect the changes in $\Delta \log$ (draft animals) relative to its level in the second last year prior to collectivization. All regressions include $\Delta \log$(rural population), $\Delta \log$(arable lands), flood, drought, calendar year dummies, county dummies, and a constant. The coefficients are reported in Appendix Table 3.
Figure 7 The Distribution (in percentages) of Lands, Households, and Draft Animals, before and after the Land Reform, by the Classes Assigned in the Reform

Notes: In Panel C, data before the land reform are not available.
Figure 8 The Distributions of County-specific Changes in the Growth Rate of the Animal Inventory after Collectivization

Panel A: By the Ratio of Middle Peasant Households

Panel B: By the Size of an Advanced Co-op

Notes: Panel A divides counties into two groups, according to the median of the ratio of middle peasant households. Panel B does so according to the median of the size of an advanced cooperative.
Table 1 Summary Statistics

<table>
<thead>
<tr>
<th>Panel A: Variables that change across 1,600 counties and over time, 1952-57</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draft animals (1,000 head)</td>
<td>9600</td>
<td>35.82</td>
<td>25.06</td>
<td>0.59</td>
<td>183.82</td>
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<td>Log(draft animals)</td>
<td>9600</td>
<td>10.22</td>
<td>0.8</td>
<td>6.38</td>
<td>12.12</td>
</tr>
<tr>
<td>First difference in log(draft animals)</td>
<td>8000</td>
<td>0.01</td>
<td>0.12</td>
<td>-1.12</td>
<td>2.53</td>
</tr>
<tr>
<td>Collectivization</td>
<td>9600</td>
<td>0.39</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Rural Population (1,000)</td>
<td>8862</td>
<td>255.1</td>
<td>185.9</td>
<td>22.12</td>
<td>1106</td>
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<tr>
<td>Arable land (1,000 hectares)</td>
<td>8699</td>
<td>56.25</td>
<td>44.43</td>
<td>0.66</td>
<td>369.28</td>
</tr>
<tr>
<td>Grain output (1,000 tons)</td>
<td>9190</td>
<td>79.23</td>
<td>61.54</td>
<td>0.11</td>
<td>531</td>
</tr>
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<td>Flood</td>
<td>9524</td>
<td>0.19</td>
<td>0.39</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Drought</td>
<td>9524</td>
<td>0.12</td>
<td>0.32</td>
<td>0</td>
<td>1</td>
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<table>
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<th>Panel B: County characteristics that do not change over time, 1952-57</th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Ratio of middle peasant households</td>
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<td>0.32</td>
<td>0.11</td>
<td>0.07</td>
<td>0.89</td>
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<td>Number of people included in an advanced cooperative</td>
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<td>1154</td>
<td>1395</td>
<td>108</td>
<td>22906</td>
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<td>Distance to the provincial capital (km)</td>
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<td>187</td>
<td>164</td>
<td>0</td>
<td>1339</td>
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<tr>
<td>Revolutionary base</td>
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<td>0.10</td>
<td>0.31</td>
<td>0</td>
<td>1</td>
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<tr>
<td>Ratio of ethnic minorities</td>
<td>1600</td>
<td>0.12</td>
<td>0.24</td>
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</tbody>
</table>
This table reports the difference-in-differences estimates of the effects of collectivization on $\Delta \log$ (draft animals). The collectivization dummy equals one for the year that a county started to establish advanced cooperatives and for the years after. The estimates show that collectivization reduces the annual growth rate of draft animals by 6 percentage points. In columns 1 and 2, we divide all counties into two groups according to when they started collectivizing: in 1955 or 1956. A group indicator captures the average difference between the two groups.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>collectivization</td>
<td>-0.055***</td>
<td>-0.063***</td>
<td>-0.055***</td>
<td>-0.061***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.007)</td>
<td>(0.006)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>group 1956</td>
<td>0.008***</td>
<td>0.006**</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>$\Delta \log$ (rural population)</td>
<td>0.047*</td>
<td>0.047*</td>
<td>(0.027)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>$\Delta \log$ (arable lands)</td>
<td>0.168**</td>
<td>0.141*</td>
<td>(0.075)</td>
<td>(0.075)</td>
</tr>
<tr>
<td>flood</td>
<td>-0.026***</td>
<td>-0.017***</td>
<td>(0.004)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>drought</td>
<td>-0.019***</td>
<td>-0.020***</td>
<td>(0.004)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>constant</td>
<td>0.013</td>
<td>0.053***</td>
<td>0.018***</td>
<td>0.059***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.004)</td>
<td>(0.007)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>county FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>8,000</td>
<td>6,516</td>
<td>8,000</td>
<td>6,516</td>
</tr>
</tbody>
</table>

