Campaigning for Extinction: Eradication of Sparrows and the Great Famine in China*

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Abstract

How do large disruptions to ecosystems affect human well-being? In 1958, China embarked on the "Four Pests Campaign" that aimed to quickly eradicate flies, mosquitoes, rats, and sparrows nationwide, despite warnings from scientists that sparrows play important roles in pest control. Historians have long speculated that eradicating sparrows, by letting other pest populations grow out of control, contributed to the Great Famine in China between 1959 and 1961—the largest in human history. This paper combines newly digitized data on historical agricultural productivity in China with habitat suitability modeling methods in ecology to quantitatively test this hypothesis. We document that regions with higher "sparrow suitability" experienced significant drops in agricultural output after the Four Pests Campaign, as compared to their low-suitability counterparts. A one standard deviation difference in sparrow suitability explains a 5.3% or 8.7% decline in rice or wheat agricultural output. We further document that the food procurement and redistribution system exacerbated the negative agricultural shock in high-sparrow suitability counties. Consequently, we find that counties with a one standard deviation in sparrow suitability experienced an elevated death rate of 3.3 deaths per 1,000 people during the Great Famine, even though there were no systematic differences between the two before 1958. These effects are driven by yield reductions for above-ground crops, which are more vulnerable to pest outbreaks, and farmers tried to mitigate pest risks by switching to below-ground crops. When China removed sparrows from the "four pests" list in 1960 and started to reboot the sparrow population, agricultural productivity gradually recovered, while the change in crop choices persisted.

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"Damned Creature. Criminals for thousands of years. Today's payment day"

-Chinese anti-sparrow poem

1 Introduction

Scientists, politicians, and popular media have argued that the continued degradation of ecosystems will negatively affect human well-being (Dasgupta 2021; Heal 2000; IPBES 2019). Most noticeably, warnings regarding the devastating consequences of "ecosystem collapses" have emphasized the complex non-linearities of natural systems (Cooper et al. 2020; Strona and Lafferty 2016)—agricultural systems in particular as they are strongly connected with their surrounding ecosystems (Foley et al. 2011; Mendenhall et al. 2014). While the potentially catastrophic costs of such tail events have been theoretically established in environmental economics (Weitzman 2009), empirical evidence is scarce. The rarity of "ecosystem collapses," the difficulty in clearly tracing their triggers, and the lack of granular data, all pose a barrier to rigorous empirical investigation.

In this paper, we study one of the most catastrophic ecosystem collapses in history, the 1958 "Four Pests Campaign" (FPC) in China, which successfully drove sparrows to local extinction within two years. The key contribution this paper makes is to provide evidence for how this local extinction event played a role in causing the Great Famine—as previously hypothesized by environmental historians (Butt and Sajid 2018; Harrell 2021; Mao 2019; Steinfeld 2018)—in which an estimated 16.5 to 45 million people starved to death between 1959 and 1961(Meng et al. 2015; Smil 1999; Yao 1999). As part of the FPC, which aimed to improve agricultural productivity and public health, the central government ordered local officials to exterminate sparrows—targeted because they were eating grains. However, while adult sparrows do feed on grains, they also feed their fledgling with insects, making them an important predator of crop-damaging pests. In their absence, anecdotal evidence claims that the country experienced severe crop-pest infestations (Chen and Wang 2021).

Combining newly digitized data on historical agricultural production in China with well-established habitat suitability modeling methods in ecology, we compare how counties with higher habitat suitability for sparrows got differentially affected by the FPC, relative to their low-suitability counterparts. We find that the sparrow suitability score was orthogonal to agricultural production and demographic trends prior to the FPC; but after the start of the FPC, the high-suitability counties experienced significant reductions in agricultural output. The high-suitability counties also experienced an increase in their death rates, and a drop in their birth rates as compared to counties less suitable for sparrow habitation. Our calculation indicates that sparrow eradication could account for 39.7% of the total yield reduction during the Great Famine and was thus responsible for 1.9 million lives lost.

Further analysis reveals that the yield reduction caused by the FPC was primarily driven by above-ground crops such as rice and wheat, which are more vulnerable to pests (locusts in particular). In contrast, the yield of below-ground crops, such as sweet potatoes, actually increased during the same period—likely reflecting farmers' substitutions across crops to mitigate pest risks induced by the FPC. In addition to crop switching, we also observe another margin of adjustment made by farmers in the form of more pesticide applications following sparrow killings, albeit these results are noisier and more suggestive.

In 1960, three years after the initiation of the FPC, and having killed 1.9 billion sparrows nationwide, the central government realized its mistake and removed sparrows from the list of the four pests, replacing it with bedbugs. Given that sparrows were locally extinct in most parts of the country, to reboot sparrow population, it was reported that the central government had to import 250,000 sparrows from the USSR. After this reversal of sparrow eradication, we observe rice and wheat yields gradually returning to their pre-FPC levels, while the growth in sweet potatoes persisted even after the FPC.

Our findings are robust to controlling for a series of other concurrent events and institutional features, such as the procurement quota and price of different crops, the reduction of livestock animals and production of iron and steel during the Great Leap Forward, the popularization of fertilizers and other agricultural mechanics, as well as the eradication of the other three species on the FPC list. Taken together, our findings echo the conjectures proposed in historical research that the eradication of sparrows was an important contributing factor to the largest famine in human history.

This paper speaks to three strands of literature. First, it adds to a recent and growing body of work in environmental economics studying the role of species in production functions of interest. Recent papers have documented how sudden and unexpected die-offs of trees, bats, amphibians, and vultures can impact human health (Frank 2021; Frank and Sudarshan 2023; Jones and McDermott 2018; Springborn et al. 2022) or how the recovery of wolves reduces vehicle collision with wildlife animals (Raynor et al. 2021). Our analysis, in addition to quantifying the direct benefits that specific species provide (Solow et al. 1993; Weitzman 1992; 1998), complements additional work that uses quasi-experimental methods to quantify the economic benefits of well-functioning ecosystems. Specifically, the findings on the impacts of eradicating sparrows make new contributions to the literature by providing among the first rigorous evidence on the degree to which large, non-marginal disruptions to agricultural ecosystems can have dire consequences for humans (Cardinale et al. 2012; Jenkins 2003).[1]

Second, our findings shed new light on the determinants of the Great Famine in China. A large body of literature has investigated various political economic determinants of the famine, such as farmers' free-riding incentives (Lin 1990), urban bias in food distribution (Lin and Yang 2000), excessive grain procurement (Li and Yang 2005), political promotion incentives (Chen and Kung 2011), rigid procurement quotas (Meng et al. 2015), grain export (Li and Kasahara 2020), and social capital (Cao et al. 2022). However, while environmental

[1] Severely destabilizing agro-ecosystems can increase food insecurity, which could culminate in famines (Diamond 2005; O'Rourke 1994; Ravallion 1997). Historically, large human-caused disruptions to ecosystems occurred when species became locally extirpated either because of their role as pests (Musiani and Paquet 2004) or their value as a resource (Taylor 2011). In hindsight, many of these local extinction events are lamented as poor management of biological resources, and retrospective analyses highlight the important role those species had, often as natural enemies of other species (Frank 2021; Frank and Sudarshan 2023; Raynor et al. 2021). Natural enemy interactions in agro-ecosystems, namely biological pest control functions, are a canonical example of how well-functioning ecosystems benefit socio-economic systems. Specifically, birds have long been recognized as limiting the abundance of crop-damaging insects (Evenden 1995; Garcia et al. 2020).

historians have long suspected that the elimination of sparrows contributed to these disasters and thus the famine (Shapiro 1999; 2001; Dikötter 2010; Becker 1998; MacFarquhar and Fairbank 1987; Manning and Wemheuer 2011; Yang 2012; Marks 2017; Harrell 2021), to the best of our knowledge, there has been little rigorous examination of this explanation. Our paper fills in this gap by providing systematic evidence that echoes this hypothesis posed by historians, that the intentional disruptions of the ecosystem was another substantial contributing factor to the famine. In addition, our findings also support that of (Meng et al. 2015), in showing that the procurement quota failed to adjust according to FPC-induced output losses until 1961, highlighting the rigidity of the procurement system as a driver of the famine.

Third, and more broadly, our findings also add new evidence to the perils of over-centralization and campaign-style policy initiatives, which could distort well-intended policies and cause disastrous policy outcomes (Kornai 1960; Nove 1971; He et al. 2020). Our results imply that, the ecological system, very much like the economic system that it is connected to, functions in subtle and complicated ways, making it hard to accurately foresee the general equilibrium consequences of a man-made infra-marginal shock without sufficient *ex ante* learning through trial and error.

Having experienced various such failures following the implementation of such drastic policies under central planning, after 1978, China's leadership decided to move away from campaign-based policy initiatives and towards gradual policy experimentation, an institutional feature that later became the pillar of policy making in China (Heilmann 2008; Xie and Xie 2017; Wang and Yang 2023).[2]

The remainder of this paper is organized as follows. In Section 2, we introduce the background of the FPC and the Great Famine. Section 3 explains the construction of

[2] That being said, to this day, China's tradition of campaign-style policy initiatives keeps trying to find its way back under strong political centralization. A recent example is the controversial "Zero-COVID" policy, which was indeed compared by many to the Sparrow Eradication Campaign: https://www.nytimes.com/2022/04/13/business/china-covid-zero-shanghai.html?_ga=2.9695221.1169382538.1698090875-1031234641.1698090875.

various historical and ecological datasets, and presents the summary statistics. In Section 4, we elaborate on the identification strategy. In Section 5, we document the agricultural and demographic impacts of sparrow eradication, and conduct various robustness checks. Section 6 concludes.

2 Background

In this section, we introduce the background of the Four Pests Campaign, and the subsequent Great Famine between 1959 and 1961.

2.1 The Four Pests Campaign

In 1955, China was formulating a decade-long plan to help accelerate agricultural development and collectivization between 1956 and 1967. In the process of drafting that plan, the Chairman of the Communist Party of China, Mao Zedong, received feedback from farmers that sparrows consume grains and thus hurt agricultural production. Mao therefore decided to include sparrows, together with flies, mosquitoes, and rats in the list of the "four pests," which should be eliminated nationwide within seven years.[3]

Three of the targeted pests—flies, mosquitoes, and rats—were included because they spread diseases and were considered public health threats, so there was relatively little controversy about eradicating them. However, sparrows were included because they eat grains, but as pointed out by biologists, sparrows are also the natural enemies of many grain-eating insects, such as locusts, rice borer, rice planthopper, etc., and these insects actually constitute more than 80% of their diet. As a result, when the FPC included sparrows in their list of eradication, there was widespread opposition from scientists in China.

Most notably, Zhu Xi, a renowned biologist from the Chinese Academy of Sciences, voiced his opposition citing the historical episode of the Prussian king Frederick the Great trying to

[3] National Agricultural Development Outline from 1956 to 1967 (Draft). See the following for more details: https://searchworks.stanford.edu/view/43324. Accessed 2/22/2024.

eliminate sparrows in 1744, but ended up with pest outbreaks and had to import sparrows from other countries to repopulate sparrows. Zhu also analyzed examples of various cities in the US and Australia importing sparrows to help pest control, and warned Mao that more research is needed before deciding on the overall cost and benefit of sparrows. However, despite the opposition, Mao decided to go along with his plan to quickly eradicate sparrows nationwide.[4]

In late 1957, the “Great Leap Forward” was formally kicked off, which also represented the start of the FPC. Between March 1958 and May 1958, Mao repeatedly emphasized the importance of eradicating sparrows in multiple meetings, which got widely covered by national and local media outlets, and encouraged many local governments to set up “special operation teams” for sparrow eradication.[5] In enlistment, the local teams mobilized millions of state employees and citizen volunteers to systematically destroy sparrow nests, break sparrow eggs, and kill sparrow chicks. In addition, in many regions, people also targeted sparrows flying in the sky by directly shooting them with slingshots, or by hitting noisy pots and pans to prevent them from resting in their nests, with the goal of causing them to drop dead from exhaustion (Cheng 1963; Harrell 2021).[6]

Within two years, the campaign effectively depleted the sparrow population: it is estimated that 200 million to 2 billion sparrows were killed between 1958 and 1959, pushing the species to near extinction within China. Anecdotally, it has been reported insects became widespread following the eradication of sparrows: in 1959, the rural areas reported a salient increase in insect outbreaks, and many major cities in China saw their trees turning bald as the leaves got eaten by insects.[7]

[4] Source: https://chinadigitaltimes.net/chinese/322533.html. Accessed 2/2/2024.

[5] Sparrow is the most notable target among the four pests, which also made it the priority in local eradication efforts.

[6] Some sparrows found a refuge in the extraterritorial premises of various diplomatic missions in China. The personnel of the Polish embassy in Beijing denied the Chinese request to enter the premises of the embassy to scare away the sparrows who were hiding there, and as a result the embassy was surrounded by people with drums. After two days of constant drumming, the Poles had to use shovels to clear the embassy of dead sparrows. See: https://wyborcza.pl/1,75248,140878.html?disableRedirects=true. Accessed 2/2/2024.

[7] Source: https://chinadigitaltimes.net/chinese/322533.html. Accessed 2/2/2024.

