

There Will Be Killing: Collectivization and Death of Draft Animals*

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Abstract

The deprivation of private property rights could wreak havoc on productive assets, as the owners could 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.

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“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 550 million Chinese 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 property rights to communal property rights in history. The collectivization set the stage for the Great Leap Forward movement in 1958, which in turn led to the Chinese Great Famine from 1959 to 1961, the worst famine in history that killed 16.5 to 45 million people (Meng, Qian, and Yared, 2015).¹ The collective land ownership has shaped the lives of Chinese peasants over generations, and it lasts to today.²

The collectivization movement is an ideal setting for examining how weakened private property rights affect agricultural productivity and peasants’ investment in productive assets. The sweeping movement was carried out relatively smoothly, not accompanied with major social unrest. In the collectives, called advanced cooperatives, all the rent payments for land and draft animals were eliminated. Income was distributed only in the form of wage, according to the “work points” earned by each member. Members must turn over their land to the cooperative, receiving no compensation; and sell their draft animals to the cooperative, accepting a low payment in installments over 3 to 5 years. The principle of voluntary participation was largely ignored in practice, as officials rushed to finish the collectivization.³ By the end of 1956, in only one year and a half, 88 percent of the rural population were organized into collectives. In 1957, the percentage reached to 96 percent (National Bureau of Statistics, 1957, 1980).

Peasants slaughtered their draft animals instead of passing them to the collective, observed by historians (Friedman, Pickowicz, and Selden, 1991).⁴ The contemporary government reports and documents were full of anecdotal evidence of animal slaughter (Huang, 1992; Ye, 2006). This paper assesses the causal effect of the collectivization on the draft ani-

¹The 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.

²For an introduction of collectives and China’s urban-rural divide, see Naughton (2007).

³The contemporary government reports and documents frequently mentioned that unwilling peasants were forced to join the cooperatives (Huang, 1992; Ye, 2006).

⁴Their cases occurred in Hebei province. For similar observations in other provinces by historians, see Hinton (1983) and Shue (1980).

mal inventory. We use a novel data set of yearly inventory of draft animals in 1,600 counties from 1952 to 1957, hand-collected from a wide 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 the collectivization movement in 1955 and the others did so in 1956, we explore this timing variation to identify the effect of the movement. The difference-in-differences estimates show that the collectivization lowered the growth rate of the animal inventory by six percentage points. In the first two years of the movement, the accumulative animal loss reached to 12 to 15 percent, or 7.4 to 9.5 million head nationwide.

The dead animals were not replaced by tractors or other farming machines. The immediate animal loss in the process of establishing the collectives was also unlikely to be explained by the overuse and mistreatment in the collectives. Our hypothesis is that the deprivation of private property rights suppressed the investment in draft animals. In face of losing land and the full claim of the future revenue generated by the animals, peasants slaughtered them to retain some value.

This hypothesis has two testable implications. First, animal owners would lose more if they had to join a large collective and share the revenue with more members.⁵ We find that the animal inventory declined more in counties with larger cooperatives. Second, the collectivization would incur a large loss of animals in counties in which the property rights had been well protected prior to the collectivization. We use the ratio of so-called “middle peasant” households in the rural population to measure the protection. Three to four years prior to the collectivization movement, China just finished a land reform. 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). We find that the animal inventory declined more in counties with more middle peasants.

In evaluating the effects of property rights on agricultural production, it is important to consider both the effect on inputs and the effect on productivity.⁶ The collectivization reduced annual grain output by 6.7 percent: 1.3 percent attributable to lower animal in-

⁵As 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 the output produced with the asset is a public or private good (Besley and Ghatak, 2010).

⁶Banerjee, Getler, and Ghatak (2002) discuss the two effects in theory, but they are not able to separate them in the 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.

puts and 5.4 percent to lower total factor productivity. These results do not support the hypothesis that the collectives managed to reduce the demand for draft animals by pooling resources together 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.⁷ While the most papers test how improved protection of private property rights affects investment, the Chinese collectivization movement allows us to see how the deprivation of private property rights destroys existent productive assets. But the phenomenon discussed in this paper is not a special case of China. Historians have documented similar mass animal slaughter during the collectivization movement from 1929 to 1933 in the Soviet Union, also followed by a severe famine (Jasny, 1949; Fitzpatrick, 1996). Different from these records of national patterns, our county-level data allow us to identify the causal effects of the collectivization on the animal inventory, explore the heterogeneity across counties, and translate the animal loss into grain output.

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 the collectivization on the inventory of draft animals. Section 5 discusses how the 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 redistributed lands and draft animals from landlords to tenants and landless laborers. In 1952, the government adopted a Stalinist heavy-industry-oriented development strategy. To fund 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 the cooperation among peasants.

⁷For some microeconomic evidence, see Besley (1995), Banerjee, Getler, and Ghatak (2002), Jacoby, Li, and Rozelle (2002), Johnson, McMillan, and Woodruff (2002), Goldstein and Udry (2008), Hornbeck (2010), Galiani and Schargrodsky (2010), and Fenske (2011). For cross country studies, see Svensson (1998) and Acemoglu, Johnson, and Robinson (2001). Secure property rights could also increase labor supply and migration (Field, 2007; De Janvry et al., 2015). Besley and Ghatak (2010) summarize the literature.

From 1952 to 1955

The government first started to press for establishing Mutual Aid Teams (MAT) throughout China in 1952.⁸ An average MAT consisted of 7 households (National Bureau of Statistics, 1957), usually 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 ten million MATs.

The national movement from MATs towards elementary production cooperatives was launched 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, including 20 or more households (National Bureau of Statistics, 1957). Different from 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. Income of members were from the rent payment for their land and the wage payment for their labor. Members could sell their animals to the cooperative at the going price, or own and rear the animals 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 to a draft animal was about 40 RMB. The annual rent to 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. It was about to change in the sweeping collectivization movement, started in the latter half of 1955.

The 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 prerequisites for large collective farms, otherwise the economy of scale would not be realized. Thus collectivization should be a gradual process, accompanied with industrialization. In

⁸In December 1951, the Central Committee of the Communist Party of China issued the "First Draft Decision on Mutual Aid and Cooperation in Agriculture", launching the nationwide MAT movement. For a detailed discussion, see Ye (2006).

the spring of 1955, the central government called for a halt to the rapid development of elementary cooperatives, and the number of the cooperatives stopped growing in the second quarter.⁹ In the summer of 1955, however, Mao changed his mind and started to believe that fast collectivization in agriculture 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 his 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.’ ”(Hinton, 1983) Mao’s intervention settled the policy debate on the pace of collectivization. From August to October, all the other top party leaders self-criticized their own conservative attitude and announced their endorsement of 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 about only 500 advanced cooperatives nationwide.¹¹ By the end of the year, the number surged to 17,000, covering 4 percent of all rural households. In Liaoning province, 58 percent of rural households had joined advanced cooperatives by the end of 1955. In 1956, 88 percent of all rural households joined 312 thousand advanced cooperatives. In 1957, the percentage reached to 96. Within only two years, advanced cooperatives completely replaced elementary cooperatives, MATs, and individual households, and became the main organization of agricultural production. The collectivization developed much faster even than Mao’s expectation, who thought that the most regions should start some experiments of advanced cooperatives in 1956 and 1957, then finish in 1960 (Huang, 1992). In such a fast and sweeping movement, the principle of voluntary participation of cooperatives was largely ignored in practice, and bureaucratic commandism and even violence against distressed peasants were not uncommon.¹²

All the rent payments for land, draft animals, and implements in advanced cooperatives

⁹The number of cooperatives increased from 96,000 in March of 1954 to 633,000 in March of 1955. The quarterly growth rate was 140%. In June of 1955, the number was 634,000, barely changed from March (National Bureau of Statistics, 1957).

¹⁰Ye (2006) is a comprehensive document of the development from MATs to advanced co-operatives. Lin (2009) describes more details in many policy debates during China’s transformation to a socialist state between 1953 and 1955. For short introductions in English, see Teiwes (1987) and Lardy (1987).

¹¹Before 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.

¹²For the reports in contemporary government documents, see Huang (1992) and Ye (2006).

were eliminated. Income was distributed only in the form of wage, according to the “work points” earned by each member. Peasants must turn over their land to the cooperative, receiving no 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 be a burden for the most members who were too poor to own a draft animal and had to pay off the installment with their labor. By accepting a low price, the animal owners had to not only subsidize other members, but also take the risk that the installment payments might never be honored. After all, many propagandized elementary cooperatives lasted for only two years, who could guarantee the advanced cooperatives would last for three or even five years? Unwilling to turn over their valuable animals in exchange of 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 the contemporary government reports and documents, and by historians.¹³ For example, in a chapter titled “Against Cooperation”, Friedman, Pickowicz, and Selden(1991) 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. (*Chapter 8 Against Cooperation*, pp. 191)

According to the 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 dropped by 3.6 million head from 1954. The disappeared animals were indeed slaughtered. Figure 2B shows a hike in the trade volume of cowhide from 1955 to 1957. The accumulated abnormal increase in cowhide seemed higher than the accumulated loss of draft animals. Many calves, female animals, or even milk-cows were slaughtered too.

The observed loss in the national inventory of draft animals could well underestimate the true loss caused by the collectivization. Had the inventory kept growing without the

¹³For examples of government reports, see Huang (1992) and Ye (2006). For observations from historians, in both the north and the south China, see Friedman, Pickowicz, and Selden (1991), Hinton (1983), and Shue (1980).

disruption in 1955, it would have been much higher in 1957 than the observed 53.7 million head. The rest of the paper tries to estimate the causal effect of the collectivization on the loss of draft animals. We start with introducing our data.

3 Data

We assemble a novel data set of yearly inventory of draft animals, agricultural production, land use, and population in 1,720 counties from 1952 to 1957. The sample covers 77 percent of all Chinese counties and 80 percent of 550 million rural population.¹⁴ The sample counties spread over all provinces except for Shanghai and Tibet.¹⁵ The statistics are from a wide variety of official sources, including many de-classified government files and recently released compilations of statistics. For a centrally planning economy in the 1950s, these county-level statistics were indispensable to the planning committees and governments. For the counties in which the official compilations of statistics are missing, we resort to 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 the 1990s. Every county gazetteer documents important agricultural policies and some official statistics of agricultural production.¹⁶ Appendix I reports in details the data sources and how we collect them.

Our identification strategy relies on the timing variation across counties in introducing an advanced cooperative. Figure 3 divides the counties into three groups based on the years 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, as the revolutionary transformation from thousands of years of private land ownership to collective ownership. By the end of 1956, while 1,600 counties had almost finished the collectivization, 120 counties had not started to establish an advanced cooperative. We drop these 120 counties from the sample since they were different. 62 counties were on the north or northwest pastureland in Inner Mongolia, Xinjiang, Qinghai, Sichuan, and Yunnan. The most population in these counties in the 1950s were nomads. Without fixed residence and grazing area, it was difficult to collectivize their livestock and establish an advanced

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

¹⁵As far as we know, the yearly 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 did not find any records of their yearly inventory of draft animals for every year from 1952 to 1957.

¹⁶Not many gazetteers report the inventory of draft animals in the 1950s. We find such statistics in 252 county gazetteers.

cooperative. The other 58 counties were mainly in the southwest mountains and the forests in Sichuan and Yunan 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 in 1956 (1,031 counties). Table 1 shows that an average Chinese county is quite large, including 255, 096 people and 56, 250 hectares of arable land. The smallest county has about only two thousand people, but some largest counties have over one million.