Standard errors are clustered at the county level

*p<0.1, **p<0.05, ***p<0.01
Table 3 The Effects of Collectivization on $\Delta \log$ (draft animals), Varied with County Characteristics

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collectivization</td>
<td>-0.042***</td>
<td>-0.054***</td>
<td>-0.039***</td>
<td>-0.066***</td>
<td>-0.042***</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.008)</td>
<td>(0.014)</td>
<td>(0.007)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Collectivization*ratio of middle peasant households†</td>
<td>-0.087***</td>
<td>-0.091***</td>
<td>-0.088***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.033)</td>
<td>(0.033)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collectivization*log(number of people in a co-op)†</td>
<td>-0.025***</td>
<td>-0.023***</td>
<td>-0.024***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.008)</td>
<td>(0.008)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collectivization*log(distance from the capital city)†</td>
<td></td>
<td></td>
<td></td>
<td>-0.009***</td>
<td>-0.007***</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.003)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Collectivization*dummy for a revolutionary base</td>
<td>0.014</td>
<td>0.008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.016)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collectivization*ratio of ethnic minorities</td>
<td>0.036***</td>
<td>0.019</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.013)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>3,653</td>
<td>5,376</td>
<td>3,332</td>
<td>6,516</td>
<td>3,332</td>
</tr>
</tbody>
</table>

Standard errors are clustered at the county level

**p<0.05, ***p<0.01

The collectivization dummy equals one for the year that a county started to establish advanced cooperatives and for the years after. All regressions include $\Delta \log$(rural population), $\Delta \log$(arable land), flood, drought, year dummies, county dummies, and a constant.

† The variables are the deviation from their mean. This transformation does not affect the coefficients of the interaction terms, and the coefficients of the collectivization indicator are the effect at the mean level of these variables.
Table 4 The Effects of Collectivization on $\Delta \log$ (draft animals), in a Truncated Sample

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collectivization</td>
<td>-0.053***</td>
<td>-0.035***</td>
<td>-0.056***</td>
<td>-0.037***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.010)</td>
<td>(0.008)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Collectivization*ratio of middle peasant households†</td>
<td>-0.091**</td>
<td>-0.088**</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.041)</td>
<td>(0.042)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collectivization*\log(number of people in a co-op)†</td>
<td>-0.023***</td>
<td>-0.023***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collectivization*\log(distance from the capital city)†</td>
<td></td>
<td></td>
<td>-0.005</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.004)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Collectivization*dummy for a revolutionary base</td>
<td>0.004</td>
<td>0.010</td>
<td>(0.014)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Collectivization*ratio of ethnic minorities</td>
<td>0.026**</td>
<td>0.014</td>
<td>(0.013)</td>
<td>(0.017)</td>
</tr>
</tbody>
</table>

N   | 4,747 | 2,423 | 4,747 | 2,423 |

Standard errors are clustered at the county level

**$p<0.05$, ***$p<0.01$**

These regressions estimate the immediate effect of collectivization. We drop the observations in 1956 and 1957 for counties that started collectivizing in 1955, and we drop the observations in 1957 for counties that started in 1956. The collectivization dummy equals one for the year that a county started to establish advanced cooperatives and for the years after. All regressions include $\Delta \log$ (rural population), $\Delta \log$ (arable land), flood, drought, year dummies, county dummies, and a constant.