By the end of 1959, seeing the widespread surges in insect outbreaks, a large number of prominent scientists have again voiced their strong opposition to the sparrow eradication movement. In November 1959, the party secretary of the Chinese Academy of Sciences (CAS), Zhang Jinfu, wrote a report titled “Report to the Chairman Regarding the Costs and Benefits of Sparrows,” which provided detailed data on the dietary composition of sparrows, as well as extensive scientific findings in foreign literature. This report was read by Mao, and forwarded to all scientists at the CAS. The CAS later held two conferences discussing the costs and benefits of sparrows, and established a team of scientists investigating this issue. Finally, in March 1960, Mao decided that “we should stop killing sparrows, and we can replace sparrows with bedbugs,” which was approved in April 1960. However, by this point, sparrows were already functionally extinct in China. In order to re-populate sparrows, China had to import 250,000 sparrows from the USSR in the 1960s.[8] The FPC posters from 1958 and 1960 depict how sparrows were initially included, but later excluded, from the list of pests (Figure 1).

2.2 The Great Famine

Between 1959 and 1961, China experienced what is generally believed to be the largest famine in human history, with an estimated death toll of 16.5 to 45 million (Meng et al. 2015; Smil 1999; Yao 1999). According to estimates by Cao (2005), during the Great Famine, the most stricken provinces were Anhui (18% dead), Chongqing (15%), Sichuan (13%), Guizhou (11%) and Hunan (8%).

There are two main schools of thought in terms of explaining the root causes of the Great Famine. The first considers agricultural output during this period. As shown in Figure 3a, China maintained robust growth in agricultural output in the years leading up to the Great Famine, but then experienced four consecutive years of productivity decline

[8] While difficult to find a formal validation of this purchase, it appears in books written about the era (page 177 of Žižek (2022)), and referenced in popular writing about the end of the eradication campaign: https://www.thelondoner.ca/news/local-news/a-tale-of-sparrows. Accessed 2/22/2024.

Figure 1: Recognizing the Error of Exterminating the Sparrow

(a) Four Pests Campaign Poster 1958

(b) Four Pests Campaign Poster 1960

Notes: The posters show the transition from 1958 to 1960 in the composition of the four pests. The 1960 campaign switched out sparrows with bed bugs after China decided to buy 200,000 sparrows from the Soviet Union to replenish its sparrow population.

between 1959 and 1962, and economists have examined various potential explanations to that reversal. Lin (1990) points out that when the agricultural communes stopped allowing farmers to freely exist in 1958, a free-riding prisoner's dilemma emerged, which paralyzed agricultural production. Chen and Lan (2017) show that the collectivization of agriculture also led peasants to slaughter household draft animals to consume the meat, which reduced the input for agricultural production in the subsequent years.

In contrast, another more recent line of work has also pointed out that, production-based explanations alone are insufficient in explaining the magnitude of the famine, and one must also combine them with severe distortions in the distribution of agricultural output—in agreement with the point raised by Sen (1981) regarding distribution failures as a necessary condition to generate severe famines. Consistent with this view, as shown in Figure 3b, the excessive death rate was the highest in 1960, and partially recovered in 1961, when the central government started sending grains to the rural areas in need. Specifically, Li and Yang (2005) suggest that the procurement quota—the amount of agricultural produce that was collected from the county and redistributed—was excessive. Meng et al. (2015) show that in addition to the excessiveness, the rigidity of the agricultural procurement system played key roles in causing the famine. Li and Kasahara (2020) find that grain exporting during the famine period also worsened the situation. Evidence has also been documented that political and cultural factors contributed to the distributional distortions (Chen and Kung 2011; Cao et al. 2022).

The Chinese government officially referred to the Great Famine as the "Three Years of Natural Disasters." Later research has shown no sudden and abnormal changes in basic weather conditions between 1959 and 1961, which partially contradicts the official narrative. That being said, historians have long suspected that the Four Pests Campaign, by eradicating sparrows and destabilizing the ecosystem, also contributed to the drop in agricultural output and hence the famine (Shapiro 1999; Dikötter 2010; Becker 1998; MacFarquhar and Fairbank 1987; Manning and Wemheuer 2011; Yang 2012). This version of the production-based hypothesis for famine origin has received much attention in qualitative discussions, but has not been tested empirically.

3 Sparrow Suitability, Agricultural Production & Population Data

The empirical analysis aims to examine whether eradicating sparrows during the 1958-1960 FPC played a meaningful role in the conditions that resulted in the Great Famine. To do so, we need data sources that allow us to define exposure to the eradication shock, measure agricultural production, and summarize total mortality. In the following, we briefly summarize the core data sets used in the analysis: (i) sparrow suitability scores derived from a habitat suitability model, (ii) previously used as well as newly digitized crop production data, and (iii) population levels and all-cause mortality counts. We summarize the key variables in Table 1, map cross-sectional variation in sparrow suitability in Figure 2, and plot national-level trends for agricultural production and mortality in Figure 3.

3.1 Sparrow Suitability Score

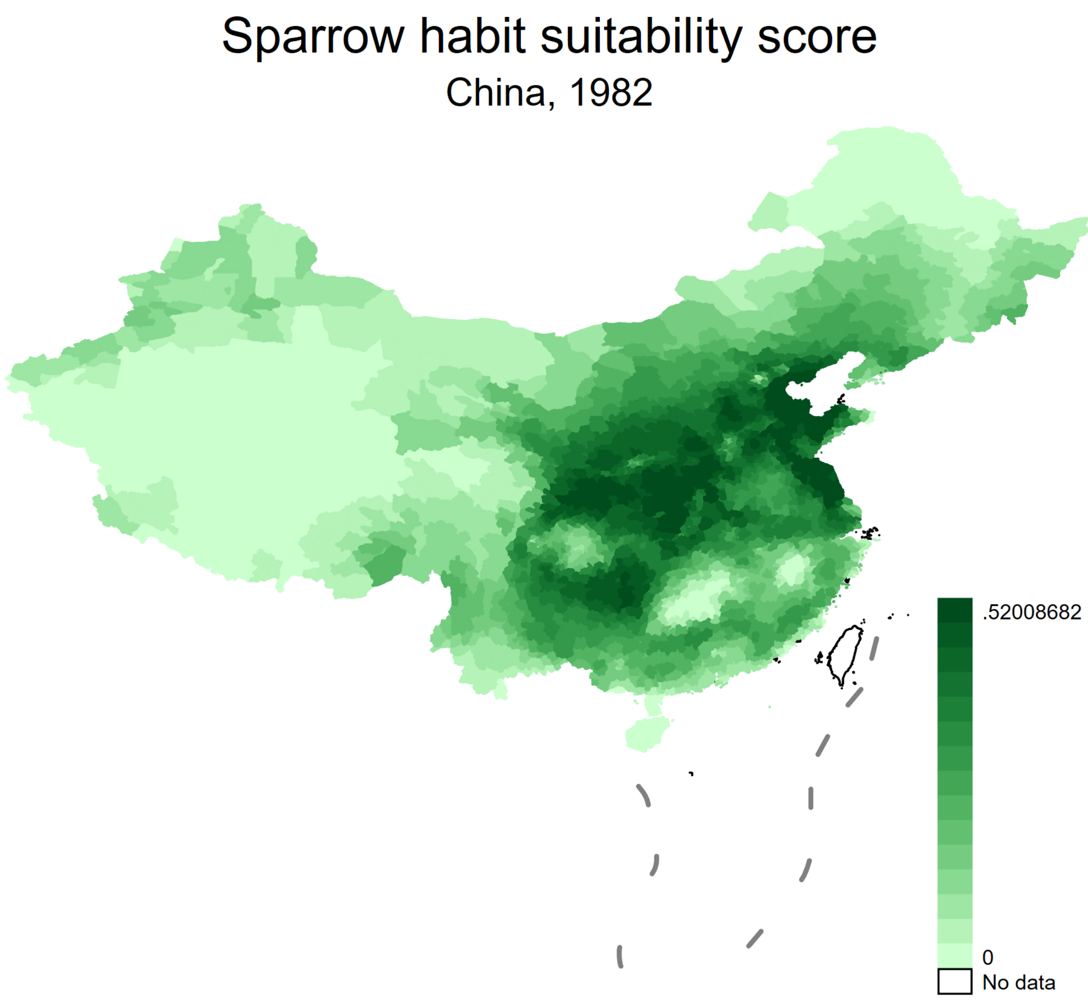
We use a proxy for sparrow population levels during our study period in the form of a habitat suitability score for each county and province. This score combines data on current observations of sparrows with the environmental features in each county to quantify the degree of habitat suitability for sparrows. Because sparrow population levels were not monitored during our study period, the sparrow suitability score provides a numerical value that is proportional to the sparrow population when it is in equilibrium. Our approach to using suitability scores in the absence of detailed wildlife population counts is similar to that used by Alsan (2015) and Frank and Sudarshan (2023). In Section A.1 of the Online Appendix, we provide results from an empirical exercise that validates the agreement between habitat suitability scores for birds, and scientifically collected counts of those bird species.

We calculate the sparrow suitability score using the BIOCLIM model, which has been widely used since its introduction in 1984 (Booth et al. 2014). The model combines data on the presence of a species, which we obtain from eBird records, and local bioclimatic variables such as elevation, temperature, and precipitation.[9] The presence data and environmental data allow BIOCLIM to construct the convex hull of environmental conditions that appear to be beneficial for the presence of the species, which then gets projected back into geographic

[9] Because eBird relies on self-reported observations of birds by citizen scientists instead of a scientifically designed monitoring protocol, we cannot simply use the mean number of sparrow records in eBird to infer habitat suitability. Habitat suitability models, such as BIOCLIM, are designed to overcome the inherent sampling biases in such species presence data.

space to calculate suitability scores. The higher the score, the more likely the area is a suitable niche for the species. In short, observing polar bears in the the Arctic landscapes would result in a high suitability score in Alaska, but not California. Similarly, observing mountain goats in high-elevation regions would result in a high suitability score across the Northern Rocky Mountains, but not across the Great Plains. We plot the mean sparrow suitability score we obtain from the BIOCLIM model in Figure 2, and use it to assign county-level exposure to the treatment—the eradication of the sparrows.

Figure 2: Spatial Distribution of the BIOCLIM-Derived Sparrow Suitability Score



Notes: We obtain sparrow suitability for each county using the BIOCLIM Habitat Suitability Model (HSM). See text for more details.

It is important to note that suitability scores characterize the theoretical ecological niche a species can occupy—how well a species can survive in that environment—but other factors such as dispersion, competition with other species, and predators affect the ability of a species to occupy the niche. In the case of birds and contiguous habitats, dispersion is not considered to be a limiting factor to their occupancy. For sparrows, food availability and environmental conditions are of higher importance than competition with other birds and the presence of predators (Repasky and Schluter 1994).

3.2 Agricultural Production

Our baseline county-level crop data is from China county gazetteers—the historical archives that comprehensively document the history from 1949 to 1990. Our data source comes from two sections for each gazetteer: total agricultural output, and total arable land from the *Economy* section and the crop-specific cultivated area and output by crop from the *Agriculture* section. First, we restrict our sample to areas titled "Xian" in 1990 to ensure these areas were mainly agricultural counties. Thus, all urban cities are excluded from our analysis, even if these cities provide detailed agricultural output data by crop. Second, we require the county to provide annual data from 1954 to 1965 for either rice or wheat, the dominant food crops grown in China. Our data sample consists of 704 rural counties; among them, 356 counties contain rice, mostly in southern China, and 432 counties contain wheat production, mostly in northern China.

The county-level crop output data are an unbalanced panel, and we test whether the distribution of missing values is related to the sparrow suitability. In the Online Appendix Table A1, we report an analysis that examines whether the reporting patterns of rice and wheat are correlated with sparrow suitability. We find no evidence for the timing of reporting or having non-missing values before and after the FPC to be correlated with sparrow suitability. Consistent with the higher suitability scores observed in northern China, high-suitability counties are more likely to report wheat output and less likely to report rice output.

We also obtain province-level data from various sources. The provincial crop data from

1950 to 1980 is obtained from the National Bureau of Statistics of China. The provincial data does not necessarily match the county-level data in gazetteers, as each provincial government puts together aggregate statistics with retrospective data revisions rather than data based on raw county-level archives.

3.3 Mortality and Population Data

We obtain demographic data to quantify the linkage between sparrow killing and the subsequent Great Famine. The county-level fertility and mortality rates are from Li and Kasahara (2020), which we use as the dependent variables to quantify mortality rates in the subsequent Great Famine. We complement the county-level data with province-level population data from Meng et al. (2015). Online Appendix Figure A3 correlates the average mortality of province-level and county-level death rates. Death rates from these two data sources are strongly correlated at 53% in 1960, which is not meaningfully different than the correlation from 1954 to 1965 (57%). While, in general, county-level death rates can be double that of the provinces they are in, once we take population-weighted means of the county-level death rates in 1960, the coefficient from the regression of the province-level death rate on the population-weighted mean is 0.996, reflecting almost perfect agreement between the two.

3.4 Other Supplementary Data

We also collect additional data on reported sparrow killings, pesticide use, and procurement for food redistribution.

The counties reported sparrow-killing data, which we can use to validate that our sparrow suitability score does capture the ecological shock variations of sparrow eradication. The number of sparrows killed is only found at the province level and reported in mainstream provincial newspapers, such as the Beijing Daily, which is the official organization of the Beijing Municipal Party Committee. The FPC was a significant event in the agricultural sector during the Great Leap Forward period, and most party newspapers provide detailed tracking records of the progress and the number of sparrows killed, with the caveat that bureaucrats might have systematic incentives to over-report these numbers.