The key dependent variable is the year-end inventory of draft animals. In the north China, these animals are mainly cattles, horses, donkeys, and mules. In the south China, they are mainly cattles 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. On average, Table 1 shows that each county has 35,816 draft animals. The total number of draft animals is somewhat larger than the national inventory shown in Figure 2A. The reason is that 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 the animals first increases and then declines over 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 0.217 hectare, and the grain output per peasant 0.322 tons.¹⁷ 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.¹⁸

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.¹⁹ The weather data use a discrete variable for rainfall: 1 for exceptional floods, 2 for limited floods,

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

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

¹⁹This 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.

3 for normal weather, 4 for limited droughts, and 5 for exceptional droughts.²⁰ 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 floods, one of the worst floods in the 20th century in China. The estimated effects of the collectivization may vary with some county characteristics, listed in Panel B of Table 1. We will explain these variables in Section 5.

4 The Declined Inventory of Draft Animals

Visual Evidence

The counties that introduced advanced cooperatives in 1955 saw the immediate loss of draft animals, 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 animal inventory of 1954. For the other counties that started to establish advanced cooperatives in 1956, the animal inventory continued growing until 1956.²¹

In order to highlight the year-by-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 four percent to negative three percent. It 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, other two key inputs in agricultural production. The year-by-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 the collectivization process in 1955 would have been three percent instead of the actual negative three percent. Thus a visual comparison suggests that the collectivization reduces the annual growth rate of draft animals by 6 percentage points. Now we turn to the regression analysis to estimate this causal effect.

²⁰The variable is defined according to the descriptions in local gazetteers, or the amount of precipitation when available. Typical descriptions 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 a 1.17 standard deviation above the mean.

²¹The information traveled slow in the backward Chinese rural areas in the 1950s. Most peasants might have no idea about what an advanced cooperative was until it was imposed upon them. Even if they did know about it, it seems not rational to slaughter the animals before the introduction of advanced cooperatives. The animal remains valuable and productive, before it has to be sold to the cooperative.

The Difference-in-Differences Estimation

We use the following general difference-in-differences specification to estimate the effects of the collectivization on the annual change in the inventory of draft animals. The first difference, $\Delta\log(\textit{animal_inventory})$, eliminates the inherent trend in the animal inventory.

$$\begin{aligned}\Delta\log(\textit{animal_inventory})_{it} &= \beta * \textit{collectivization}_{it} + \textit{year}_t + \textit{county}_i \\ &+ \Delta\log(\textit{rural_population})_{it} + \Delta\log(\textit{arable_land})_{it} \\ &+ \textit{dought}_{it} + \textit{flood}_{it} + \varepsilon_{it} \quad (1)\end{aligned}$$

For a county i in year t , $\textit{collectivization}_{it}$ is a dummy variable equal to one for the year that a county started to establish advanced cooperatives and for the years after. For most counties, the collectivization movement was carried out village by village and was not finished until 1957, the last year in our sample. Thus β , the coefficient of interests, captures the average difference in the animal growth rate during the collectivization process. Since counties start the process in different years, β is identified from the differences fixed over years and across counties, captured in a set of year dummies \textit{year}_t and county dummies \textit{county}_i . $\Delta\log(\textit{animal_inventory})_{it}$ 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 north China use more donkeys and mules, and counties in south China use more water buffaloes. Different animals may have different fertility rates. By adding the county dummies, \textit{county}_i , we further control for *county-specific linear trends* in the animal inventory. We also include the change rate of 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 the 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 $\hat{\beta}$.²²

Table 2 reports the results. In columns 1 and 2, instead of using county fixed effects, we divide all counties into two groups that started the collectivization in 1955 or 1956. A group indicator captures the average difference in $\Delta\log(\textit{animal_inventory})_{it}$ 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 drops by about 6 percentage points during the collectivization process, close to the decline 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 do not change much.

²²The calculation of two-way cluster error is based on Cameron, Gelbach, and Miller (2011).

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 of B and C in Figure 5. A placebo test confirms that the collectivization does not affect either $\Delta\log(rural_population)_{it}$ or $\Delta\log(arable_land)_{it}$, reported in Appendix Table 2. Both the population and the 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, the collectivization is three times more effective than these calamities.

The Dynamic Effects and Internal Validity Checks

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

We replace $collectivization_{it}$ in equation (1) with a set of dummy variables $I(CY_{it} = k)$ that indicate the k_{th} year in the collectivization movement. $CY_{it} = 0$ indicates the year of 1955 for the counties starting the movement in 1955, and the year of 1956 for the rest counties. $CY_{it} = 1$ is the second year in the movement, and $CY_{it} = -1$ is the year before the movement. Since our data of $\Delta\log(animal_inventory)_{it}$ start in 1953 and end in 1957, we could estimate the coefficients of $I(CY_{it} = k)$ for $k = -1, 0, 1$, using $k = -2$ as the base group.

$$\begin{aligned} \Delta\log(animal_inventory)_{it} &= \sum_k \beta_k * I(CY_{it} = k) + year_t + county_i \\ &+ \Delta\log(rural_population)_{it} + \Delta\log(arable_land)_{it} \\ &+ drought_{it} + flood_{it} + e_{it} \quad (2) \end{aligned}$$

Figure 6 shows the estimated $\hat{\beta}_k$ for $k = -1, 0, 1$, and the 95% 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 the 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 of the 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. The accumulative change in $\log(\text{animal_inventory})_{it}$ is thus -0.15. In the two years of the collectivization, the accumulative loss in the animal inventory caused by the collectivization is approximately 15 percent. If we take the lower bound of our estimates, the estimated two-year accumulative loss is about 12 percent. The accumulative loss is clear in Figure 4. For the counties starting the collectivization in 1955, had there not been the collectivization, the log of the animal inventory would have increased to about 10.57 in 1956, instead of the actual 10.43. Compared with the counterfactual 10.57, the accumulative two-year change caused by the collectivization is -0.14 log points, or 14 percent of the animal inventory. If we take 54 million head as the national inventory after two years in the collectivization, as shown in Figure 2A, our estimates suggest that the two-year accumulative animal loss is about 7.4 to 9.5 million head.

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

5 Interpretations

The backward economy of China in the 1950s precludes the hypothesis 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, for 550 million peasants. Among all tilled areas, only 2.4 percent were tilled by machines (National Bureau of Statistics, 1980). As a comparison, the Soviet Union had 924,000 tractors, 483,000 combine harvester, 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). According to the 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 5 provinces, the percentages ranged from 10 to 21 percent. We re-estimate equation (1) in each group. Appendix Table 4 shows that the effects of the collectivization on the animal inventory are almost identical

between the two groups. The employment of farming machinery could not explain our results.

Our interpretation of the results is that weakened private property rights suppress the investment in draft animals. Without the full claim of the most future revenue generated by the animals, peasants tend to slaughter the animals to retain some residual value. The interpretation has two testable implications. First, the collectivization would incur a larger animal loss in counties in which private property rights had been more well-established prior to the 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 would be slaughtered.

The Property Rights Prior to the Collectivization

Prior to the collectivization in 1955 and 1956, the private property rights in some counties were more established than in the others. In 1951 and 1952, China just finished a land reform. In this reform of “land to the tiller”, properties, including lands, draft animals, houses, farm implements, and other valuables, of millions of landlords and rich peasants were confiscated and given to poor peasants and landless laborers.²³ According to the National Bureau of Statistics (1980), landlords and rich peasants owned 53 percent of all land before the reform. The number dropped to 8.6 percent after the reform, shown in Panel A of Figure 7. Prior to the collectivization, the rights attached to the most 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.²⁴

The properties of so-called “middle peasants” survived the reform. 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. They were too poor to be labeled as rich peasants.²⁵ The CPC believed that the firm alliance with the middle peasants was a key to succeed in the revolution and in the reform. The policies in the land reform 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 informative about how established the private property rights had been prior

²³The classical references to the land reform are Hinton (1966) and Shue (1980).

²⁴Historians have documented that some poor peasants sent their newly assigned valuables back to the original owners (Hinton, 1966; Shue, 1980).

²⁵*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.* This official definition from a top CPC leader is translated by William Hinton (Hinton, 1966).

to the collectivization.²⁶

Middle peasants were unwilling to join advanced cooperatives but were forced to do so (Du, 2002; Ye, 2006). The reason was simple: an average middle peasant household owned more land and draft animals than the other classes. By pooling all capitals 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 the collectivization, but they owned 44 percent of land and 52 percent of 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. By 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 $\Delta \log(\text{animal_inventory})$, after the collectivization. Regardless of the ratio of middle peasants, the most counties see a decline in $\Delta \log(\text{animal_inventory})$ after the collectivization. For the 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 the counties with the mean ratio of middle peasant households, 0.32, the collectivization reduces the animal growth rate by 4 percentage points. If the ratio increases by 0.1, the animal growth rate would further decline by 0.9 percentage point.

The Size of an Advanced Cooperative

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

²⁶There are some slight changes in the ratio of the households of different classes before and after the land reform. There were typically two or three waves of the reform in the same county, addressing the issues of mis-classification. As a result, the ratio of different classes was adjusted a bit in each wave. In the following analysis, we use the last reported ratio in county gazetteers.

cooperative includes 246 households and 1,082 people.

By the median of the size, Panel B of Figure 8 divides the counties into two groups and plots the mean change in $\Delta \log(\text{animal_inventory})$ after the 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 cooperatives. Column 2 of Table 3 shows that the collectivization reduces the animal growth rate by 5.4 percentage points, when the size of the cooperatives is at its mean value. Doubling the size (or an increase by about 0.7 log points) would further drive down 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 the collectivization. Unlike the ratio of middle peasant households, which is pre-determined prior to the collectivization, the size of advanced cooperatives could be affected by the local animal growth rate. In fact, to mitigate the impact of the collectivization and the challenges of managing large cooperatives, many local governments downsized the cooperative (Ye, 2006). If the cooperatives shrink in order to reduce the animal loss, the effects of the cooperative size on the animal loss would be underestimated.

Other County Characteristics

Some other county characteristics may also influence the effects of the collectivization. For example, the distance from the provincial capital, or the county's revolutionary legacy, could affect their political connections to the government and to the CPC. A county at the national border, or a county with a large population of ethnic minorities, might be able to enjoy some favorable policies or subsidies during the collectivization. We calculate the distance to the provincial capital, create an indicator for the counties on the national land border and an indicator for those officially recognized "revolutionary base" (Ministry of Agriculture, 1989), and calculate the share of ethnic minorities in the population from the 1982 census. Panel B of Table 1 shows that three percent of counties in our sample are on the national border, and ten percent are a revolutionary base. The average ratio of ethnic minorities is 0.12. An half of the counties do not have any ethnic minorities, and 10 percent of the counties have more than 50 percent of minorities in its population. None of these county characteristics, except for the ratio of middle peasant households and the size of advanced cooperatives, alters the mean effect of the collectivization across counties, shown in column 4 of Table 3.

The Tragedy of the Commons

The estimated effects of the collectivization were likely to be a mixed consequences of two types of behavior, both related to weak private property rights. Owners could 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 take in charge of the animals. The effects of overuse and mistreatment are also likely to be more gradual, compared to the immediate slaughter during the collectivization movement,

Thus, at the time of introducing the advanced cooperatives, the immediate decline in the animals was more likely to be a result of slaughter. To highlight this immediate effect, we drop the observations in 1956 and 1957 for the group of counties that started the collectivization in 1955, and the observations in 1957 for the group that started in 1956. Columns 5 and 6 of Table 3 re-estimate the main specifications with this truncated sample, and the results are similar to the previous estimates. On average, the collectivization reduces the animal growth rate by 5 percentage points, and this effect is larger in the counties with more middle peasants or with larger advanced cooperatives.