† The variables are the deviation from their mean. This transformation does not affect the coefficients of the interaction terms, and the coefficients of the collectivization indicator are the effect at the mean level of these variables.
### Table 5 The Effects of Collectivization on Log(Grain Output)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collectivization, one-year lag</td>
<td>-0.067***</td>
<td>-0.068***</td>
<td>-0.054***</td>
<td>-0.058***</td>
<td>-0.057***</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.013)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>Collectivization (one year lag)*log(number of people in a co-op)†</td>
<td>-0.008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collectivization (one year lag)*change of area sown with grain</td>
<td></td>
<td></td>
<td>-0.273</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.439)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>log(draft animals)</td>
<td></td>
<td>0.277***</td>
<td>0.265***</td>
<td>0.275***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.031)</td>
<td>(0.038)</td>
<td>(0.032)</td>
<td></td>
</tr>
<tr>
<td>log(arable land)</td>
<td>0.702***</td>
<td>0.616***</td>
<td>0.571***</td>
<td>0.616***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.145)</td>
<td>(0.138)</td>
<td>(0.149)</td>
<td>(0.140)</td>
<td></td>
</tr>
<tr>
<td>log(rural population)</td>
<td>0.097</td>
<td>0.097*</td>
<td>0.108</td>
<td>0.098*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.061)</td>
<td>(0.057)</td>
<td>(0.093)</td>
<td>(0.058)</td>
<td></td>
</tr>
<tr>
<td>flood</td>
<td>-0.081***</td>
<td>-0.073***</td>
<td>-0.071***</td>
<td>-0.073***</td>
<td>-0.072***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.008)</td>
<td>(0.007)</td>
<td>(0.008)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>drought</td>
<td>-0.050***</td>
<td>-0.054***</td>
<td>-0.052***</td>
<td>-0.054***</td>
<td>-0.051***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.011)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>N</td>
<td>9,114</td>
<td>7,877</td>
<td>7,877</td>
<td>6,491</td>
<td>7,781</td>
</tr>
</tbody>
</table>

Standard errors are clustered at the county level

*p<0.1, **p<0.05, ***p<0.01

This table reports the difference-in-differences estimates of the effects of collectivization on grain output. We allow for a one-year lag in the effect, because most counties started collectivizing in the latter half of a year to avoid disrupting the harvest. All regressions include year dummies, county dummies, and a constant.

† The variable is the deviation from its mean. This transformation does not affect the coefficient of the interaction term, and the coefficients of the collectivization indicator are the effect at the mean level of the variable.
Appendix Figure 1 Some Declassified Government Files

The picture on the left shows the three volumes of the *Economic Statistics in Hunan Province (Section 2: Agriculture): 1949-1975*. The picture on the right highlights the classification level of the file, *Top Secret*, on the front cover.
This figure shows that collectivization, started in year 0, changes the growth rate of the animal inventory. We regress $\Delta \log$ (draft animals) on the normalized year dummies and report the coefficients. The dotted lines indicate the 95 percent confidence intervals. We use an unbalanced panel data set, in which some counties have data back to 1949. The reported coefficients reflect the changes in $\Delta \log$ (draft animals) relative to its level in the five years before collectivization. All regressions include $\Delta \log$(rural population), $\Delta \log$(arable lands), flood, drought, calendar year dummies, county dummies, and a constant. The coefficients are reported in Appendix Table 3.
Appendix Figure 3 The Area Sown with Grain as a Proportion of the Area Sown with All Types of Crops

This figure shows that from 1950 to 1957, among all the sown land, the portion allocated to grain was continuously decreasing. The accumulative decline, however, was modest - less than 4 percentage points. This decline was not disrupted or accelerated by collectivization.
### Appendix Table 1: The Effects of Collectivization on the Annual Growth Rate of Draft Animals: $\Delta \log$ (draft animals), with Different Clustered Errors

<table>
<thead>
<tr>
<th></th>
<th>Cluster at province level</th>
<th>Two-way clusters at province and year levels</th>
<th>Two-way clusters at county and year levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>collectivization</td>
<td>-0.061***</td>
<td>-0.061***</td>
<td>-0.061***</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.016)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>$\Delta \log$ (rural population)</td>
<td>0.047</td>
<td>0.047</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.035)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>$\Delta \log$ (arable lands)</td>
<td>0.141**</td>
<td>0.141*</td>
<td>0.141</td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
<td>(0.079)</td>
<td>(0.090)</td>
</tr>
<tr>
<td>flood</td>
<td>-0.017*</td>
<td>-0.017</td>
<td>-0.017</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.017)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>drought</td>
<td>-0.020**</td>
<td>-0.020*</td>
<td>-0.020**</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.011)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>county FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>6,516</td>
<td>6,516</td>
<td>6,516</td>
</tr>
</tbody>
</table>

*p<0.1, **p<0.05, ***p<0.01

This table repeats the estimates in column 4 of Table 2, with different cluster errors.
Appendix Table 2 The Effects of Collectivization on the Annual Growth Rate of the Rural Population and Arable Land