With a sharp decline in biological pest control by sparrows, farmers could have increased their use of pesticides as an alternative for pest control—substituting for the role of sparrows in agricultural production. We further manually collect the data on the sales volume of chemical pesticides from the provincial-level Cooperative Society publications, agricultural statistical data, and national economic statistical data, such as the *Cooperative Society Publication of Liaoning Province* and the *Agricultural Economic Statistical Data of Zhejiang Province, 1949-1985*. Appendix Figure A2 plots the total quantity of pesticide usage and the grain yield from 1954 to 1965. Pesticide usage first jumped in 1958—one year before the significant drop in grain output. Pesticide usage remained unusually high till 1961 when agricultural productivity started to recover.

Centrally controlled redistribution of food is consequential in this setting as Meng et al. (2015) argued that procurement rigidity played an important factor in the Great Famine. To examine the relationship between procurement and sparrow suitability, we also obtain the annual county-level crop procurement data, as collected by Li and Kasahara (2020), and compute the share of the crop being procured as a metric for policy rigidity in the planned economy. These data also allow us to examine how government policy reacted to food shortages and the subsequent famine.

Finally, we complement the data with crop suitability scores from the Food and Agriculture Organization Global Agro-Ecological Zones database (version 4.0) (Fischer et al. 2021). We choose the no-irrigation suitability scores, and use those in robustness checks that we detail in the results section.

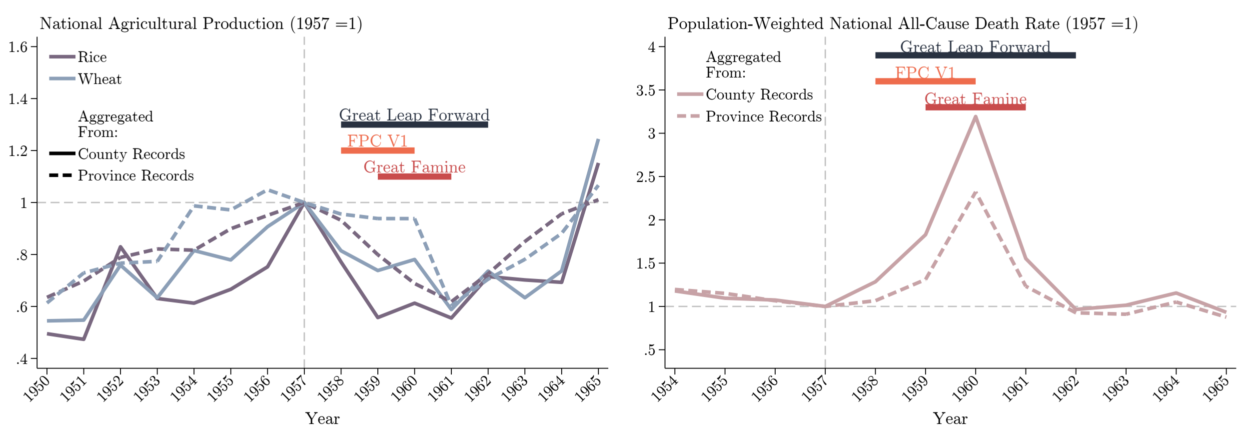
3.5 Secular Trends & Summary Statistics

During our sample period of 1954 to 1965, China saw growth in grain production alongside a reduction in the all-cause death rate up until 1958, at which point the trend reversed. In

Figure 3, we plot the total production of rice and wheat, aggregated from either the county records or the provincial records, as well as the population-weighted all-cause death rate. We normalize each time series relative to 1957, the year before the launch of the Great Leap Forward and the FPC. We observe that by 1957, rice and wheat production had doubled relative to its 1950 baseline levels; however, those declined back to their 1951-1952 levels during 1959-1961. China also saw a steady improvement in public health, as observed by the declining all-cause death rate from 1954 to 1957. During the peak of the Great Famine in 1961, mean mortality levels doubled or tripled relative to 1957 levels, according to the provincial or county records, respectively.

Figure 3: National Trends in Agricultural Production and Mortality

(a) Agricultural Production (b) Mortality



Notes: Aggregating data to the yearly level from either the provincial records or the county gazetteers. We use the unbalanced panel to aggregate the data and normalize the time series for each variable relative to 1957. We highlight the duration of the Great Leap Forward, the Four Pest Campaign (FPC) in its first version, which included sparrows and the Great Famine.

We summarize the key variables of sparrow suitability score and population levels across below- and above-median suitability score in Table 1. As expected, the mean suitability score is much higher, by an order of magnitude, in the above median suitability score counties. Mean population levels from 1954 to 1965 are similar across both groups. We also compare baseline levels, from 1954 to 1957, of rice output, wheat output, procurement rate, and all-cause mortality. There are lower levels of rice production and higher levels of wheat production in the above-median suitability counties. The procurement rate in the above-median suitability counties is three percentage points lower, relative to a base of about 22-25%.

We observe a sharp widening in the mortality differential between the above- and below-median suitability counties between the two time periods of interest. The above-median suitability counties have 0.51 deaths per 1,000 people more than the below-median counties, for which we can reject the null hypothesis of a zero difference at the 5% significance level. That difference in the death rate increases eight-fold, from 0.51 to 4.1, during the 1958 to 1961 period, which we can reject the null hypothesis of zero difference at the 1% significance level. Differences in the production of rice or wheat and procurement maintained the same signs and roughly the same magnitudes in the 1958 to 1961 period as in the 1954 to 1957 period.

Table 1.
Differences in Observables Before & During the Four Pest Campaign

	(1)	(2)	(3)	(4)
	Group Means		Δ:(2)-(1)	N
Sparrow Suitability	*Low*	*High*		
Sparrow Suitability Score	.0392	.195	.156	691
	(.0262)	(.0773)	(.00418)	
Population[1]	3.29	2.98	-.307	7,947
	(3.37)	(2.36)	(.0676)	
Rice Output, 1954-1957[2]	6,043	5,580	-464	901
	(11,918)	(10,028)	(737)	
Wheat Output, 1954-1957[2]	903	1,473	570	1,100
	(2,144)	(1,797)	(125)	
Procurement Rate, 1954-1957[2]	.255	.215	-.0397	1,878
	(.123)	(.0977)	(.00535)	
All-Cause Death Rate, 1954-1957[3]	11.8	12.3	.532	2,364
	(4.5)	(4.71)	(.191)	
Rice Output, 1958-1961[2]	5,281	4,152	-1,129	873
	(10,924)	(6,052)	(600)	
Wheat Output, 1958-1961[2]	770	1,224	454	1,054
	(1,673)	(1,385)	(98.8)	
Procurement Rate, 1958-1961[2]	.324	.292	-.0314	1,903
	(.148)	(.124)	(.00645)	
All-Cause Death Rate, 1958-1961[3]	17.9	21.2	3.24	2,338
	(15)	(19.6)	(.714)	

Notes: Counties with non-missing rice or wheat data in both pre- and post-1958. Robust standard errors in parentheses.
1: In 100,000s.
2: In 10,000s kg.
3: Per-1,000 People.

4 The Sudden Extirpation of Sparrows as a Natural Experiment

In this section we first present descriptive evidence at the level of the province, summarizing the correlations between sparrow suitability, reported sparrow-killing levels, and outcomes such as: grain production, pesticide use, and all-cause mortality. We then proceed to describe the use of the sparrow suitability score in our econometric framework using the county-level data.

4.1 Descriptive Evidence on Sparrow Killings & Key Outcomes

To motivate the subsequent econometric analysis, in this section, we document a series of correlational patterns at the provincial level, which help shed light on the relationships between sparrow suitability, sparrow eradication, and the Great Famine.

We first document that in addition to the variation in sparrow suitability (Figure 2), provinces also reported different numbers of total sparrows killed (Figure 4a). An important step in evaluating the province-level data, and our own calculations of the sparrow suitability score, is to compare the correlation between sparrow killings and suitability. In Figure 4b, we report a noisy, yet positive, correlation between the sparrow suitability score and the reported number of sparrows killed, normalized by area. The fact that we observe a low number of reported sparrow killings per square km where the suitability score is low is reassuring—provinces did not all report a uniformly high level of sparrow killings that was independent of habitat suitability for sparrows. Similarly, we observe that, at least on average, provinces that reported a high number of sparrows killed are also those for which we calculate a high sparrow suitability score. Combined, we find that the correlation in Figure 4b helps to validate that the sparrow suitability metric acts as a proxy for baseline levels of sparrow populations. In addition, higher sparrow killings are correlated with lower grain production, higher pesticide use, and higher death rates in the immediate post-sparrow eradication campaign (1959 to 1961) relative to the preceding years (1955 to 1957) (Figures 4c-4e).[10]

The province-level correlations help provide suggestive evidence that aligns with the hypothesis put forward by environmental historians: the campaign to eradicate sparrows contributed to the Great Famine. We avoid interpreting the empirical findings we discuss above as causal evidence because, especially at the level of the province, a key cause for concern is that local governments could have had other political motivations, which could have caused them to enthusiastically implement not only the sparrow eradication campaign, but also many other potentially harmful policy campaigns in the era. Those additional Great Leap Forward policies could also have contributed to the conditions that led to and exacerbated the famine. If the adoption of those additional policies was systematically correlated with the effort put into sparrow eradication, then that would confound the relationship between the outcomes of interest and sparrow eradication.

Our research design instead leverages the local exposure to the eradication shock—the combination of the baseline suitability and the sudden local extinction event—with the local agricultural production and mortality data. The empirical strategy, discussed below, uses more fine-scaled spatial variation at the level of the county to compare within geographic clusters, between counties with higher and lower sparrow suitability scores. This comparison for the main outcomes, as well as with other outcomes that were targeted by the Great Leap Forward, will better allow us to separately identify the role of sparrow eradication, while disentangling the role of other ongoing policies at the time.

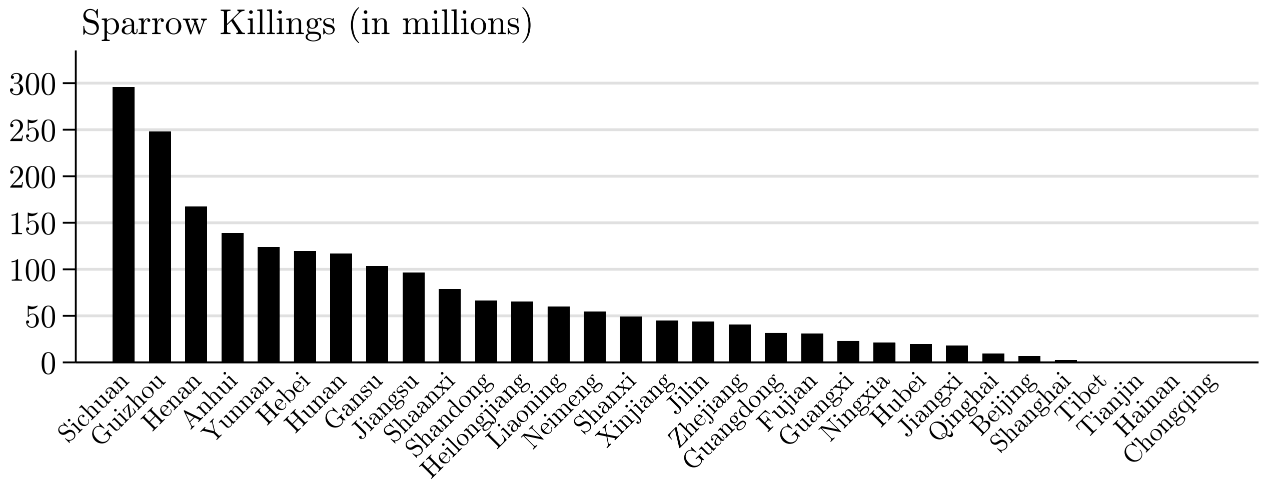
4.2 Econometric Specification

Our main empirical analyses are conducted at the county-year level. We will adopt a difference-in-differences design (or a shift-share design when using sparrow suitability as a continuous variable), exploiting variations in each county's innate suitability for sparrow

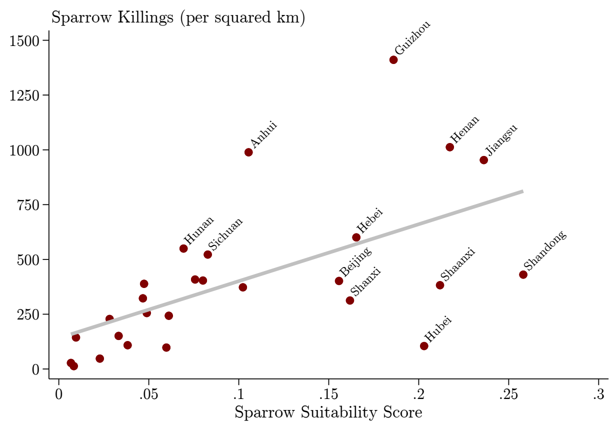
[10] We treat 1958 as a buffer year and omit it from the calculations in Figures 4c-4e.