6 Grain Output

The main goal of the 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). The collectivization and larger cooperatives could lead to lower productivity, however, for at least two reasons discussed in Lin (1990). First, the work incentives could be lower in such a large collective because of the little 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 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 the effects of the collectivization could be captured in productivity. The collectivization also reduces the inventory of draft animals, an important input in grain production. The overall effect of the 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.

$$\begin{aligned}
\log(\text{grain_output})_{it} = & \gamma \text{collectivization}_{it-1} + \beta_l \log(\text{arable_land})_{it} + \beta_p \log(\text{rural_population})_{it} \\
& + \beta_a \log(\text{animal_inventory})_{it} + \text{year}_t + \text{county}_i + \text{flood}_{it} \\
& + \text{drought}_{it} + \varepsilon_{it} \quad (3)
\end{aligned}$$

$\text{Collectivization}_{it-1}$ is a dummy equal to one for the years after the first year of introducing the advanced cooperatives. The national collectivization movement started in the fall of 1955, and the most counties started in the winter to avoid disrupting the harvest. For the counties that started the movement in 1956, many waited until the summer harvest was finished.²⁷ Thus, we allow for an one year lag in the effect of the collectivization on grain output. A set of year dummies year_t and two calamity indicators capture the general shocks to grain production. County dummies, county_i , capture the average difference in grain output across counties, perhaps through the difference in land quality.

Without including the three production inputs, $\hat{\gamma}$ summarizes the overall causal effect of the 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 the collectivization across counties is not related to the amount of land and rural population, as shown both in Figure 5 and in Appendix Table 2. Adding $\log(\text{animal_inventory})_{it}$, however, would attenuate $\hat{\gamma}$, since the collectivization results in lower 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 the collectivization.

Table 4 reports the estimates. 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, consistent with the estimates from provincial level data in Li and Yang (2005). Overall, the 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, significantly different from the estimate in column 2, suggested by a Hausman test. Thus the total loss in grain output caused by the collectivization, 6.7 percent, could be attributed to lower productivity (5.4 percent) and the loss of draft animals (1.3 percent).

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).²⁸ Using provincial-

²⁷For example, according to the People's Daily on October 28 in 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 the collectivization.

²⁸See the coefficient of $\ln(\text{farm capital})$ in column 1 of Table 5 in Li and Yang (2005), pp 863. They

level data from 1952 to 1977, they argue that the allocation of production inputs at the provincial level was decided by the central planner. The decisions were based on the 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 multiple it by -0.06, the lower bound of the estimated annual change in the animal inventory caused by the collectivization, we conclude that through the channel of killing draft animals, the collectivization reduces grain output by 1.5 percent, similar to the decomposition in the last paragraph.

An alternative explanation for the declined grain output is that the collectives allocate 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 1957, among all the sown land, the ratio allocated to grain was continuously decreasing. The accumulative decline in the eight years, however, was small, from 0.89 to 0.85. More importantly, the decline was neither accelerated nor reversed in the years following the collectivization.

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 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. More animals were slaughtered in counties where private property rights had been more established prior to the collectivization, or where agricultural output had to be shared in large collectives with more members. The 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.

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 ignorable, as shown in Section 5 in this paper and in 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 either sparse or not available at all. Instead, we use rural population and the area of arable land.

References

- Acemoglu, Daron, Simon Johnson and James A Robinson. 2001. “The Colonial Origins of Comparative Development: An Empirical Investigation.” *American Economic Review* 91(5):1369–1401.
- Alchian, Armen A. and Harold Demsetz. 1973. “The Property Right Paradigm.” *Journal of Economic History* 33(01):16–27.
- Banerjee, Abhijit V, Paul J Gertler and Maitreesh Ghatak. 2002. “Empowerment and Efficiency: Tenancy Reform in West Bengal.” *Journal of Political Economy* 110(2):239–280.
- Besley, Timothy. 1995. “Property Rights and Investment Incentives: Theory and Evidence from Ghana.” *Journal of Political Economy* 103(5):903–937.
- Besley, Timothy and Maitreesh Ghatak. 2010. Property Rights and Economic Development. In *Handbook of Development Economics Vol. 5*, ed. Dani Rodrik and Mark Rosenzweig. North-Holland.
- Cameron, Colin A., John B. Gelbach and Douglas L. Miller. 2011. “Robust Inference With Multiway Clustering.” *Journal of Business & Economic Statistics* 29(2):238–249.
- Coase, Ronald H. 1960. “The Problem of Social Cost.” *Journal of Law and Economics* 3:1–44.
- De Janvry, Alain, Kyle Emerick, Marco Gonzalez-Navarro and Elisabeth Sadoulet. 2015. “Delinking Land Rights from Land Use: Certification and Migration in Mexico.” *American Economic Review* 105(10):3125–3149.
- Demsetz, Harold. 1967. “Toward a Theory of Property Rights.” *American Economic Review, Papers and Proceedings* 57(2):347–359.
- Du, Runsheng(ed). 2002. *The Agricultural Collectivization in Modern China (in Chinese)*. Contemporary China Publishing House.
- Fenske, James. 2011. “Land Tenure and Investment Incentives: Evidence from West Africa.” *Journal of Development Economics* 95(2):137–156.
- Field, Erica. 2007. “Entitled to Work: Urban Property Rights and Labor Supply in Peru.” *Quarterly Journal of Economics* 122(4):1561–1602.
- Fitzpatrick, Sheila. 1996. *Stalin’s Peasants: Resistance and Survival in the Russian Village after Collectivization*. Oxford University Press.

- Friedman, Edward, Paul Pickowicz and Mark Selden. 1991. *Chinese Village, Socialist State*. Yale University Press.
- Galiani, Sebastian and Ernesto Schargrotsky. 2010. "Property Rights for the Poor: Effects of Land Titling." *Journal of Public Economics* 94(9):700–729.
- Goldstein, Markus and Christopher Udry. 2008. "The Profits of Power: Land Rights and Agricultural Investment in Ghana." *Journal of Political Economy* 116(6):981–1022.
- Hinton, William. 1966. *Fanshen: A Documentary of Revolution in a Chinese Village*. University of California Press.
- Hinton, William. 1983. *Shenfan: the Continuing Revolution in a Chinese Village*. New York: RandomHouse Inc.
- Hornbeck, Richard. 2010. "Barbed Wire: Property Rights and Agricultural Development." *Quarterly Journal of Economics* 125(2):767–810.
- Huang, Daoxia(ed). 1992. *Compendium of Historical Documents on Collectivization Since the Founding of the People's Republic of China (in Chinese)*. Press of Central Party School of the Communist Party of China.
- Jacoby, Hanan G, Guo Li and Scott Rozelle. 2002. "Hazards of Expropriation: Tenure Insecurity and Investment in Rural China." *American Economic Review* 92(5):1420–1447.
- Jasny, Naum. 1949. *The Socialized Agriculture of the USSR: Plans and Performance*. Stanford University Press.
- Johnson, Simon, John McMillan and Christopher Woodruff. 2002. "Property Rights and Finance." *American Economic Review* 92(5):1335–1356.
- Kung, James Kai-sing and Shuo Chen. 2011. "The Tragedy of the Nomenklatura: Career Incentives and Political Radicalism during China's Great Leap Famine." *American Political Science Review* 105(01):27–45.
- Lardy, Nicholas R. 1987. Economic Recovery and the First Five-Year Plan. In *The Cambridge History of China: The People's Republic, Part I*, ed. Roderick MacFarquhar and John King Fairbank. Vol. 14 pp. 144–184.
- Li, Renfeng. 1981. *Compendium of Agricultural Statistics in the Soviet Union (in Chinese)*. China Economic Publishing House.

- Li, Wei and Dennis Tao Yang. 2005. "The Great Leap Forward: Anatomy of a Central Planning Disaster." *Journal of Political Economy* 113(4):840–877.
- Lin, Justin Yifu. 1990. "Collectivization and China's Agricultural Crisis in 1959-1961." *Journal of Political Economy* 98(6):1228–1252.
- Lin, Justin Yifu. 1992. "Rural Reforms and Agricultural Growth in China." *American Economic Review* 82:34–51.
- Lin, Yunhui. 2009. *Moving Toward Socialism: The Transformation of China's Economy and Society (1953-1955) (in Chinese)*. The Chinese University Press.
- Meng, Xin, Nancy Qian and Pierre Yared. 2015. "The Institutional Causes of China's Great Famine, 1959–1961." *Review of Economic Studies* 82(4):1568–1611.
- Ministry of Agriculture. 1989. *Encyclopedia of Statistics of the Rural Economy in China, 1949-1986 (in Chinese)*. Agricultural Publishing House.
- Ministry of Agriculture. 1990. *Statistics of Animal Husbandry in China, 1949-1989 (in Chinese)*. China Economic Publishing House.
- National Bureau of Statistics. 1956. *Survey Statistics of Revenue Distributions in Agricultural Cooperatives in 1955 (in Chinese)*. Statistics Press.
- National Bureau of Statistics. 1957. *Statistics of Cooperativization in Agriculture and Revenue Distributions in Cooperatives in 1955 (in Chinese)*. Statistics Press.
- National Bureau of Statistics. 1957b. *Survey Statistics of Revenue Distributions in Agricultural Cooperatives in 24 Provinces, Municipalities, and Autonomous Regions in 1956 (in Chinese)*. Declassified Reports.
- National Bureau of Statistics. 1980. *National Agricultural Statistics in the Three Decades since the Founding of the People's Republic of China (1949-1979) (in Chinese)*. Declassified Reports.
- National Bureau of Statistics. 2010. *China Compendium of Statistics: 1949-2008*. China Statistics Press.
- Naughton, Barry. 2007. *The Chinese economy: Transitions and growth*. MIT press.
- Shue, Vivienne. 1980. *Peasant China in Transition: the Dynamics of Development toward Socialism, 1949-1956*. University of California Press.

- Svensson, Jakob. 1998. "Investment, Property Rights and Political Instability: Theory and Evidence." *European Economic Review* 42(7):1317–1341.
- Teiwes, Frederick C. 1987. Establishment and Consolidation of the New Regime. In *The Cambridge History of China: The People's Republic, Part I*, ed. Roderick MacFarquhar and John King Fairbank. Vol. 14 pp. 51–143.
- The State Meteorological Society. 1981. *Yearly Charts of Dryness/Wetness in China for the Last 500-year Period (in Chinese)*. Di Tu Publishing House.
- Wen, Guanzhong James. 1993. "Total Factor Productivity Change in China's Farming Sector: 1952-1989." *Economic Development and Cultural Change* 42(1):1–41.
- Ye, Yangbin. 2006. *The China's Movement of Cooperativization in Agriculture (in Chinese)*. Intellectual Properties Press.

Appendix: Data Sources

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

For 1,323 counties in 20 provinces, we find the complete agricultural statistics compiled by the provincial bureaus of statistics or bureaus of agriculture. For a centrally planning 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 is in 1958, which summarizes the first five-year plan (1953-1957). The second wave is between 1978 and 1983, which reviews the first three decades of the People's Republic of China since its founding in 1949. The third wave is for celebrating the 60th anniversary of the Republic in 2009. Many provinces display their achievements in the past six decades by publishing volumes of statistics, usually aggregated at the provincial or prefectural level. Some provinces, such as Jilin and Yunan, report county statistics as well.