<table>
<thead>
<tr>
<th></th>
<th>( \Delta \log (\text{rural population}) ) (1)</th>
<th>( \Delta \log (\text{arable land}) ) (2)</th>
<th>( \Delta \log (\text{arable land}) ) (3)</th>
<th>( \Delta \log (\text{arable land}) ) (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>collectivization</td>
<td>0.003</td>
<td>0.002</td>
<td>0.003</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>flood</td>
<td>-0.003</td>
<td>-0.003</td>
<td>-0.011***</td>
<td>-0.011***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>drought</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.008**</td>
<td>-0.008**</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>constant</td>
<td>0.017***</td>
<td>0.019***</td>
<td>-0.007</td>
<td>0.024***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.004)</td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>county FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>7,222</td>
<td>7,207</td>
<td>7,247</td>
<td>7,190</td>
</tr>
</tbody>
</table>

Standard errors are clustered at the county level

**p<0.05, ***p<0.01

This table reports the results of a placebo test. It shows the difference-in-differences estimates of the effects of collectivization on \( \Delta \log (\text{rural population}) \) and \( \Delta \log (\text{arable land}) \). The collectivization dummy equals one for the year that a county started to establish advanced cooperatives and for the years after.
Appendix Table 3 The Dynamic Effects of Collectivization on the Annual Growth Rate of Draft Animals: \( \triangle \log (\text{draft animals}) \)

<table>
<thead>
<tr>
<th>Four years prior to collectivization</th>
<th>Sample years: 1952-57</th>
<th>Sample years: 1949-57</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.003</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Three years prior to collectivization</td>
<td>0.016</td>
<td>0.016</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Two years prior to collectivization</td>
<td>-0.003</td>
<td>-0.003</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>One year prior to collectivization</td>
<td>-0.006</td>
<td>-0.009</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>The year that started collectivization</td>
<td>-0.076***</td>
<td>-0.078***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.016)</td>
</tr>
<tr>
<td>The year after collectivization</td>
<td>-0.081***</td>
<td>-0.081***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.018)</td>
</tr>
</tbody>
</table>

| N | 5,216 | 7,912 |

Standard errors are clustered at the county level

This table shows how collectivization affects the growth rate of the animal inventory, year on year. We regress \( \triangle \log (\text{draft animals}) \) on the normalized year dummies. The reported coefficients reflect the changes in \( \triangle \log (\text{draft animals}) \) relative to the base year. In the first column, the base year is the second to last year prior to collectivization. In the second column, we use an unbalanced panel data set in which some counties have data back to 1949. The base year is five years before collectivization. All regressions include \( \Delta \log (\text{rural population}) \), \( \Delta \log (\text{arable land}) \), flood, drought, calendar year dummies, county dummies, and a constant.

***p<0.01
Appendix Table 4 The Effects of Collectivization on the Annual Growth Rate of Draft Animals: $\Delta \log$ (draft animals)  
By Two Sets of Provinces, Grouped by the Extent of Mechanization

<table>
<thead>
<tr>
<th></th>
<th>Beijing, Heilongjiang, Xinjiang, Hebei, and Qinghai (1)</th>
<th>All other provinces (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>collectivization</td>
<td>-0.058** (0.023)</td>
<td>-0.061*** (0.007)</td>
</tr>
<tr>
<td>$\Delta \log$ (rural population)</td>
<td>0.020 (0.022)</td>
<td>0.097 (0.063)</td>
</tr>
<tr>
<td>$\Delta \log$ (arable lands)</td>
<td>0.245** (0.100)</td>
<td>0.128 (0.081)</td>
</tr>
<tr>
<td>flood</td>
<td>-0.001 (0.012)</td>
<td>-0.020*** (0.005)</td>
</tr>
<tr>
<td>drought</td>
<td>-0.033*** (0.011)</td>
<td>-0.017*** (0.005)</td>
</tr>
<tr>
<td>N</td>
<td>808</td>
<td>5,708</td>
</tr>
</tbody>
</table>

Standard errors are clustered at the county level  

**p<0.05, ***p<0.01

This table shows that the effects of collectivization on the animal growth rate do not vary across two sets of provinces, grouped according to the extent of their mechanization. According to the National Bureau of Statistics (1980), 21 percent of tilled areas in Beijing were tilled by machines in 1958. The percentages were 17.4 in Heilongjiang, 15.4 in Xinjiang, 13.1 in Hebei, and 10.4 in Qinghai. In all other provinces in column 2, the percentages were lower than 4.2. All regressions include year dummies, county dummies, and a constant.