Figure 4: Province-Level Correlations Between Sparrow Killings & Outcomes

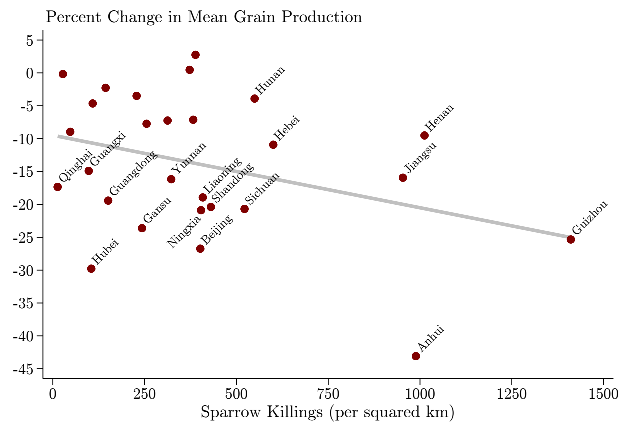
(a) Number of Reported Sparrow Killings by Province



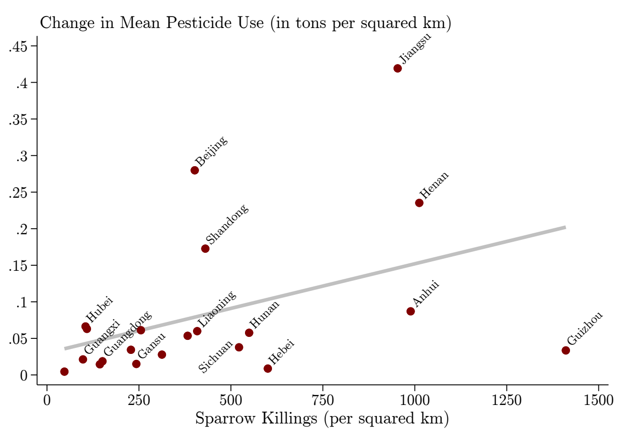
(b) Sparrow Killings VS. Sparrow Suitability



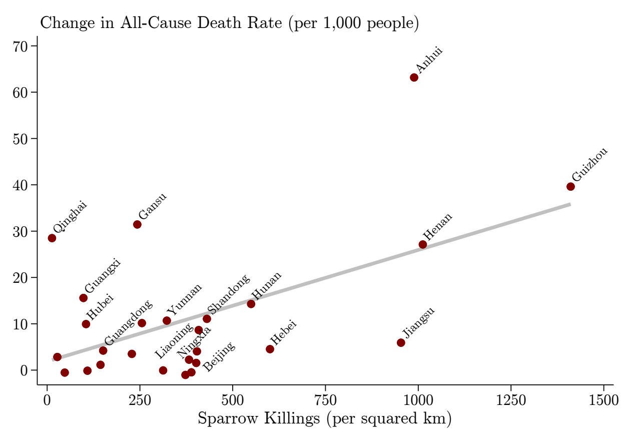
(c) Grain Production VS. Sparrow Killings



(d) Pesticide Use VS. Sparrow Killings



(e) All-Cause Mortality VS. Sparrow Killings



Notes: Summary of descriptive statistics of province-level statistics. Changes in panels (c)-(e) are for 1959-1961 relative to 1955-1957. Panel (d) excludes Shanghai for easier visual inspection as it has an outlier value of (372.7, 1.4).

habitation, and compare how high- vs. low-suitability counties differed in agricultural and demographic outcomes, before and after the initiation of the FPC.

Specifically, for each county c, we calculate its sparrow suitability index $Suitability_c$, following the procedure discussed in Section 3. We then estimate the following specification:

$$Y_{ct} = \sum_{\tau \neq 1957} \beta_\tau Suitability_c \times \mathbb{1}\{t = \tau\} + \phi_c + \lambda_t + \varepsilon_{ct} \quad (1)$$

Where Y_{ct} is the outcome of interest in county c in year t. We interact the sparrow suitability index, $Suitability_c$—either as a dummy for having an above median score, or as the continuous score—with year dummies. The parameters of interest are the β_τ coefficients that capture the dynamic response of the outcome to the impulse of the sparrow eradication, relative to 1957 which is the omitted category.

We account for time-invariant factors and pooled shocks by including ϕ_c and λ_t, which are county and year fixed effects, respectively. County fixed effects absorb factors that affect baseline agricultural productivity such as soil conditions, local crop pest composition, and climatology. Year fixed effects absorb pooled shocks such as extreme weather events, technological improvements, and structural transformation trends. In robustness tests, we allow the year fixed effects to vary at sub-national levels. Any unobserved heterogeneity is captured by the error term, ε_{ct}. The standard errors are clustered at the county level. In the Appendix, we also report results that adjust the standard errors for spatial correlation, in addition to serial correlation.

Our identifying assumption is that, in the absence of the FPC, local sparrow suitability index should have been orthogonal to the trajectories of agricultural production and demographic change. Therefore, in the event studies for the outcomes of interest, we expect β_τ to be statistically indistinguishable from zero before the onset of the FPC.

In addition to verifying parallel trends prior to the FPC, one additional potential confounder is that, sparrow suitability might be systematically correlated with certain regional features, such as political zealousness in enforcing central policies, or levels of social capital, that could trigger differential responses to the national campaigns during the Great Leap Forward, and thereby generating breaks in trends after 1958. To investigate this possibility, we will directly examine the correlations between sparrow suitability index and a set of province-level variables that capture other GLF policies that were ongoing during the FPC.

5 Economic & Demographic Consequences of Sparrow Eradication

In this section, we follow the baseline econometric specifications, as laid out in Equation 1, to investigate the economic impacts of sparrow eradication. In Section 5.1, we document the impacts of sparrow eradication on agricultural output. In Section 5.2, we examine the farmers' responses to sparrow eradication. In Section 5.3, we show how the government procurement policies responded to the sparrow-induced agricultural productivity loss. In Section 5.4, we examine the impacts on mortality and fertility. In section 5.5, we describe additional results that test for the robustness of the results, and explore potential threats to internal validity.

5.1 Grain Output Declined Following the FPC

In Figure 5, we plot the event study coefficients obtained from estimating Equation 1, for the output of two key grain crops: rice and wheat. For both crops, local sparrow suitability scores appeared to be orthogonal to the pre-1958 trends in production, which gives us additional confidence in the validity of our research design. In contrast, after 1958, when the sparrow eradication began, we see salient drops in rice and wheat output, which later gradually recovered in the post-1961 era, coinciding with the re-population and recovery of sparrows after the FPC.

We observe a sharp decline in total grain production (rice or wheat) when defining treatment as the continuous sparrow suitability score, or when defining it as having high sparrow suitability—above-median sparrow suitability.

Taken together, these empirical patterns are consistent with our interpretation that counties more suitable for sparrow habitation were affected more by the eradication of sparrows. As a result, these counties became more vulnerable to locusts and other pest outbreaks, which negatively affected their agricultural production. By re-populating sparrows after 1961, agricultural production in these affected counties gradually returned to their baseline levels.

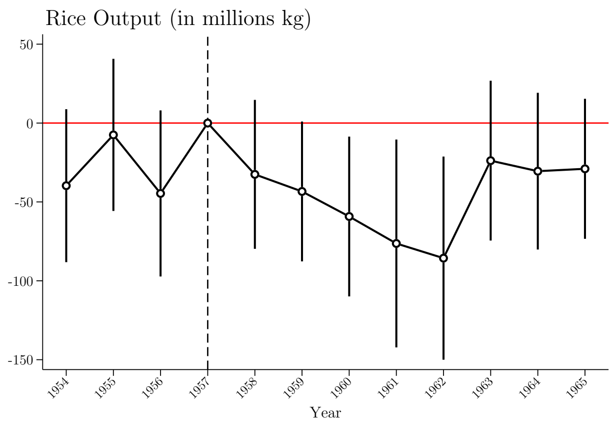
The event-study results are somewhat imprecisely estimated, with several of the 95% confidence intervals including zero; however, when we pool the treatment effects for 1958 to 1961, and 1962 to 1965, we recover more precisely estimated treatment effects. In Table 2, we summarize the patterns observed in Figure 5. When we use the continuous suitability score (CSS), we see that counties with higher sparrow suitability scores experienced a large and significant drop in rice and wheat output during the FPC, compared to 1954 to 1957 (Panel A, columns 1 to 6).

To place the magnitudes in context, a one standard deviation increase in CSS results in a 3,129 or 1,145 metric tons decline in total rice or wheat output from 1958 to 1961 (Panel A, columns 1 and 4). Relative to the mean levels in the sample, these reflect declines of 5.3% and 8.7%. Alternatively, the difference in rice or wheat output between counties that have CSS values at the 75th percentile versus the 25th percentile is 4,886 or 1,787 metric tons, respectively. In addition, if we compare the counties that have a CSS that is above the median—hereafter, High Sparrow Suitability (HSS)—we find that rice or wheat declined in the HSS counties by 8,130 or 1,460 metric tons relative to their below-median counterparts (Panel B, columns 1 and 4). For both the CSS and HSS, we find that output was still meaningfully lower from 1962 to 1965, relative to 1954 to 1957, as the recovery of output towards baseline levels occurred around 1964 and 1965. We continue to recover coefficients of similar magnitude and precision when we control for the dynamic impacts of baseline population—average population between 1954 and 1957 interacted with year fixed effects

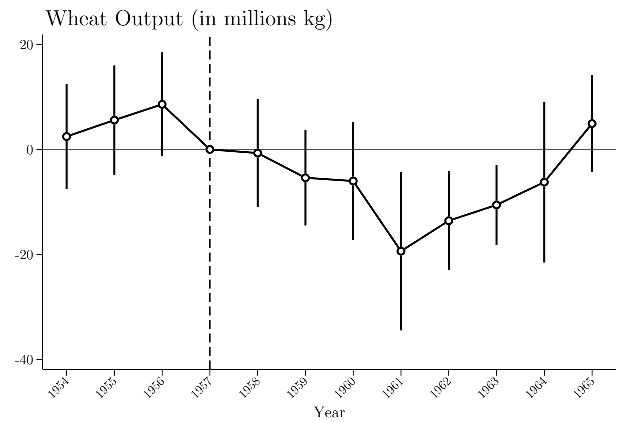
Figure 5: Effects on Rice and Wheat Output at County Level

Continuous Sparrow Suitability

(a) Rice Production

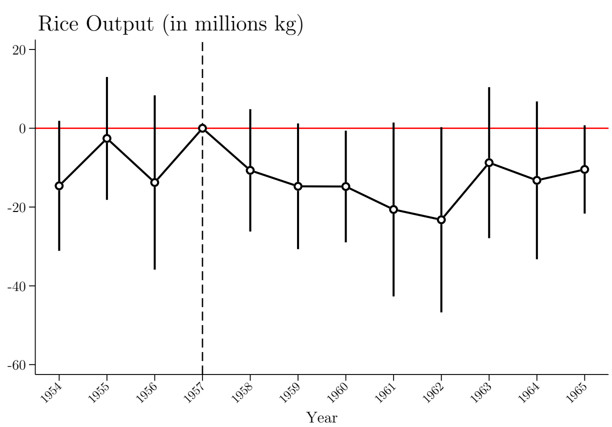


(b) Wheat Production

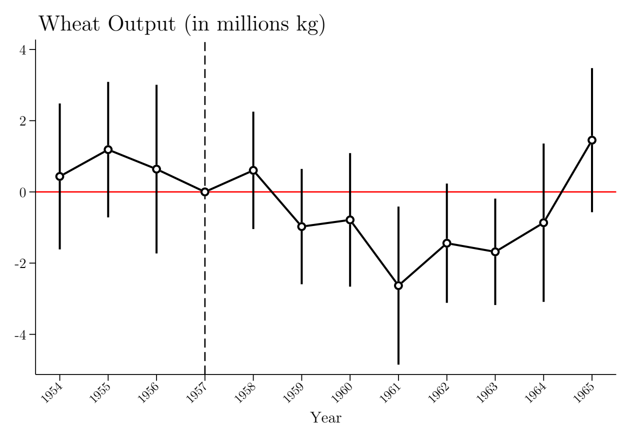


High Sparrow Suitability

(c) Rice Production



(d) Wheat Production



Notes: Coefficients and 95% CIs for the estimation specification in Equation (1). Panels (a) and (b) interact the continuous sparrow suitability score with year dummies, while panels (c) and (d) interact the dummy for above-median sparrow suitability (high sparrow suitability) with the year dummies. Each regression includes county and year fixed effects. Samples include all unbalanced counties with at least one year of non-missing data for rice and wheat before and after the onset of the FPC. Standard errors are clustered at the county level.

(column 2), and when including crop suitability interacted with year fixed effects (column 3).