When provincial compilations are unavailable, we use prefectural compilations of county statistics. A prefecture is an administrative division under a province, and each prefecture

consists of several counties. We manage to find 19 prefectural compilations of statistics of 155 counties. When neither provincial nor prefectural compilations are available, we resort to 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 the 1990s. Every county gazetteer has a section on agriculture that documents relevant policies and some official statistics of agricultural production. Not many gazetteers, however, report the inventory of draft animals in the 1950s. We find such statistics in 252 county gazetteers.

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

11 (Administrative Division Code) Beijing Municipality [the number of counties included in our sample: 4]

The statistics are from county gazetteers.

12 Tianjin Municipality [11 counties]

Historical Yearly Statistics of Animal Husbandry in Tianjin Municipality, the Bureau of Animal Husbandry in Tianjin Municipality, Hebei Science and Technology Press, 1988

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

Economic Statistics in Langfang Prefecture: 1949-1979, the Statistic Bureau of Langfang Prefecture, 1980

Economic Statistics in Qinhuangdao Prefecture: 1949-1984, the Statistic Bureau of Qinhuangdao Prefecture, 1985

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]

Statistics of Agricultural and Animal Husbandry Production: 1947-1978, Volumes I-IV. the Statistic Bureau of Nei Mongol Autonomous Region, 1983

Brilliant Inner Mongolia: 1947-1999, China Statistics Press, 1999. We use this book for the data of population.

21 Liaoning Province [33 counties]

One Decade of Economic Achievements of Jinzhou Prefecture 1949-1958, the Statistics Bureau of Jinzhou Prefecture, 1959

Economic Statistics in Andong Prefecture: 1949-1962, the Statistics Bureau of Andong Prefecture, 1964

Compendium of Economic Statistics in Benxi Prefecture: 1949-1971, the Statistics Bureau of Benxi Prefecture, 1975

The statistics of other counties are from county gazetteers.

22 Jilin Province [36 counties]

Jilin Compendium of Statistics of Sixty Years of Agricultural Development: 1949-2009, Jilin Press Group Corporation, 2011

23 Heilongjiang Province [59 counties]

Heilongjiang Compendium of Economic Statistics (Agricultural and Subsidiary Production): 1949-1957, the Statistics Bureau of Heilongjiang Province, 1958

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

Vivid Wenzhou Prefecture: Four Decades of Great Economic and Social Achievements (1949-1988), the Statistic Bureau of Wenzhou Prefecture, 1989

Four Decades of Zhoushan Prefecture (1949-1988), the Statistic Bureau of Zhoushan Prefecture, 1989

Progressive Taizhou Prefecture: 1947-1990, the Statistics Bureau of Taizhou Prefecture, China Statistics Press, 1994

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]

Jiangxi Compendium of Agricultural Statistics, by Cities and Counties (1949-1965), Volumes I and II, the Bureau of Agriculture, Animal Husbandry, and Fishery in Jiangxi Province, 1989

37 Shandong Province [100 counties]

Statistics of Agricultural Production of Shandong Province during the First Five-Year Plan Period: 1952-1957, the Agricultural Bureau of Shandong Province, and the Statistic Bureau of Shandong Province, 1958

41 Henan Province [112 counties]

Agricultural Statistics in Henan Province in the Three Decades since 1949: 1949-1979, Volumes II-XI, the Agricultural Bureau of Henan Province, and the Statistic Bureau of Henan Province, 1981

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]

Economic Statistics in Guangxi Zhuang Autonomous Region (Agriculture): 1949-1980, Volumes II and III, the Statistics Bureau of Guangxi Zhuang Autonomous Region, 1985

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

Historical Statistics of the Economic and Social Development in the Ethnic Minority Regions in Sichuan Province: 1949-1985, the Committee of Minorities Affair of Sichuan Province, and the Statistics Bureau of Sichuan Province, 1988

The statistics of other counties are from county gazetteers.

52 Guizhou Province [63 counties]

Economic Statistics of Bijie Prefecture in Guizhou Province: 1949-1959, the Statistics Bureau of Bijie Prefecture, 1960

Forty Years of Progress in Qiannan Prefecture: 1949-1988, the Editorial Committee of the Book, and the Statistics Bureau of Qiannan Buyei and Miao Autonomous Prefecture, 1989

Fifty Years of Tongren Prefecture: 1949-2009, the Editorial Committee of the Book, 1999

Sixty Years of Zunyi Prefecture: 1949-2009, the Statistics Bureau of Zunyi, and the Survey Team of Zunyi of the National Bureau of Statistics, 2009

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

Xi'an Compendium of Historical Statistics: 1949-1989, Volume I, the Statistics Bureau of Xi'an Prefecture, China Statistics Press, 1995

The statistics of other counties are from county gazetteers.

62 Gansu Province [73 counties]

Statistics in Agriculture, Forestry, Animal Husbandry, Water Conservation, and Weather in Gansu Province: 1949-1957, the Division on Rural Issues of the Committee of Chinese Communist Party of Gansu Province, 1958

63 Qinghai Province [33 counties]

Economic Statistics in Qinghai Province :1949-1979, the Statistics Bureau of Qinghai Province, 1981

64 Ningxia Hui Autonomous Region [18 counties]

Economic Statistics in Ningxia Hui Autonomous Region (Agriculture) :1949-1965, Statistics Bureau of Ningxia Hui Autonomous Region, 1966

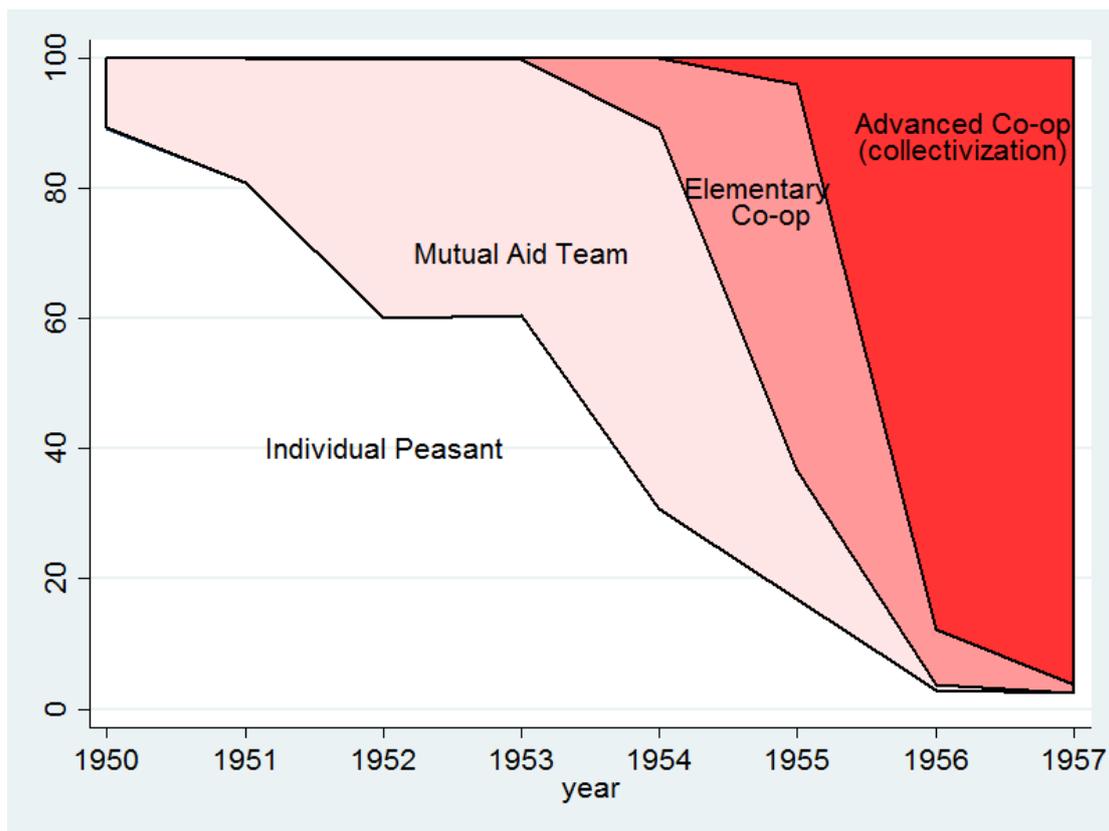
65 Xinjiang Uygur Autonomous Region [80 counties]

Agricultural Statistics in Xinjiang Uygur Autonomous Region: 1949-1978, Volumes I and II, the Agricultural Bureau of Xinjiang Uygur Autonomous Region, and the Statistics Bureau of Xinjiang Uygur Autonomous Region; 1980

Animal Husbandry Statistics in Xinjiang Uygur Autonomous Region: 1949-1978, the Animal Husbandry Bureau of Xinjiang Uygur Autonomous Region, and the Statistics Bureau of Xinjiang Uygur Autonomous Region; 1980

The statistics of population are from county gazetteers.

Figure 1 Percentage of Rural Households Included in Various Organizations



Source: National Bureau of Statistics (1957, 1980)

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 1950 to 1953, in the end of the year. In 1955, only the total percentage of individual peasants and mutual aid teams was available.

Figure 2A The National Inventory of Draft Animals (million head)

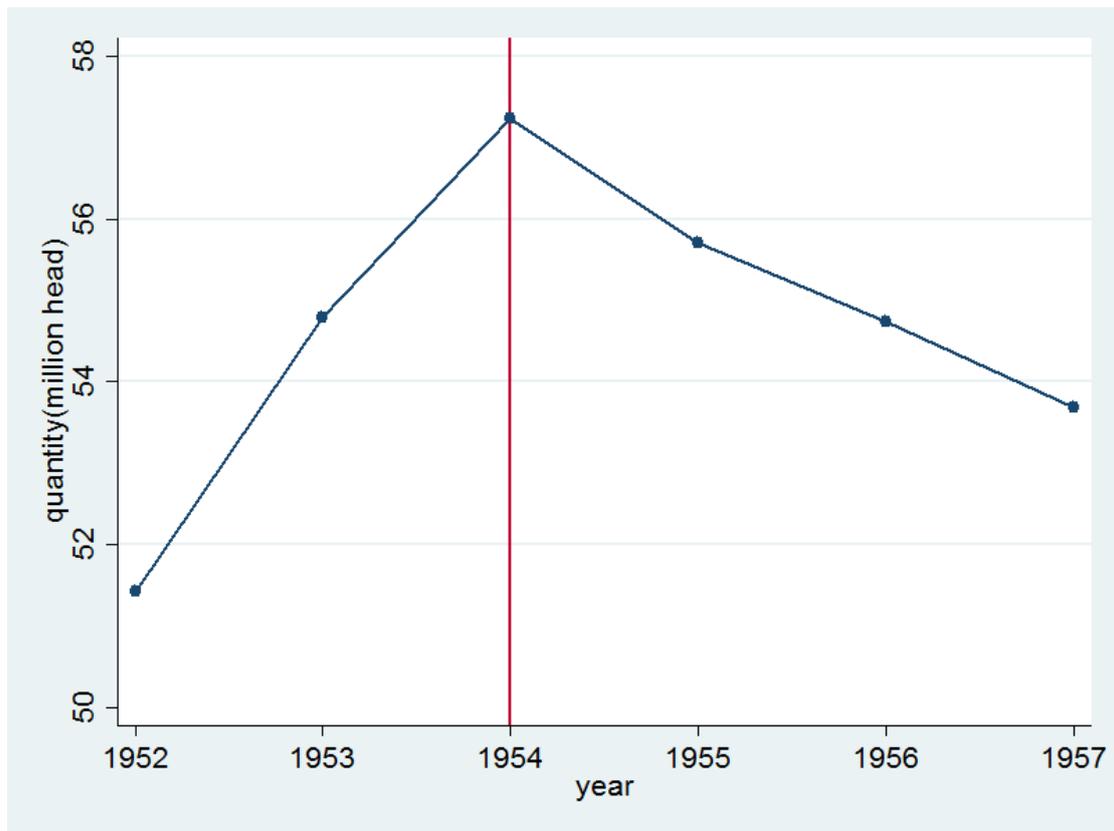
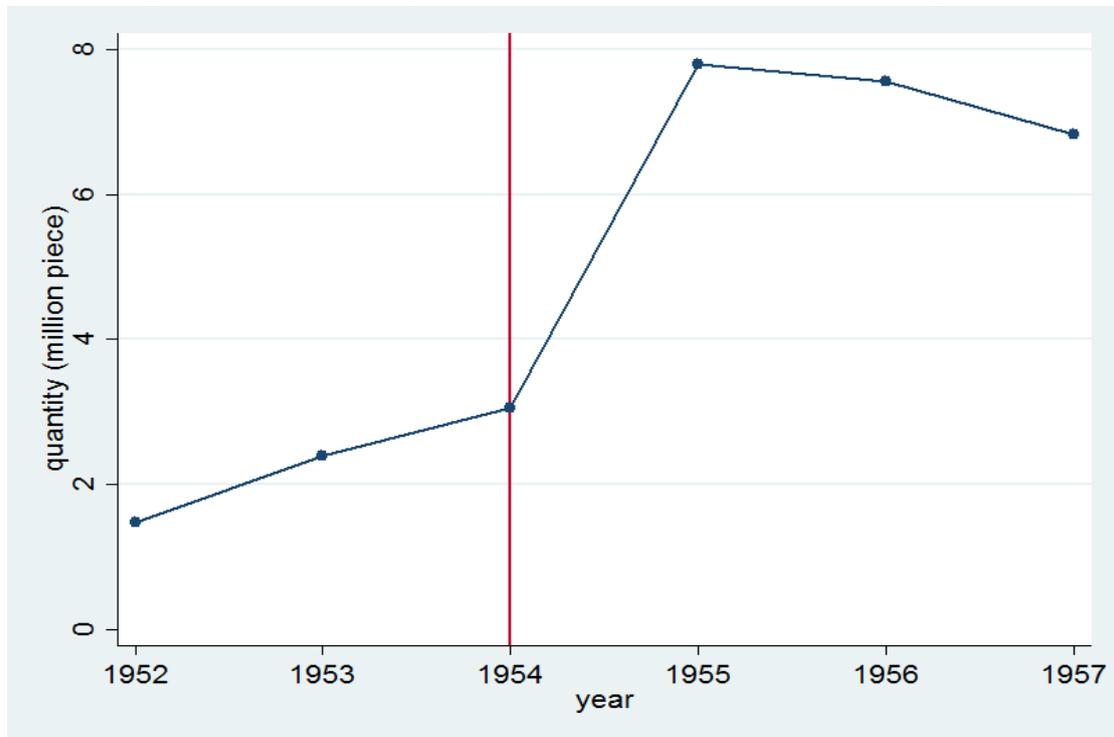
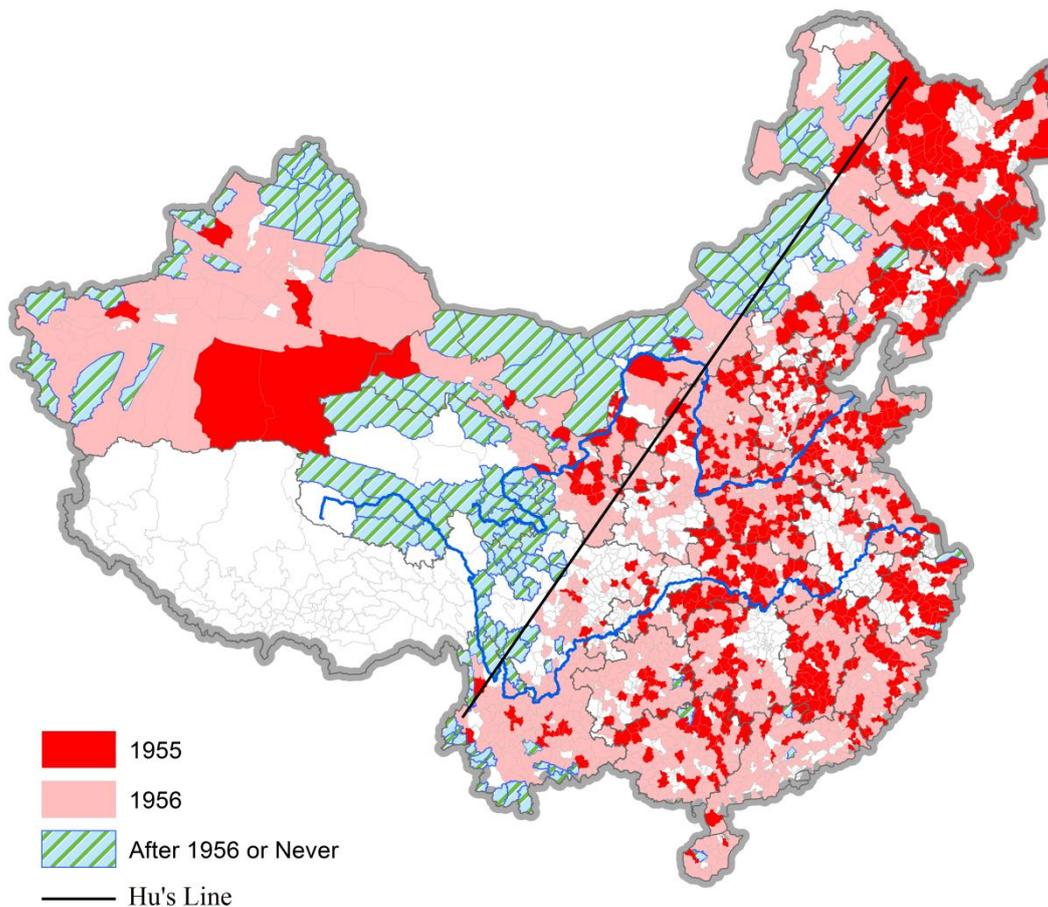


Figure 2B The Quantity of Cowhide Sold Nationwide (million piece)



Source: Ministry of Agriculture (1990)

Figure 3 The Year of the Introduction of Advanced Cooperatives in 1,720 Counties



Note: In our sample of 1720 counties, 569 counties started to establish advanced cooperatives in 1955; and 1031 counties started in 1956. 120 counties started later, or never established an advanced cooperative. The majority of these counties are on the pasturelands of China.

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

Source: County gazetteers.

Figure 4 The Log of the Average Inventory of Draft Animals, in Two Groups of Counties that Introduced Advanced Cooperatives in 1955 or 1956

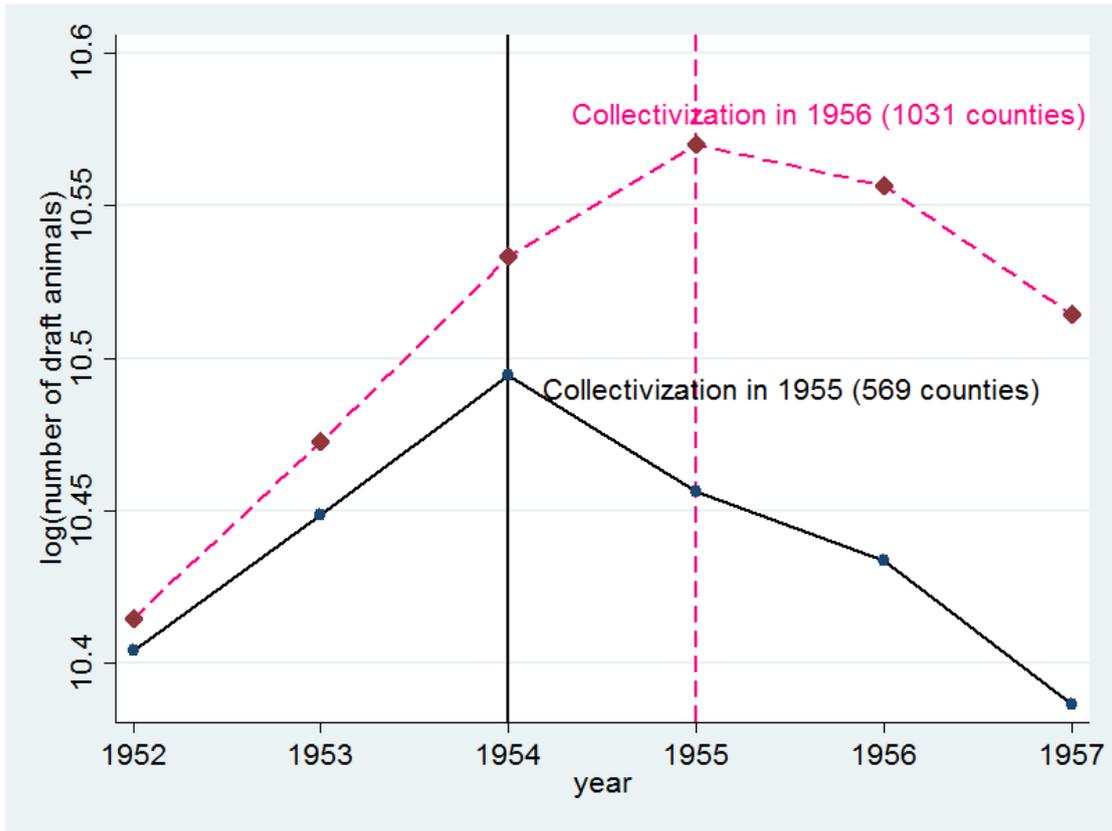


Figure 5 The Average Growth Rates, in Two Groups of Counties that Introduced Advanced Cooperatives in 1955 or 1956