Table 2
Effects on Rice and Wheat Output

	Rice Output			Wheat Output		
Panel A. Continous Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
CSS×1958-1961	-32.12**	-24.09**	-40.27***	-11.75***	-8.98**	-10.83***
	(14.79)	(11.39)	(13.71)	(3.65)	(3.54)	(3.63)
CSS×1962-1965	-21.61	-30.92**	-21.19	-9.68***	-8.87***	-9.69***
	(15.20)	(12.95)	(15.70)	(3.44)	(3.22)	(3.43)
R^2	0.89	0.90	0.89	0.90	0.88	0.90
Dep. Var. Mean	59.54	55.28	59.54	13.22	11.41	13.22
N	3,473	2,712	3,473	4,081	3,290	4,081
Clusters	421	336	421	495	407	495
Panel B. High Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
HSS×1958-1961	-8.13**	-9.05***	-7.77**	-1.46**	-1.07	-1.29*
	(3.45)	(2.93)	(3.31)	(0.70)	(0.79)	(0.70)
HSS×1962-1965	-7.01*	-9.34**	-7.06*	-1.03*	-1.60***	-1.07*
	(4.06)	(4.22)	(4.12)	(0.61)	(0.60)	(0.61)
R^2	0.89	0.90	0.89	0.90	0.88	0.90
Dep. Var. Mean	59.54	55.28	59.54	13.22	11.41	13.22
N	3,473	2,712	3,473	4,081	3,290	4,081
Clusters	421	336	421	495	407	495
Baseline Population-by-Year FE	N	Y	N	N	Y	N
Crop Suitability-by-Year FE	N	N	Y	N	N	Y

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

5.2 Farmers' Adjustments

Farmers were limited in their ability to make adjustments in response to a potential increase in crop pest pressure for several reasons. First, most crop planting decisions were centrally planned, especially for grains such as rice and wheat. One notable exception to this was that after 1960, farmers were allowed to plant sweet potatoes for subsistence purposes (Meng et al. 2015). Second, other beneficial inputs such as pesticides and fertilizer were centrally distributed as opposed to purchased by farmers—preventing farmers from increasing inputs. Finally, migration and labor allocations were rigidly managed through the Hukou system (Yang 2012).

We begin examining potential adaptation by estimating whether there was a differential adoption of sweet potatoes in the counties that are more suitable for sparrows. It is important to note that grain crops such as rice and wheat are above-ground crops, while sweet potatoes are (root) below-ground crops. This feature makes sweet potatoes potentially less susceptible to an above-ground crop pest infestation—in particular locust outbreaks that were the main threat to agricultural production throughout Chinese history—the type that sparrows might have played a key role in preventing (Mullié 2009; Sharma and Sharma 2017).

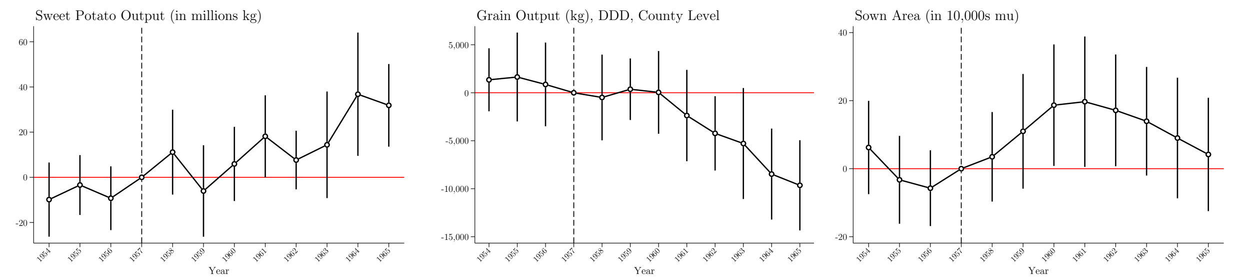
In Figures 6a and 6d, we report the coefficients from the estimation of Equation (1) for total sweet potato production, and find *opposite* effects to rice and wheat. The event study coefficients demonstrate a re-assuring flat pre-trend, and then a large and persistent *increase* in crop output after 1960—when sweet potato planting was allowed for self-consumption. This indicates that counties more suitable for sparrow habitation experienced significant spikes in the production of sweet potatoes following the FPC, which persisted even as rice and wheat crops returned to baseline levels. It is important to note, however, that our sample size for counties with sweet potato data is smaller—206 counties relative to 421 and 495 counties for rice and wheat.

Such empirical patterns are consistent with the different susceptibility of the below- versus above-ground features we described above. We interpret these findings as suggestive evidence

Figure 6: Effects on Sweet Potato Output and Crop Sown Area at County Level

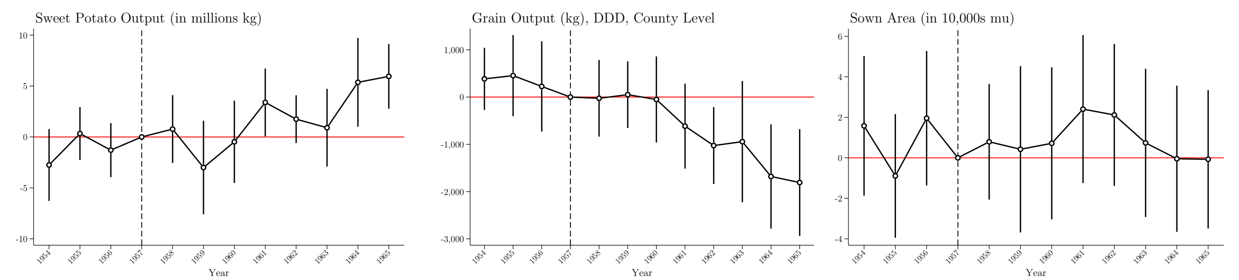
Continuous Sparrow Suitability

(a) Sweet Potato Production (b) Grain Output, DDD (c) Crop Sown Area



High Sparrow Suitability

(d) Sweet Potato Production (e) Grain Output, DDD (f) Crop Sown Area



Notes: Coefficients and 95% CIs for the estimation specification in Equation (1). Panels (a)-(c) interact the continuous sparrow suitability score with year dummies, while panels (d)-(f) interact the dummy for above-median sparrow suitability (high sparrow suitability) with the year dummies. Each regression includes county and year fixed effects. Samples include all unbalanced counties with at least one year of non-missing data for rice and wheat before and after the onset of the FPC. Standard errors are clustered at the county level.

that in the absence of the biological provision of pest control functions, historically provided by sparrows, farmers of rice and wheat crops would become more willing to switch or increase their sweet potato cultivation to hedge themselves against future pest outbreaks. Such a switch in crop choice in the more sparrow-suitable counties appears persistent even after the re-population of sparrows, which can be potentially rationalized by either a fixed cost of crop switching or shock-induced learning (about the benefits of growing sweet potatoes).

The cultivation of sweet potatoes provides for a time-varying output that could account for other factors that could explain changes to rice and wheat production—for example, drought conditions. We estimate a triple-differences specification by using a sample of rice, wheat, and sweet potato, where the former two crops are the third sub-group of interest.

In Figures 6b and 6e, we report the coefficients for the triple-interaction of sparrow suitability (continuous or dummy for above-median), rice or wheat crops, and year dummies. Effectively, this specification uses sweet potatoes to benchmark the decline in rice and wheat against the growth in sweet potatoes, across counties with different levels of sparrow suitability score, before and after the FPC. The results again reveal that, after the start of sparrow eradication, counties more affected by sparrow eradication shifted from relying on rice and wheat to relying on sweet potatoes, creating a clear divergence in crop choices that persisted even after the end of the FPC.

In addition to farmers in sparrow-suitable counties increasing their sweet potato cultivation, we also test if the total sown area increased differentially in those counties following the FPC. One potential way farmers could have increased production is to increase the amount of land area under cultivation. However, one challenge to that could have been that labor reallocation from rural villages led to the abandonment of agricultural lands, leading to reduced total agricultural output. If sparrow suitable counties systematically reduced the sown area more than non-suitable counties then this presents a threat to our identification strategy as it offers an alternative explanation to the decline in output. In Figures 6c and 6f, we report imprecisely estimated *increases* in sown area in the sparrow suitable counties. We interpret this result as the data on sown area not being consistent with the notion that grain output fell in sparrow suitable counties because of a sharp reduction in cultivated land for agricultural production.

In Table 3, we summarize the graphical patterns documented in Figure 6, following the same specifications used in Table 2. Our estimates indicate that a one standard deviation increase in the sparrow suitability score resulted in an increase of 1,263 and 2,732 metric tons of sweet potato production during the periods of 1958-1961 and 1962-1965 (Panel A, column 1). The fact that sparrow-suitable counties keep producing more sweet potatoes in the long run, combined with the fact that rice or wheat production in these counties returned to baseline by 1965, suggests that the passive adoption of sweet potatoes during a time of crisis might have long-run benefits to these counties, who suffered the most in the short run due to the sparrow eradication. In Panel B of Table 3, we fail to recover an estimate of sweet potato production increasing in the HSS counties from 1958 to 1961, but we recover meaningful and precisely estimated spikes in production from 1962 to 1965. Finally, when using either the CSS or HSS, we always fail to detect significant changes in crop sown area.

Table 3
Effects on Sweet Potato Output and Crop Sown Area

	Sweet Potato Output			Crop Sown Area		
Panel A. Continous Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
CSS×1958-1961	12.97*	-0.87	6.19	14.03*	10.26	13.85*
	(7.75)	(5.72)	(7.50)	(8.18)	(7.64)	(7.93)
CSS×1962-1965	28.05***	11.02***	20.11**	11.59	7.45	11.55
	(10.27)	(3.92)	(8.48)	(8.39)	(7.43)	(8.16)
R^2	0.85	0.87	0.86	0.98	0.98	0.98
Dep. Var. Mean	17.02	14.11	17.02	85.15	82.89	85.15
N	1,588	1,219	1,588	3,741	3,345	3,741
Clusters	206	164	206	459	417	459
Panel B. High Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
HSS×1958-1961	1.09	-1.26	-0.29	0.49	0.12	0.39
	(1.45)	(1.36)	(1.50)	(1.79)	(1.56)	(1.77)
HSS×1962-1965	4.46***	2.07**	2.88**	0.10	-0.55	0.05
	(1.60)	(0.87)	(1.28)	(1.93)	(1.63)	(1.91)
R^2	0.85	0.88	0.86	0.98	0.98	0.98
Dep. Var. Mean	17.02	14.11	17.02	85.15	82.89	85.15
N	1,588	1,219	1,588	3,741	3,345	3,741
Clusters	206	164	206	459	417	459
Baseline Population-by-Year FE	N	Y	N	N	Y	N
Crop Suitability-by-Year FE	N	N	Y	N	N	Y

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

5.3 Government Responses

As documented by (Meng et al. 2015), during the GLF, in addition to declines in agricultural output, a rigid procurement standard also played a key role in generating regional food shortages and thereby causing the famine. Guided by this insight, we formally examine whether the government was able to adjust procurement requirements in the regions that were more affected by the FPC, which helps shed light on whether, and through what potential mechanisms, the FPC would play a role in the formation of the Great Famine.

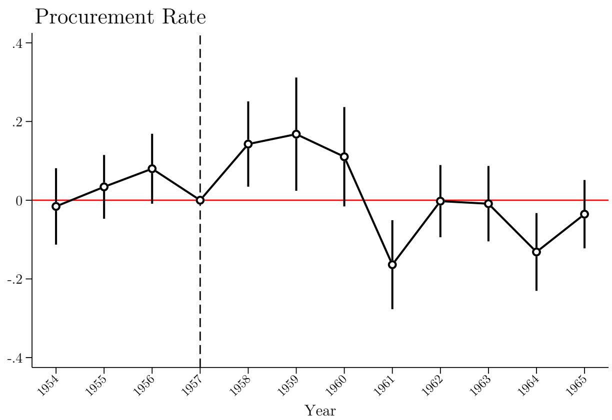
As shown in Figure 7, the rigid crop procurement rule likely exacerbated the negative agricultural production shock. When high-suitability counties experienced a negative output shock after sparrow eradication, they actually got assigned even higher procurement amounts, which was likely driven by the central government's working assumption for the FPC—that sparrow eradication would boost agricultural productivity, rather than reducing it. This reversal in the trends of agricultural productivity and crop procurement did not get corrected until 1961, which was towards the end of the famine. As a result, the effective procurement rate (procurement divided by output) went up substantially for the high-suitability counties during the FPC, which echoes the patterns documented by Meng et al. (2015). After 1960, both the procurement amount and the effective procurement rate started to catch up with the lower yields in high-suitability counties, consistent with the historical background documented in the Great Famine literature—the Chinese government realized the severity of the famine after 1960, and adjusted its procurement policies accordingly (Yang 2012).

Taking stock, our results indicate that the eradication of sparrows hurt crop yields in counties with high sparrow suitability scores between 1958 and 1961, while the procurement of crops in these areas did not adjust accordingly until 1961. As a result, 1960 was likely a particularly difficult year for the high-suitability counties—yield had been falling significantly, while procurement amount further went up. We examine this hypothesis explicitly in the following section.