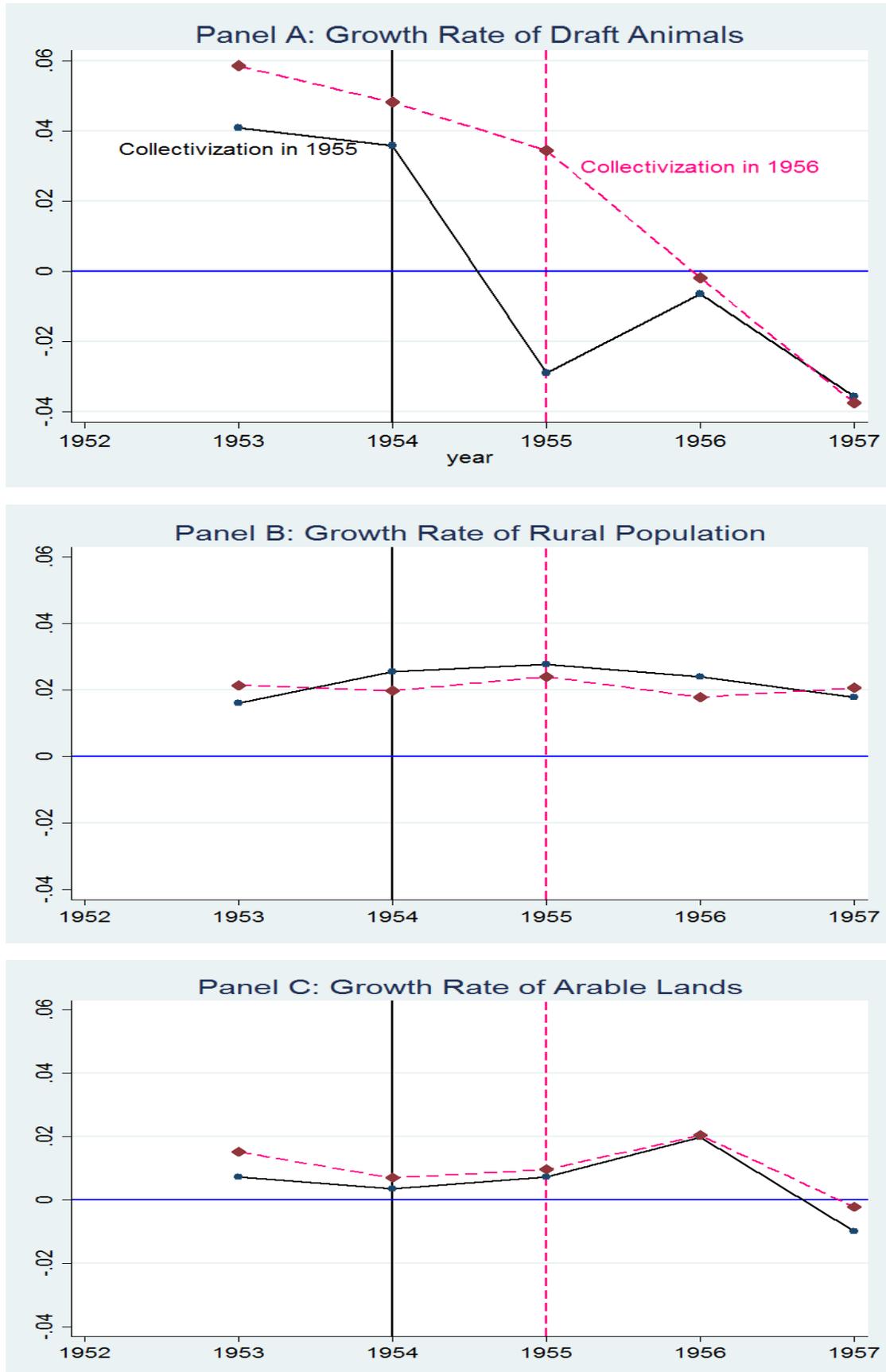
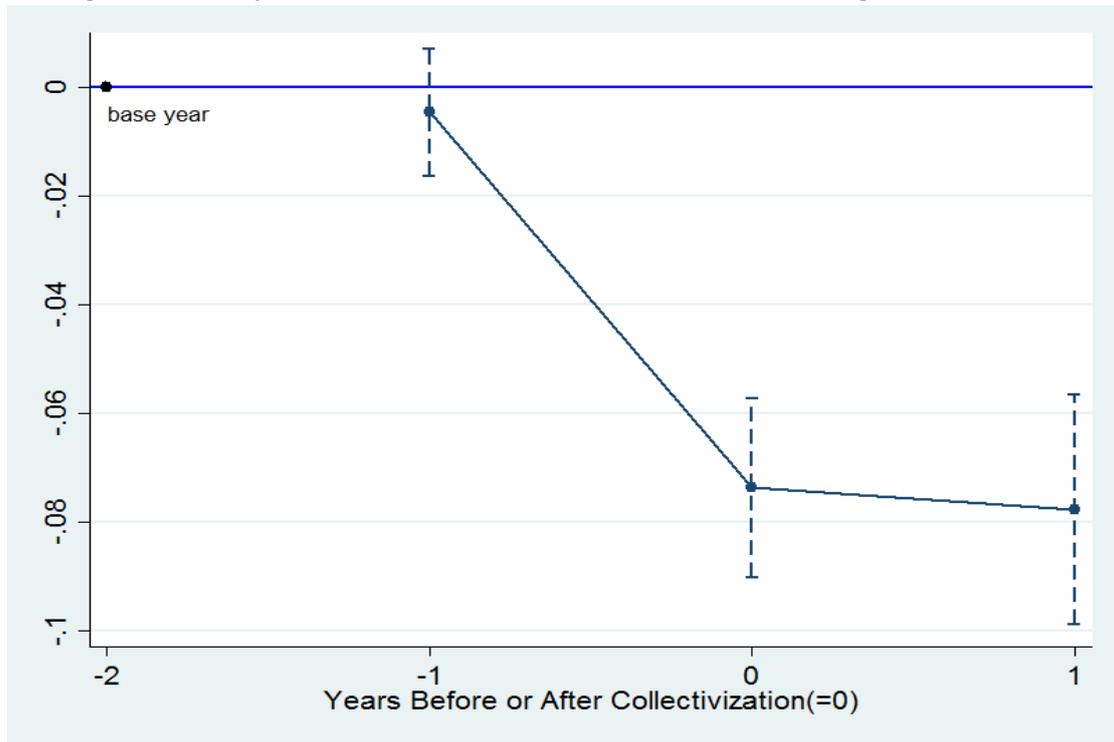
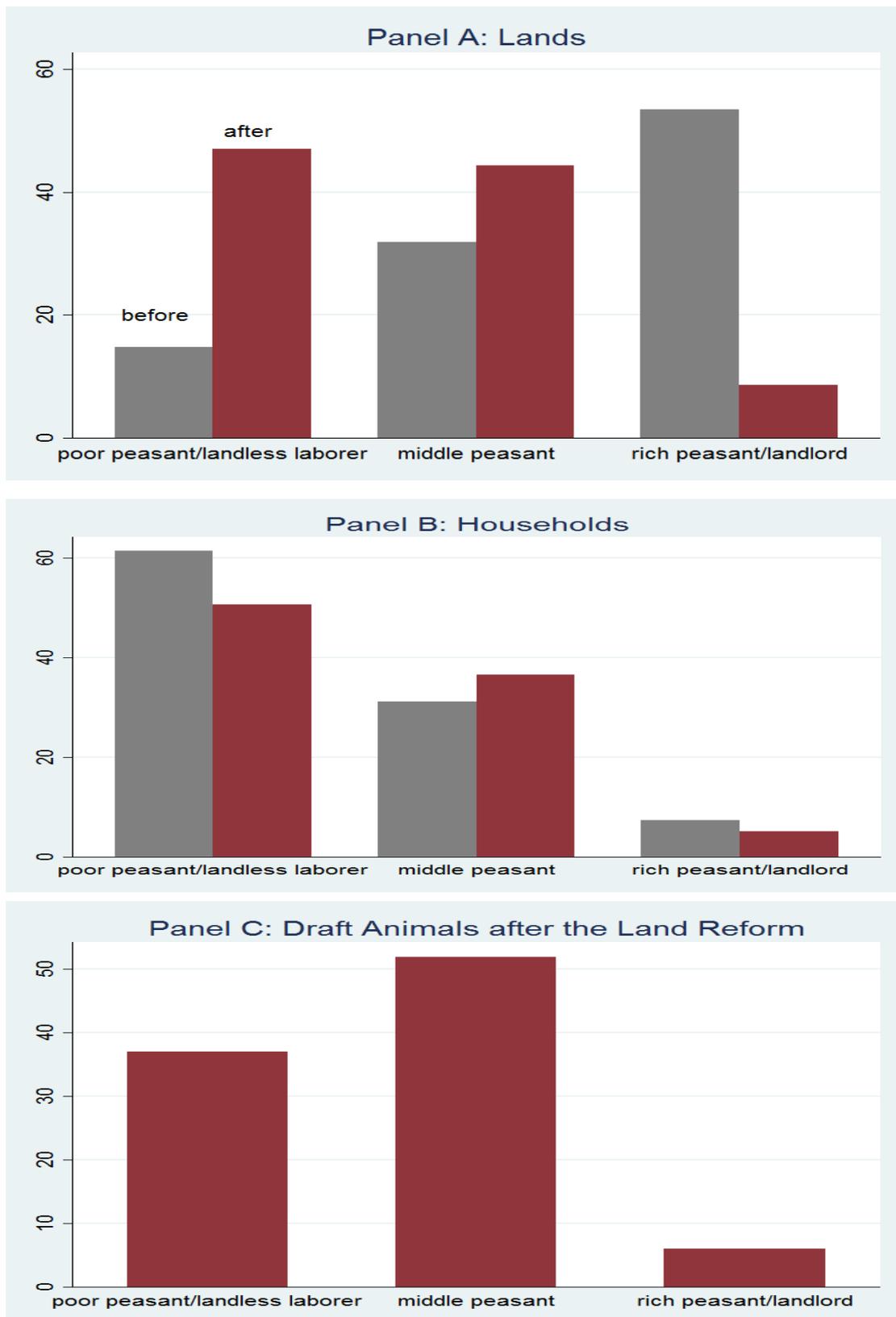


Figure 6 The Dynamic Effects of the Collectivization on $\Delta\log$ (draft animals)



This figure shows that the 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 reports the coefficients. The dotted lines indicate the 95% 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 the collectivization. All regressions also 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 2.

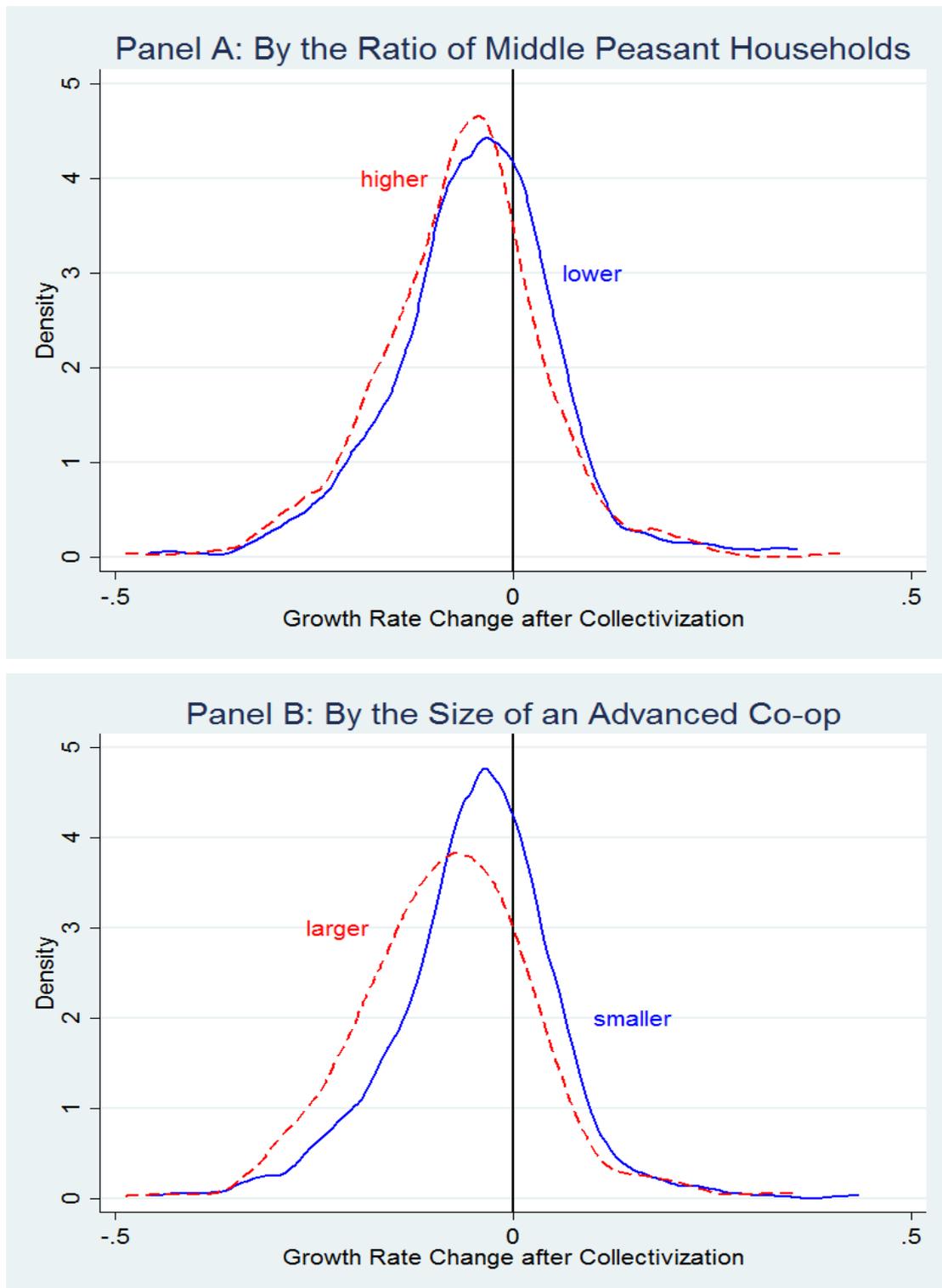
Figure 7 The Distribution (in percentages) of Lands, Households, and Draft Animals, before and after the Land Reform, by the Classes Assigned in the Reform



Notes: In Panel C, the data before the land reform are not available.

Source: National Bureau of Statistics (1980)

Figure 8 The Distributions of the County-specific Changes in the Growth Rate of the Animal Inventory after the Collectivization



Notes: Panel A divides the two groups of counties by the median of the ratio of middle peasant households. Panel B divides the two groups are divided by the median of the size of an advanced cooperative.

Table 1 Summary Statistics

	N	Mean	S.D.	Min	Max
Panel A: Variables that Change across 1600 Counties and over Years (1952-57)					
Draft animals (1,000 head)	9600	35.82	25.06	0.59	183.82
Log(draft animals)	9600	10.22	0.8	6.38	12.12
First difference in log(draft animals)	8000	0.01	0.12	-1.12	2.53
Collectivization	9600	0.39	0.49	0	1
Rural Population (1,000)	8862	255.1	185.9	22.12	1106
Arable land (1,000 hectares)	8699	56.25	44.43	0.66	369.28
Grain output (1,000 tons)	9190	79.23	61.54	0.11	531
Flood	9524	0.19	0.39	0	1
Drought	9524	0.12	0.32	0	1
Panel B: County Characteristics that Do Not Change over Years					
Ratio of middle peasant households	895	0.32	0.11	0.07	0.89
Number of people included in an advanced cooperative	1276	1154	1395	108	22906
Distance to the Provincial Capital (km)	1600	187	164	0	1339
A revolutionary base	1600	0.10	0.31	0	1
On the national land border	1600	0.03	0.18	0	1
Ratio of ethnic minorities	1600	0.12	0.24	0	1

Table 2 The Effects of the Collectivization on the Annual Growth Rate of Draft Animals: $\Delta\log$ (draft animals)

	(1)	(2)	(3)	(4)
collectivization	-0.055*** (0.006)	-0.063*** (0.007)	-0.055*** (0.006)	-0.061*** (0.007)
group 1956	0.008*** (0.003)	0.006** (0.003)		
$\Delta\log$ (rural population)		0.047* (0.027)		0.047* (0.028)
$\Delta\log$ (arable lands)		0.168** (0.075)		0.141* (0.075)
flood		-0.026*** (0.004)		-0.017*** (0.005)
drought		-0.019*** (0.004)		-0.020*** (0.005)
constant	0.013 (0.008)	0.052*** (0.004)	0.018*** (0.007)	0.059*** (0.008)
year FE	Y	Y	Y	Y
county FE			Y	Y
N	8,000	6,516	8,000	6,516

Standard errors are clustered at county level

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

This table reports the difference-in-differences estimates of the effects of the 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 the collectivization reduces the annual growth rate of draft animals by six percentage points. In columns 1 and 2, we divide all counties into two groups that started the collectivization in 1955 or 1956. A group indicator captures the average difference between the two groups.

Table 3 The Effects of the Collectivization on $\Delta\log$ (draft animals), Varied with County Characteristics

	Full Sample			Truncated Sample ^{††}		
	(1)	(2)	(3)	(4)	(5)	(6)
Collectivization	-0.042*** (0.009)	-0.054*** (0.008)	-0.039*** (0.014)	-0.042*** (0.010)	-0.053*** (0.008)	-0.037*** (0.011)
Collectivization*ratio of middle peasant households [†]	-0.087*** (0.031)		-0.091*** (0.033)	-0.088*** (0.033)		-0.086** (0.042)
Collectivization*log(number of people in a co-op) [†]		-0.025*** (0.005)	-0.023*** (0.008)	-0.024*** (0.008)		-0.023*** (0.008)
Collectivization*log(distance from the capital city) [†]				-0.007 (0.005)		-0.006 (0.005)
Collectivization*dummy for a revolutionary base				0.008 (0.016)		0.010 (0.022)
Collectivization*dummy for national border				-0.002 (0.022)		0.009 (0.026)
Collectivization*ratio of ethnic minorities				0.019 (0.013)		0.012 (0.017)
N	3,653	5,376	3,332	3,332	4,747	2,423

Standard errors are clustered at 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 the regressions include $\Delta\log$ (rural population), $\Delta\log$ (arable land), flood, drought, year dummies, county dummies, and a constant.

[†] The variables are the deviations 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.

^{††} These two regressions focus on the immediate effect of the collectivization. We drop the observations in 1956 and 1957 for the group of counties that started the collectivization in 1955, and we drop the observations in 1957 for the group that started in 1956.

Table 4 The Effects of the Collectivization on Log(Grain Output)

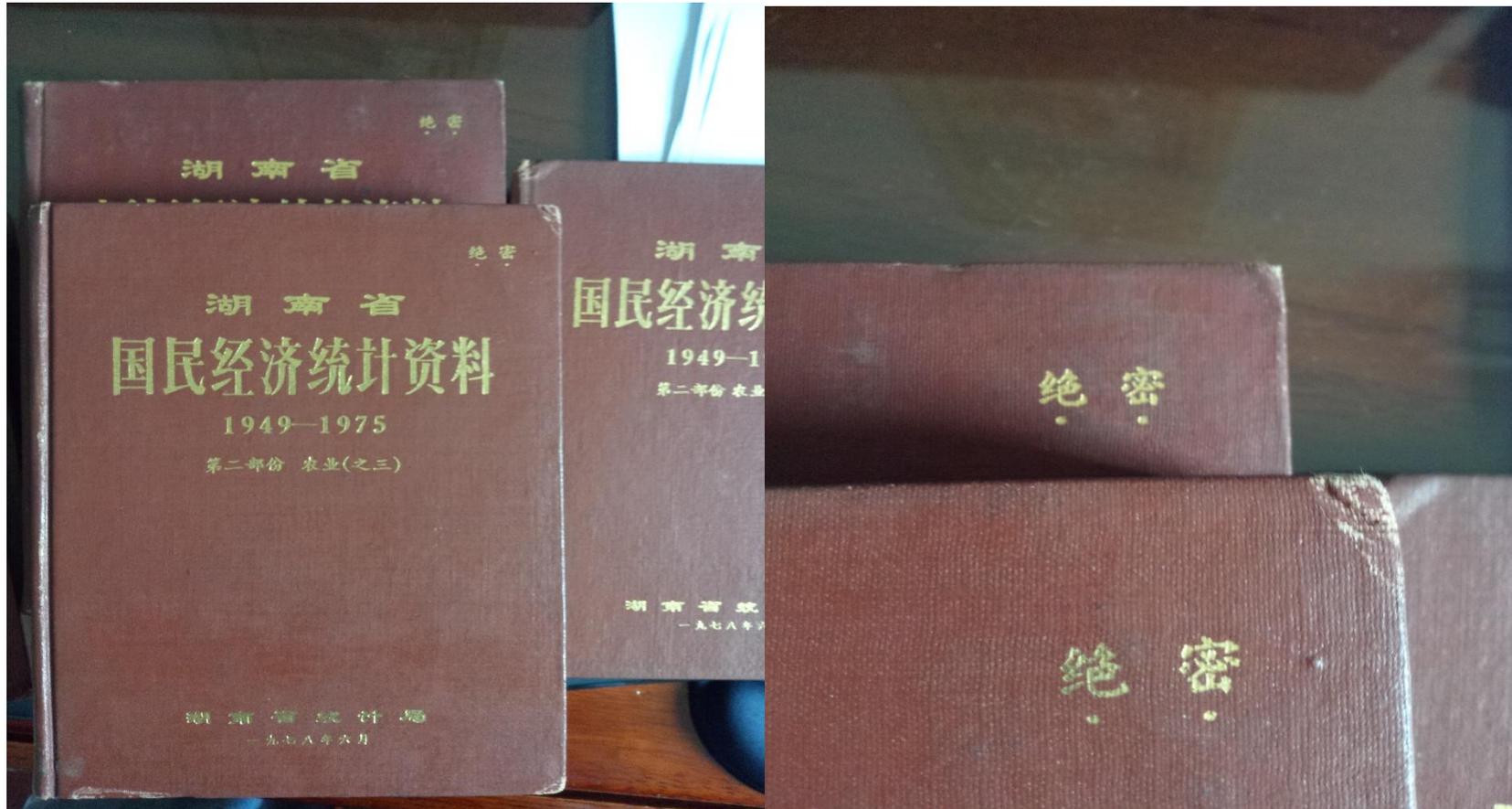
	(1)	(2)	(3)
Collectivization, one year lag	-0.067*** (0.012)	-0.068*** (0.012)	-0.054*** (0.012)
log(draft animals)			0.277*** (0.031)
log(arable land)		0.702*** (0.145)	0.616*** (0.138)
log(rural population)		0.097 (0.061)	0.097* (0.057)
flood	-0.081*** (0.007)	-0.073*** (0.008)	-0.071*** (0.007)
drought	-0.050*** (0.008)	-0.054*** (0.010)	-0.052*** (0.009)
constant	4.171*** (0.005)	0.418 (0.627)	-2.065*** (0.650)
N	9,114	7,877	7,877