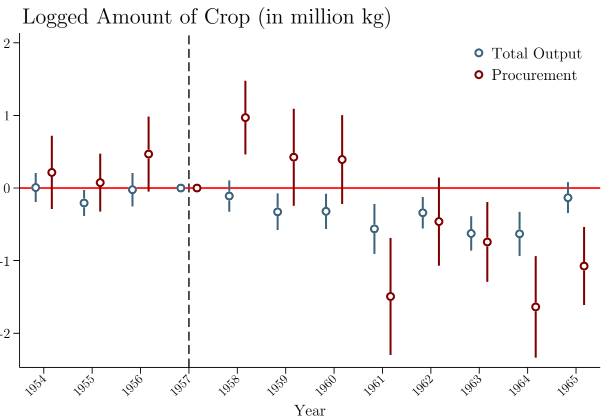
Figure 7: Examining the Role of the Procurement Policy

Continuous Sparrow Suitability

(a) Procurement Rate

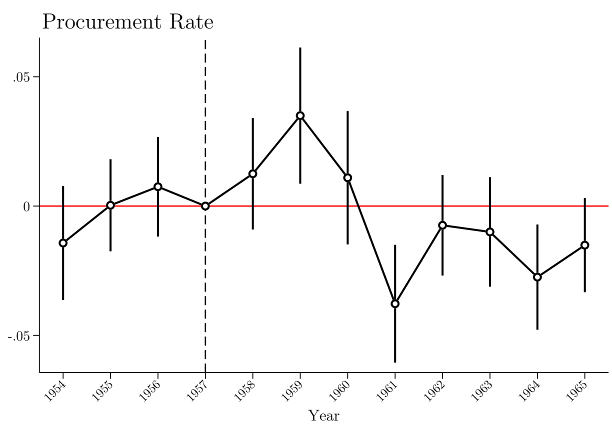


(b) Numerator and Denominator

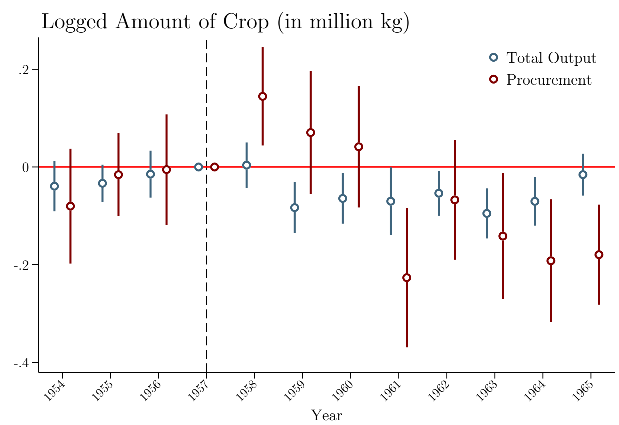


High Sparrow Suitability

(c) Procurement Rate



(d) Numerator and Denominator



Notes: Coefficients and 95% CIs for the estimation specification in Equation (1). Panels (a) and (b) interact the continuous sparrow suitability score with year dummies, while panels (c) and (d) interact the dummy for above-median sparrow suitability (high sparrow suitability) with the year dummies. In panels (a) and (c), we the procurement rate (amount procured for redistribution relative to total local production), while in panels (b) and (d), we separately examine the logged amount in the numerator or denominator in the procurement rate. Each regression includes county and year fixed effects. Samples include all unbalanced counties with at least one year of non-missing data for rice and wheat before and after the onset of the FPC. Standard errors are clustered at the county level.

5.4 Mortality and Fertility Rates

In this section, we investigate the demographic impacts of the eradication of sparrows, and conduct a back-of-the-envelope calculation to evaluate the aggregate contribution of the FPC to the Great Famine. All the demographic analyses are weighted by the pre-1957 population of each county.[11]

There was no systematic difference in mortality or fertility trends between sparrow-suitable or unsuitable counties before the FPC, but during the peak of the Great Famine, sparrow-suitable counties experienced a meaningful differential shock to these outcomes. In Figure 8, we plot the event study coefficients from Equation (1) for either the all-cause death rate or the birth rate, per 1,000 people. For the all-cause death rate, we observe no difference in how sparrow suitable counties were trending relative to the sparrow unsuitable counties in the pre-FPC years—when using either the continuous or dummy version of the treatment variable (Figures 8a or 8c). For both versions of the treatment variable, we observe a sharp spike in mortality in 1960, the peak of the Great Famine. The timing of this effect is highly consistent with the relative timelines of agricultural shock and delayed procurement adjustment, as discussed in Section 5.3. When using the above-median sparrow suitability treatment definition (Figure 8c), we observe that the high sparrow suitability counties start to diverge from the low sparrow suitability counties in 1958.

The magnitudes of the mortality effects are meaningful, even against the backdrop of the calamity of the Great Famine. For example, in 1960, a one standard deviation difference in the sparrow suitability score resulted in 3.3 additional deaths per 1,000 people. Alternatively, the difference in mortality in 1960 between a county with a sparrow suitability score at the 75th to the 25th percentile level is 5.1 additional deaths per 1,000 people. The high sparrow suitability counties (above-median suitability) had 13.14 additional deaths per 1,000 people in 1960, relative to the low sparrow suitability counties. These reflect relative differences of

[11] To allow for comparison between the previous unweighted results and results reported here, we include baseline population-weighted results for Table 2 in Table A2, and unweighted results for Table 4 in Table A3.

9.6%, 15%, and 38.9%, respectively, relative to the mean all-cause death rate in 1960 of 33.9 deaths per 1,000 people.[12]

Higher mortality is one demographic dimension through which counties could have experienced the severe negative effects of the Great Famine, while fertility is another important dimension we examine. In Figures 8b and 8d, we repeat the same exercise for fertility rate, motivated by previous findings in the literature showing that the Great Famine consisted of not only death counts but also foregone births in the corresponding cohorts. As expected, the pattern appears to be the mirror image of that in mortality results: the birth rate is strongly negatively correlated with the sparrow suitability score in 1960, but not in the years before or after.

In Table 4, we summarize the patterns we report in Figure 8. Because the events of the Great Famine were so heavily concentrated during the peak in 1960, we recover a positive but imprecisely estimated coefficient when we pool 1958 to 1961 together, using the CSS (Panel A, columns 1 to 3). When we use the HSS, we recover precisely estimated increases in mortality over the 1958-1961 period of 5.1 additional deaths per 1,000 people (Panel B, column 1). While our pooled estimates for fertility from 1958 to 1961 smooth out the sharp negative effect in 1960 we observe in Figures 8b and 8d, we observe a precisely estimated *increase* in the birth rate following the FPC, during 1962 to 1965. We find that the birth rate was 2.2 births per 1,000 people higher in the HSS counties (Panel B, column 4). This is consistent with delayed fertility decisions and with fertility choices that seek to compensate for mortality shocks (Nobles et al. 2015; Eckstein et al. 1984).

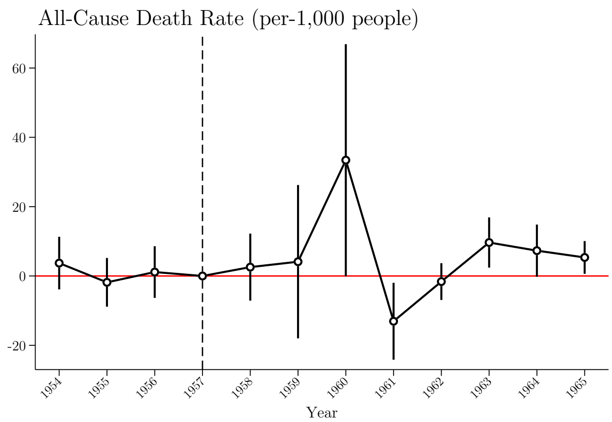
It is worth noting that while sparrow-suitable counties experienced the largest reductions in rice production in 1960-1961, and in wheat production in 1961, the main demographic consequences were heavily concentrated in 1960, which echoes Meng et al. (2015) by highlighting the central role of procurement rules in driving the famine. In fact, we observe that

[12] The mean all-cause death rate in 1960 is masking considerable heterogeneity. The 10th, 25th, 75th, and 90th percentile values for the 1960 all-cause death rate in 1960 were: 9.7, 13.6, 52.7, and 70.4 deaths per 1,000 people.

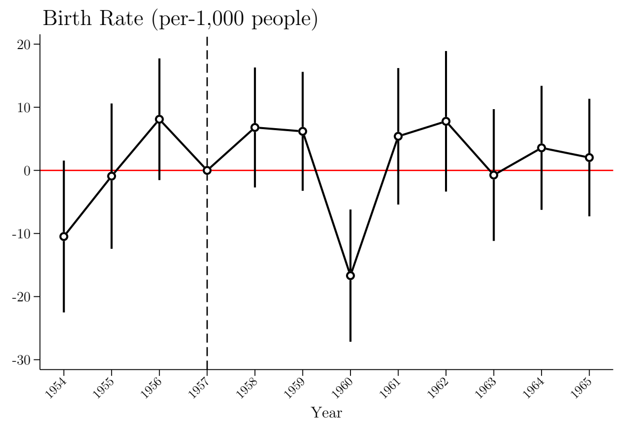
Figure 8: Effects on Population at County Level

Continuous Sparrow Suitability

(a) Mortality

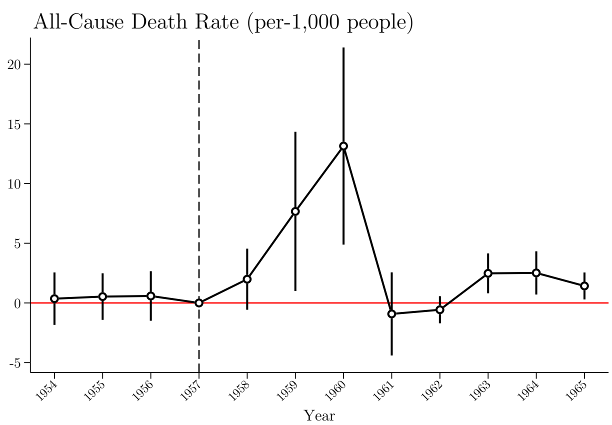


(b) Fertility

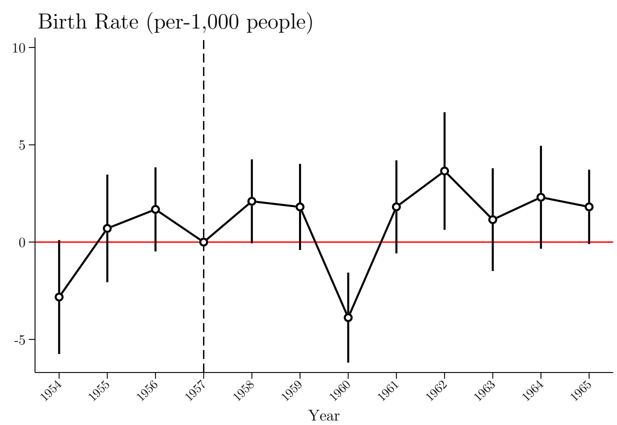


High Sparrow Suitability

(c) Mortality



(d) Fertility



Notes: Coefficients and 95% CIs for the estimation specification in Equation (1). Panels (a) and (b) interact the continuous sparrow suitability score with year dummies, while panels (c) and (d) interact the dummy for above-median sparrow suitability (high sparrow suitability) with the year dummies. Each regression includes county and year fixed effects. Samples include all unbalanced counties with at least one year of non-missing data for rice and wheat before and after the onset of the FPC. Standard errors are clustered at the county level.

Table 4
Effects on Death and Birth Rate

	Death Rate			Birth Rate		
Panel A. Continous Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
CSS×1958-1961	5.49	6.14	0.46	0.52	-0.16	-0.21
	(7.89)	(8.06)	(7.58)	(3.61)	(3.48)	(3.70)
CSS×1962-1965	4.28*	2.91	3.05	3.12	2.76	-0.10
	(2.25)	(2.22)	(2.30)	(4.02)	(4.05)	(3.68)
R^2	0.45	0.46	0.48	0.68	0.68	0.70
Dep. Var. Mean	14.65	14.65	14.65	31.63	31.63	31.63
N	3,699	3,699	3,699	3,654	3,654	3,654
Clusters	486	486	486	482	482	482
Panel B. High Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
HSS×1958-1961	5.10**	5.44**	4.17*	0.31	0.14	0.14
	(2.18)	(2.37)	(2.17)	(0.79)	(0.80)	(0.81)
HSS×1962-1965	1.00*	0.73	0.74	2.16**	2.15**	1.58*
	(0.51)	(0.49)	(0.54)	(0.91)	(0.97)	(0.86)
R^2	0.46	0.46	0.48	0.68	0.68	0.70
Dep. Var. Mean	14.65	14.65	14.65	31.63	31.63	31.63
N	3,699	3,699	3,699	3,654	3,654	3,654
Clusters	486	486	486	482	482	482
Baseline Population-by-Year FE	N	Y	N	N	Y	N
Crop Suitability-by-Year FE	N	N	Y	N	N	Y

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression is weighted by the mean population between 1954 and 1957. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

sparrow-suitable counties experienced the biggest differential change to the procurement rate in 1960 (Figures 7a and 7c). To put it in another way, it is unlikely that the eradication of sparrows alone would have caused all the documented demographic changes, had there not been such misguided procurement rules prior to 1960.

5.4.1 Back-of-the-Envelope Calculation

Linking the estimates for agricultural and demographic impacts, and imposing linearity assumptions on these effects, we can conduct back-of-the-envelope calculations on the extent to which the eradication of sparrows contributed to the Great Famine.

Specifically, according to our agricultural estimates, 23,169,473 (3,844,525) tons of lost rice (wheat) can be attributed to the eradication of sparrows, which is 8.72% of the baseline national crop yield, and accounts for 19.64% of the lost output during the Great Famine. [13] According to our demographic estimates, sparrow eradication led to the loss of 1,954,169 lives, and reduced fertility counts by 397,368.[14] This is equivalent to 0.307% of the total national population, and 6.49% of the total death count during the Great Famine.