Standard errors are clustered at county level

*** $p < 0.01$

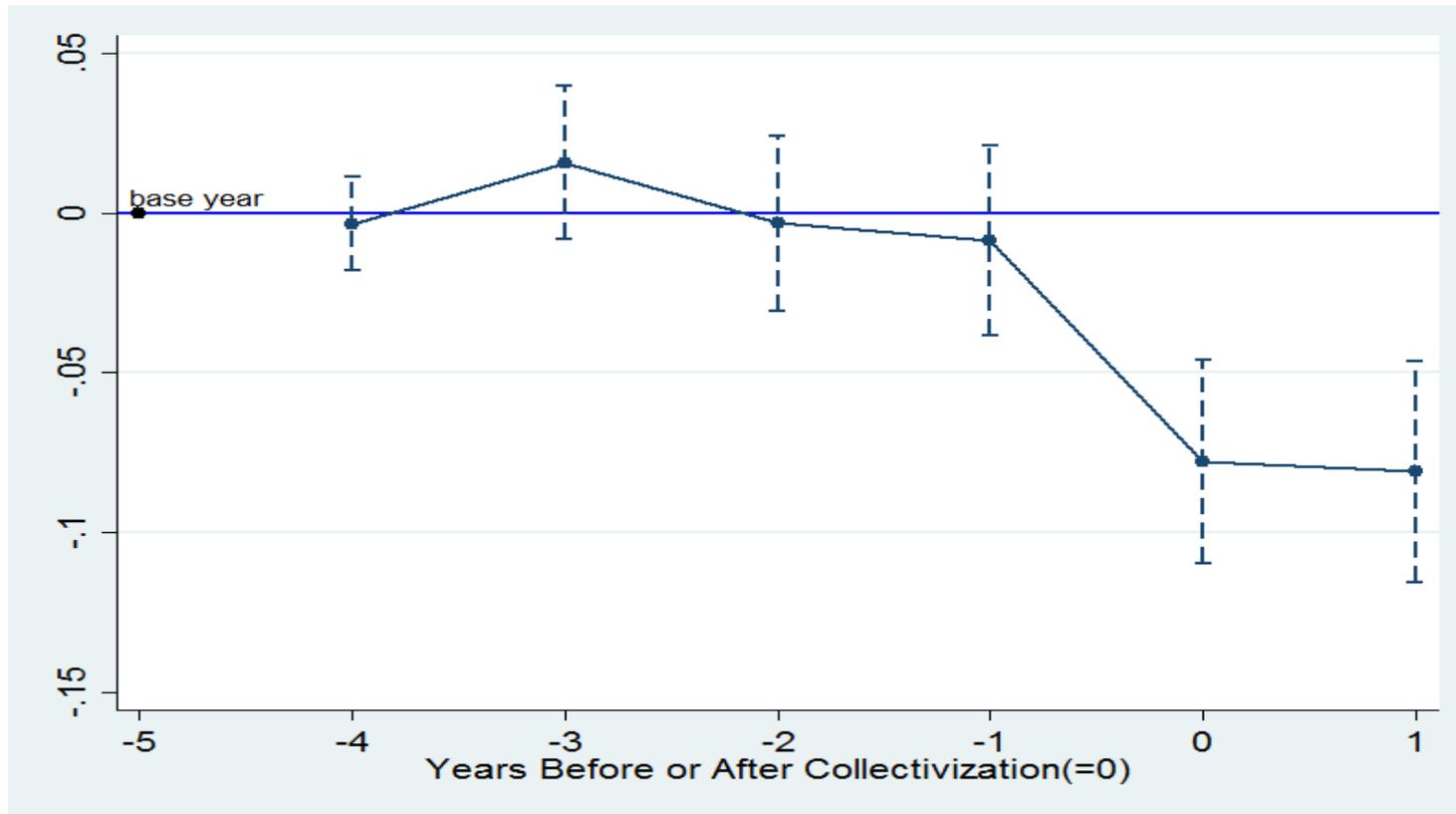
This table reports the difference-in-differences estimates of the effects of the collectivization on grain output. We allow for a one year lag in the effect, because most counties started the collectivization movement in the latter half of a year to avoid disrupting harvest. All the regressions include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

Appendix Figure 1 Some De-classified Government Files



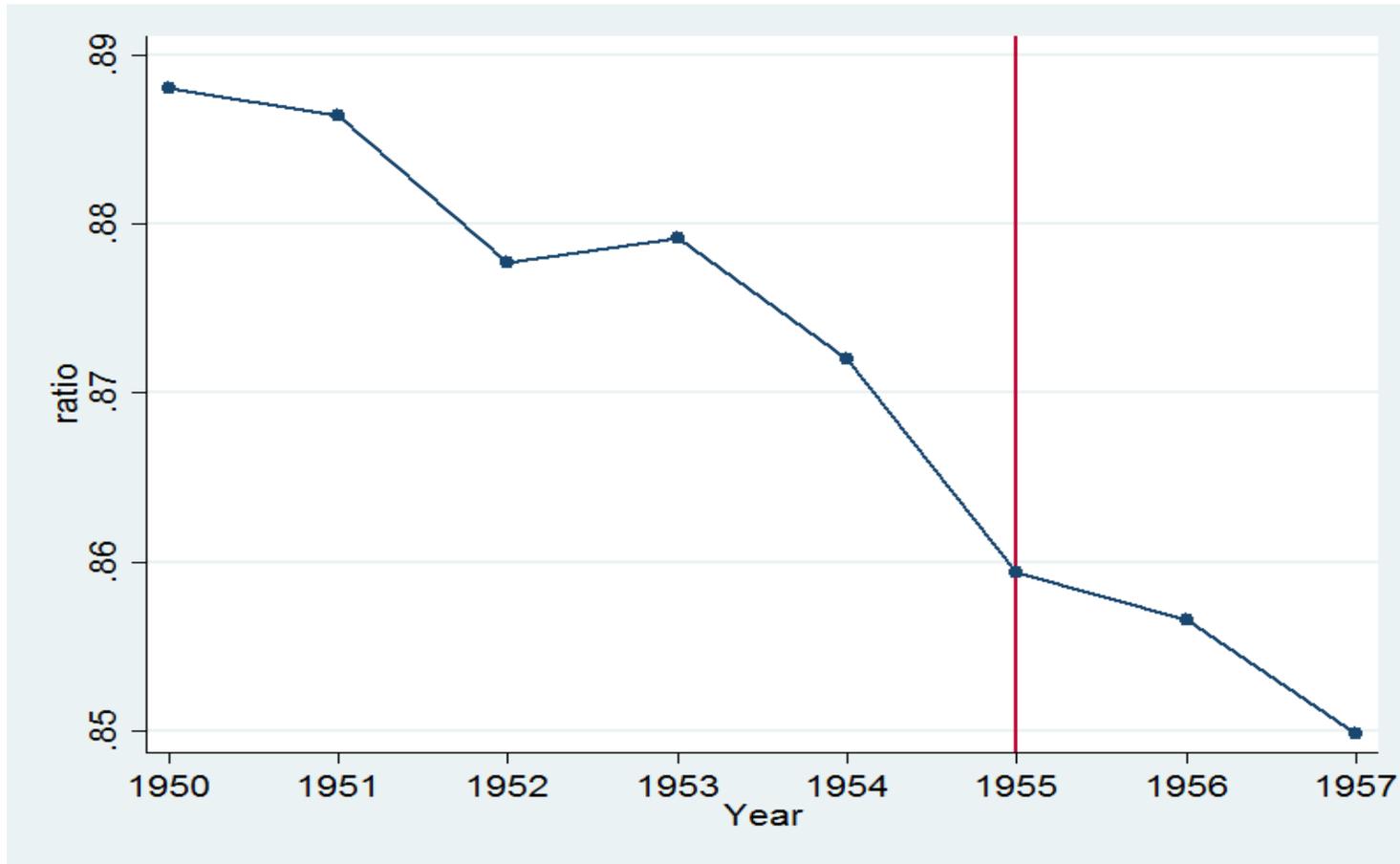
The left picture shows the three volumes of the *Economic Statistics in Hunan Province (Section 2: Agriculture): 1949-1975*. The right picture highlights the classification level of the file, *Top Secret*, on the front cover of the file.

Appendix Figure 2 The Dynamic Effects of the Collectivization on the Annual Growth Rate of Draft Animals: $\Delta \log(\text{draft animals})$



This figure shows that the collectivization, started at year 0, changes the growth rate of the animal inventory. We regress $\Delta \log(\text{draft animals})$ on the normalized year dummies and report the coefficients. The dotted lines indicate the 95% 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 $\Delta \log(\text{draft animals})$ relative to its level in the fifth last year prior to the collectivization. All regressions include $\Delta \log(\text{rural population})$, $\Delta \log(\text{arable lands})$, flood, drought, calendar year dummies, county dummies, and a constant. The coefficients are reported in Appendix Table 2.

Appendix Figure 3 The Ratio of the Area Sown with Grain to 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 small, less than 4 percentage points. The decline was not disrupted or accelerated by the collectivization.

Appendix Table 1 The Effects of the Collectivization on the Annual Growth Rate of Draft Animals: $\Delta\log$ (draft animals), with Different Clustered Errors

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

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

This table repeats the estimates in column 4 of Table 2, with different cluster errors.

Appendix Table 2 The Effects of the Collectivization on the Annual Growth Rate of Rural Population and of Arable Land

	$\Delta\log$ (rural population)		$\Delta\log$ (arable land)	
	(1)	(2)	(3)	(4)
collectivization	0.003 (0.004)	0.002 (0.004)	0.003 (0.007)	0.001 (0.007)
flood		-0.003 (0.002)		-0.011*** (0.004)
drought		-0.000 (0.003)		-0.008** (0.003)
constant	0.017*** (0.005)	0.019*** (0.004)	-0.007 (0.007)	0.024*** (0.007)
year FE	Y	Y	Y	Y
county FE	Y	Y	Y	Y
N	7,222	7,207	7,247	7,190

Standard errors are clustered at 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 the collectivization on $\Delta\log$ (rural population) and on $\Delta\log$ (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 the Collectivization on the Annual Growth Rate of Draft Animals: $\Delta \log$ (draft animals)		
	Sample Years: 1952-1957	Sample Years: 1949-1957
Four years prior to the collectivization		-0.003 (0.007)
Three years prior to the collectivization		0.016 (0.012)
Two years prior to the collectivization		-0.003 (0.014)
One year prior to the collectivization	-0.006 (0.006)	-0.009 (0.015)
The year that started the collectivization	-0.076*** (0.006)	-0.078*** (0.016)
The year after the collectivization	-0.081*** (0.006)	-0.081*** (0.018)
N	5,216	7,912

Standard errors are clustered at county level *** $p < 0.01$

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

Appendix Table 4 The Effects of the Collectivization on the Annual Growth Rate of Draft Animals: $\Delta\log$ (draft animals)
By Two Groups of Provinces, Divided by the Extent of Mechanization

	Beijing, Heilongjiang, Xinjiang, Hebei, and Qinghai (1)	All Other Provinces (2)
collectivization	-0.058** (0.023)	-0.061*** (0.007)
$\Delta\log$ (rural population)	0.020 (0.022)	0.097 (0.063)
$\Delta\log$ (arable lands)	0.245** (0.100)	0.128 (0.081)
flood	-0.001 (0.012)	-0.020*** (0.005)
drought	-0.033*** (0.011)	-0.017*** (0.005)
N	808	5,708

Standard errors are clustered at county level

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

This table shows that the effects of the collectivization on animal growth rate do not vary across two groups of provinces, divided by their extent of mechanization. According to the statistics from the National Bureau of Statistics (1980), 21 percent of tilled areas in Beijing were tilled by machines in 1958. The percentages were 17.4 for Heilongjiang, 15.4 for Xinjiang, 13.1 for Hebei, and 10.4 for 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.