5.5 Robustness & Threats to Internal Validity

We examine the robustness of our baseline findings to a variety of changes to the regression specification, or additional sample restrictions. One potential concern is the representativeness of our baseline county sample. Since official statistics were widely known to be severely exaggerated in that period, we rely on decentralized information independently documented in the county gazetteers, which has been shown to be more accurate. However, the county

[13] We calculate the lost crop caused by sparrow killing as the sum of products across counties of the suitability scores, which is weighted by the percentage of a certain crop production out of the total output of all crops, multiplied by the event study coefficients for 1959, 1960, and 1961. We calculate the total lost crop as the difference in the sum of the estimated crop output between 1959 and 1961 and the actual crop output between 1959 and 1961.

[14] We calculate the total loss of lives in a similar way to the crop losses. We take the sum of products of the suitability scores times the all-cause death rate event study coefficients for 1959, 1960, and 1961, multiplied by the county's population. We then divide that sum by the total number of deaths across all counties. We repeat this process for births.

gazetteers were only available intermittently in 898 counties, reflecting 37.7% of the total number of counties, raising questions about possible sample selection issues across regions and over time. We address these concerns in two ways.

First, as discussed in Section 4, when regressing official agricultural output numbers against official numbers of sparrow killings at the provincial level, this balanced panel shows a pattern consistent with our county-level analysis: provinces reported to have killed more sparrows during the FPC also experienced sudden losses in agricultural output during this period. This aggregated balanced panel thus helps alleviates concerns that the county-level results are driven by its incomplete coverage. While it is certainly possible that the provincial official statistics may have been manipulated, it is worth noting that such politically motivated misreporting would likely be systematically inflated for both crop yields and sparrow killings, thereby generating a spurious positive correlation between the two, rather the negative relationship observed in our data.

Second, in addition to aggregating the analysis to the provincial level, we also repeat the county-level analysis with only a balanced panel.[15] In Online Appendix Table A5, we compare estimates from the baseline specification in Equation (1) using the unbalanced panel, to the estimates we obtain when restricting the sample to be balanced between 1955 and 1962. We fail to find meaningful differences in the baseline empirical patterns. This is reassuring that our findings are indeed driven by the treatment effect of sparrow eradication, instead of potentially endogenous entry and exit of counties in our baseline sample. The results from the balanced sample complement the analysis in Table A1, where we do not find evidence that the timing of failing to report a value for rice or wheat is correlated with sparrow suitability.

One might also worry about potential outliers in the historical data, especially given that the county gazetteers data was largely voluntarily documented by the local gentry class, without a streamlined process of quality checking. To alleviate such concerns, in Online

[15] To avoid dropping too many counties from the sample, for the robustness checks with balanced panels, we focus on the sample period between 1955 and 1962.

Appendix Tables A6 and A7, we re-run the baseline regressions using winsorized samples at [1%,99%], [2.5%,97.5%], and [5%,95%], respectively. Compared to the full unwinsorized sample, the baseline empirical patterns are highly robust to these different samples, indicating that the main results are not driven by outliers.

To further verify that the estimation results are not sensitive to the choice of fixed effects in the specification, especially the temporal controls, we report several variations to the baseline regression specification in Equation (1). In Tables A13-A26, we report—for all the outcomes, using either the CSS or HSS—the baseline event-study coefficients, along with results that include the baseline population-by-year, and the crop suitability-by-year controls. To this, we add results that also allow the year fixed effects to vary by one of three regions (east, middle, or west). In a more demanding check, we include province, of which there are 31 of, linear time trends. This change leads to similar patterns in terms of the sign of the dynamics, but sometimes results in less precisely estimated coefficients.

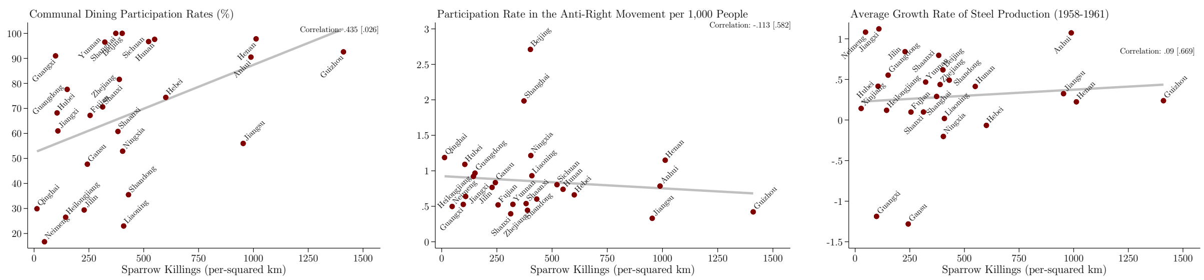
As additional time-varying controls, we add the province-level cross-sectional covariates on communal dining, participation in the anti-right movement, and steel production growth, which we interact with year fixed effects. All three have been used in previous papers on the GLF and the Great Famine to examine the varying degree of adhering to GLF policies (Lin 1990; Lin and Yang 2000; Meng et al. 2015). We summarize the province-level correlation of these variables with the reported sparrow killings in Figure 9, where we fail to detect meaningful correlations.[16] By including the interactions of these province-level proxies for GLF "zealousness," we are allowing different dynamics at the province level to absorb more of the variation in agricultural production, as well as other outcomes. As we include more of these covariates, however, we reduce the sample size because not all of these variables are reported for all of the provinces. In the most demanding specification, where we include baseline population-by-year, crop suitability-by-year, GLF covariates-by-year, and province

[16] While communal dining (Figure 9a, shows a linear fit with a positive slope, it is heavily driven by just three outlier provinces. Removing just one of the three provinces in the top-right corner of the figure, greatly suppresses the positive slope of the linear fit line.

linear time trends, we are left with a little over half of the original sample, yet we still recover meaningful and precisely estimated treatment effects of sparrow suitability.

Figure 9: Cross-Sectional Provincial Correlations With GLF Policies

(a) Communal Dining (b) Anti-Right Movement (c) Steel Production Growth



Notes: Province-level correlations of proxies for "zeolonuess" with respect to pursing other Great Leap Forward policies, and sparrow killings.

6 Conclusions

We document a large reduction in grain production and a spike in all-cause mortality, in the years leading to and during the events of the Great Famine, in Chinese counties with high habitation suitability for sparrows, following the successful campaign to eradicate them from 1958 to 1960. We provide important empirical validation to a long-standing, yet understudied, environmental history hypothesis regarding the conditions that played a role in causing the Great Famine in China. These results demonstrate that while ecosystem collapses are rare, their consequences can be catastrophic when they do occur. In recent years, countries have largely avoided driving species towards local extinction, yet due to habitat loss, climate change, and over-exploitation, many species are becoming either functionally or locally extinct. As our findings demonstrate, losses of species that play important roles in production functions that affect human well-being can have dire consequences.

References

Alsan, Marcella. 2015. “The Effect of the TseTse Fly on African Development.” *The American Economic Review* 105 (1): 382–410.

Becker, Jasper. 1998. *Hungry Ghosts: Mao’s Secret Famine.* Henry Holt / Company.

Booth, Trevor H, Henry A Nix, John R Busby, and Michael E F Hutchinson. 2014. “BIOCLIM: the first species distribution modelling package, its early applications and relevance to most current MaxEnt studies.” Edited by Janet Franklin. *Diversity & Distributions* 20 (1): 1–9.

Butt, Khalid Manzoor, and Sarah Sajid. 2018. “Chinese Economy under Mao Zedong and Deng Xiaoping.” *Journal of Political Studies* (Lahore Pakistan; China; Pakistan, Pakistan, Lahore) 25 (1): 169–178.

Cao, Jiarui, Yiqing Xu, and Chuanchuan Zhuang. 2022. “Clans and calamity: How social capital saved lives during China’s Great Famine.” *Journal of Development Economics* 157 (102865).

Cao, Shuji. 2005. “The Population Death and Causes in China between 1959 and 1961.” *Chinese Journal of Population Science,* no. 01, 16–30+97.

Cardinale, Bradley J, J Emmett Duffy, Andrew Gonzalez, David U Hooper, Charles Perrings, Patrick Venail, Anita Narwani, et al. 2012. “Biodiversity loss and its impact on humanity.” *Nature* 486 (7401): 59–67.

Chen, Hanyi, and Xuebin Wang. 2021. “Sparrow Slaughter and Grain Yield Reduction During the Great Famine of China.”

Chen, Shuo, and James Kai-sing Kung. 2011. “The Tragedy of the Nomenclature: Career Incentives and Political Radicalism during China’s Great Leap Famine.” *American Political Science Review* 105 (1): 27–45.

Chen, Shuo, and Xiaohuan Lan. 2017. “There Will Be Killing: Collectivization and Death of Draft Animals.” *American Economic Journal: Applied Economics* 9 (4): 58–77. https://doi.org/10.1257/app.20160247. https://www.aeaweb.org/articles?id=10.1257/app.20160247.

Cheng, Tien-Hsi. 1963. “Insect Control in Mainland China.” *Science* 140 (3564): 269–277.

Cooper, Gregory S, Simon Willcock, and John A Dearing. 2020. “Regime shifts occur disproportionately faster in larger ecosystems.” *Nature Communications* 11 (1): 1175.

Dasgupta, Partha. 2021. *The Economics of Biodiversity: The Dasgupta Review.* Technical report.

Diamond, Jared. 2005. *Collapse: How Societies Choose to Fail or Succeed.* Penguin.

Dikötter, Frank. 2010. *Mao’s Great Famine.* Walker & Company.

Eckstein, Zvi, T Paul Schultz, and Kenneth I Wolpin. 1984. “Short-run fluctuations in fertility and mortality in pre-industrial Sweden.” *European Economic Review* 26 (3): 295–317.

Evenden, Matthew D. 1995. "The Laborers of Nature: Economic Ornithology and the Role of Birds as Agents of Biological Pest Control in North American Agriculture, ca. 1880–1930." *Forest and Conservation History* 39 (4): 172–183.

Fischer, G, F Nachtergaele, S Prieler, E Teixeira, G Toth, H Velthuizen, L Verelst, and D Wiberg. 2021. "Global Agro-ecological Zones (GAEZ v4.0)- Model Documentation."

Foley, Jonathan A, Navin Ramankutty, Kate A Brauman, Emily S Cassidy, James S Gerber, Matt Johnston, Nathaniel D Mueller, et al. 2011. "Solutions for a cultivated planet." *Nature* 478 (7369): 337–342.

Frank, Eyal. 2021. "The Economic Impacts of Ecosystem Disruptions: Private and Social Costs From Substituting Biological Pest Control." *Working Paper.*

Frank, Eyal, and Anant Sudarshan. 2023. "The Social Costs of Keystone Species Collapse: Evidence From The Decline of Vultures in India." *Working Paper.*

Garcia, Karina, Elissa M Olimpi, Daniel S Karp, and David J Gonthier. 2020. "The Good, the Bad, and the Risky: Can Birds Be Incorporated as Biological Control Agents into Integrated Pest Management Programs?" *Journal of Integrated Pest Management* 11 (1).

Harrell, Stevan. 2021. "The Four Horsemen of the Ecopocalypse: the Agricultural Ecology of the Great Leap Forward." *Human Ecology* 49 (1): 7–18.

He, Guojun, Shaoda Wang, and Bing Zhang. 2020. "Watering Down Environmental Regulation in China." *The Quarterly Journal of Economics* 135 (4): 2135–2185. https://doi.org/10.1093/qje/qjaa024.

Heal, Geoffrey. 2000. "Valuing Ecosystem Services." *Ecosystems* 3 (1): 24–30.

Heilmann, Sebastian. 2008. "Policy Experimentation in China's Economic Rise." *Studies in Comparative International Development* 43:1–26. https://doi.org/10.1007/s12116-007-9014-4.

IPBES. 2019. *Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* Edited by S Dı az, J Settele, E S Brondı zio E. S., H T Ngo, M Guèze, J Agard, A Arneth, et al. IPBES secretariat, Bonn, Germany.

Jenkins, Martin. 2003. "Prospects for biodiversity." *Science* 302 (5648): 1175–1177.

Jones, Benjamin A, and Shana M McDermott. 2018. "Health Impacts of Invasive Species Through an Altered Natural Environment: Assessing Air Pollution Sinks as a Causal Pathway." *Environmental & Resource Economics* 71 (1): 22–43.

Kornai, Janos. 1960. "Overcentralization in Economic Administration: A Critical Analysis Based on Experience in Hungarian Light Industry." *Soviet Studies* 11 (4): 421–424.

Li, Bingjing, and Hiroyuki Kasahara. 2020. "Grain exports and the causes of China's Great Famine, 1959–1961: County-level evidence." *Journal of Development Economics* 146 (102513).

Li, Wei, and Dennis Tao Yang. 2005. “The Great Leap Forward: Anatomy of a Central Planning Disaster.” *The Journal of Political Economy* 113 (4): 840–877.

Lin, Justin Yifu. 1990. “Collectivization and China’s agricultural crisis in 1959-1961.” *The Journal of Political Economy* 98 (6): 1228–1252.

Lin, Justin Yifu, and Dennis Tao Yang. 2000. “Food Availability, Entitlements and the Chinese Famine of 1959-61.” *The Economic Journal* 110 (460): 136–158.

MacFarquhar, Roderick, and John K. Fairbank, eds. 1987. *The Great Leap Forward: 1958-1960.* Vol. 14. Cambridge University Press.

Manning, Kimberley Ens, and Felix Wemheuer, eds. 2011. *Eating Bitterness: New Perspectives on China’s Great Leap Forward and Famine.* University of British Columbia Press.

Mao, Sally Wen. 2019. “On Sparrows.” *The Kenyon Review* 41 (5): 77–93.

Marks, Robert B. 2017. *China: An environmental history.* Rowman & Littlefield.

Mendenhall, Chase D, Daniel S Karp, Christoph F J Meyer, Elizabeth A Hadly, and Gretchen C Daily. 2014. “Predicting biodiversity change and averting collapse in agricultural landscapes.” *Nature* 509 (7499): 213–217.

Meng, Xin, Nancy Qian, and Pierre Yared. 2015. “The Institutional Causes of China’s Great Famine, 1959-1961.” *The Review of Economic Studies* 82 (4 (293)): 1568–1611.

Mullié, Wim C. 2009. “Birds, locusts and grasshoppers.” In *Living on the Edge,* 202–223. KNNV Publishing.

Musiani, Marco, and Paul C Paquet. 2004. “The Practices of Wolf Persecution, Protection, and Restoration in Canada and the United States.” *Bioscience* 54 (1): 50–60.

Nobles, Jenna, Elizabeth Frankenberg, and Duncan Thomas. 2015. “The effects of mortality on fertility: population dynamics after a natural disaster.” *Demography* 52 (1): 15–38.

Nove, Alec. 1971. “An Economic History of the U.S.S.R.” *The Journal of Economic History* 31 (2): 514–515. https://doi.org/10.1017/S002205070009135X.

O’Rourke, Kevin. 1994. “The Economic Impact of the Famine in the Short and Long Run.” *The American Economic Review* 84 (2): 309–313.

Ravallion, Martin. 1997. “Famines and Economics.” *Journal of Economic Literature* 35 (3): 1205–1242.

Raynor, Jennifer L, Corbett A Grainger, and Dominic P Parker. 2021. “Wolves make roadways safer, generating large economic returns to predator conservation.” *Proceedings of the National Academy of Sciences of the United States of America* 118 (22).

Repasky, Richard R, and Dolph Schluter. 1994. “Habitat Distributions of Wintering Sparrows Along an Elevational Gradient: Tests of the Food, Predation and Microhabitat Structure Hypotheses.” *The Journal of Animal Ecology* 63 (3): 569–582.

Sen, Amartya. 1981. *Poverty and Famines: An Essay on Entitlement and Deprivation.* OUP Oxford.

Shapiro, Judith. 1999. "Mao's war against nature: Politics and the environment in revolutionary China." Ph.D. dissertation, American University.

———. 2001. "Mao's war against nature." *(No Title).*

Sharma, Jyoti Trehan, and Harsh Bala Sharma. 2017. "Reflecting on the relationship between human beings and sparrows." *Journal Of Innovation For Inclusive Development* 2 (2): 86–90.

Smil, V. 1999. "China's great famine: 40 years later." *BMJ* 319 (7225): 1619–1621.

Solow, Andrew, Stephen Polasky, and James Broadus. 1993. "On the Measurement of Biological Diversity." *Journal of Environmental Economics and Management* 24 (1): 60–68.

Springborn, Michael R, Joakim A Weill, Karen R Lips, Roberto Ibanez, and Aniruddha Ghosh. 2022. "Amphibian Collapses Exacerbated Malaria Outbreaks 3 in Central America." *Environmental Research Letters* 17 (104012): 1–12.

Steinfeld, Jemimah. 2018. "China's deadly science lesson: How an ill-conceived campaign against sparrows contributed to one of the worst famines in history." *Index on Censorship* 47 (3): 49–49.

Strona, Giovanni, and Kevin D Lafferty. 2016. "Environmental change makes robust ecological networks fragile." *Nature Communications* 7:12462.

Taylor, M Scott. 2011. "Buffalo Hunt: International Trade and the Virtual Extinction of the North American Bison." *The American Economic Review* 101 (7): 3162–3195.

Wang, Shaoda, and David Y. Yang. 2023. "Policy Experimentation in China: the Political Economy of Policy Learning." Revise and Resubmit, Journal of Political Economy.

Weitzman, Martin L. 1992. "On diversity." *The Quarterly Journal of Economics* 107 (2): 363–405.

———. 1998. "The Noah's ark problem." *Econometrica: Journal of the Econometric Society,* 1279–1298.

———. 2009. "On Modeling and Interpreting the Economics of Catastrophic Climate Change." *The Review of Economics and Statistics* 91 (1): 1–19.

Xie, Yinxi, and Yang Xie. 2017. "Machiavellian experimentation." *Journal of Comparative Economics* 45 (4): 685–711.

Yang, Jisheng. 2012. *Tombstone: The Great Chinese Famine, 1958-1962.* Translated by Stacy Mosher and Guo Jian. Farrar, Straus / Giroux.

Yao, Shujie. 1999. "A Note on the Causal Factors of China's Famine in 1959–1961." *The Journal of Political Economy* 107 (6): 1365–1369.

Žižek, Slavoj. 2022. "A Materialist Defense Of An Idealist Subjectivity." In *Ideas and idealism in philosophy,* edited by D Gruyter, 173–192. New Studies in the History and Historiography of Philosophy. de Gruyter.

Online Appendix

A Additional Results

A.1 Validating BIOCLIM Suitability Scores Predict Species Abundance

In the paper, we use the the BIOCLIM model to generate the sparrow suitability score, and then use it to define treatment and exposure to the eradication of sparrows. This relies on the assumption that the suitability score provides a strong proxy for the abundance of sparrows before the FPC. In other words, we assume that the sparrow suitability score is correlated with baseline population levels of sparrows. We cannot test this assumption holds because we lack any data on sparrow population counts, which is precisely why we use a habitat suitability model in the first place. That being said, the correlation between the reported number of sparrows killed per squared km and the sparrow suitability score (Figure 4a) does provide reassuring suggestive evidence that the suitability score is correlated with another variable that we think is proportional to baseline population levels.

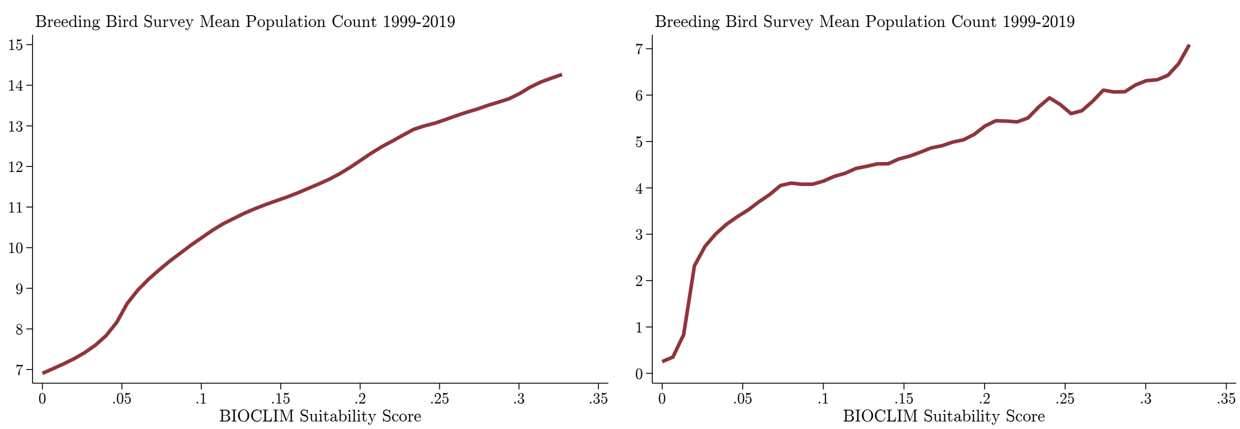
Here we report additional results from a different setting where we do get to observe *both* data on population levels that were collected using a repeated scientific protocol, and use the BIOCLIM model to generate suitability scores. We use data from the Breeding Bird Survey (BBS) in the United States, from 1999 to 2019, where trained individuals travel along pre-determined routes and collect counts on different bird species. We use these counts for different bird species as inputs to the BIOCLIM habitat suitability model and generate suitability scores. To avoid a mechanical relationship between the population data and the suitability scores we exclude one state at a time, and generate suitability scores for the bird species using only data from outside of that state. We repeat this process for all the lower 48 states in the United States.

In Figure A1, we use a local polynomial regression to summarize the relationship between

BBS mean bird counts, and the BIOCLIM suitability scores for 3,108 counties and 520 bird species. There is a clear positive relationship where higher suitability scores are correlated with higher mean population levels. We interpret this as strong support for the assumption that suitability scores from the BIOCLIM model provide a proxy for baseline population levels. This patterns hold even if we assume that missing county-species values are capturing true zero values for the mean population count. When we assume those are true zeros, we observe a sharp increase in mean bird counts as suitability scores increase from zero to non-zero values, and then a tapering of the correlation.

Figure A1: Correlation of Bird Population Counts & BIOCLIM Suitability Scores

(a) Not Assuming Missing Values Are Zeros (b) Assuming Missing Values Are Zeros

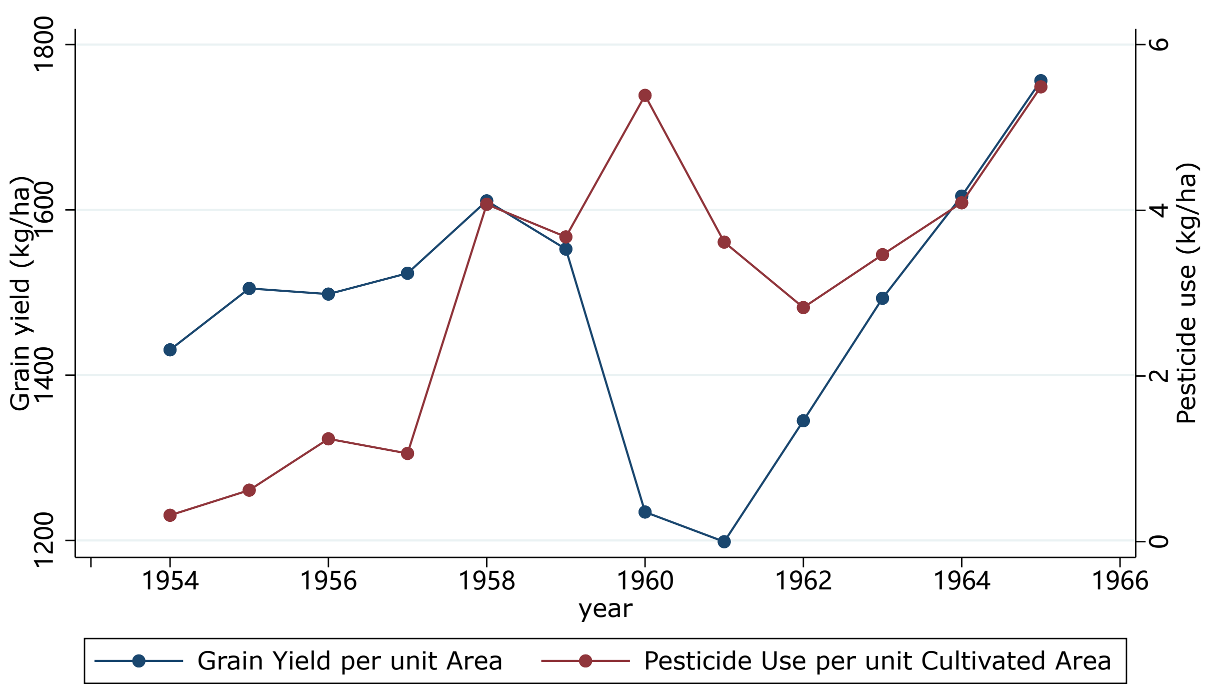


Notes: Local polynomial regression, averaging 520 bird species, across 3,108 counties in the lower 48 states in the United States. We winsorize the suitability score at the 99th percentile. In panel (a), we treat missing values as missing, while in panel (b) we treat them as true zero population counts. While the magnitudes change, the broad pattern of positive correlation between population counts suitability scores holds. See text for more details.

A.2 Examining Data Reporting & Correlation With Sparrow Suitability

As we mention in the data section of the main text, after we drop large counties from the data, we have 492 out of the 704 counties (70%) that report at least rice or wheat in both 1954 to 1957 and 1958 to 1965. However, most counties fail to report rice or wheat data every year. Here, we examine whether the missing data patterns are correlated with the sparrow suitability score. We reports results for linear probability models where the outcomes are either: (i) non-missing value in year t for rice or wheat, (ii) ever reporting rice or wheat, or (iii) having data for either rice or wheat in both pre- and post-FPC periods. In Table A1, we report results using both the continuous sparrow suitability score and the above-median suitability dummy variable. We find that the timing of missing data is not correlated with sparrow suitability; however, high sparrow suitability counties are less likely to report rice output and are more likely to report wheat output. Finally, we fail to detect any correlation between having non-missing rice or wheat data in both pre- post-FPC periods and sparrow suitability.

Figure A2: National Trends in Agricultural Production & Pesticide Use



(a) National Trend: Grain Yield and Pesticide Use

Notes: This figure shows aggregate production levels of different crops and total pesticide use, normalized by cultivated area.

Table A1: Summarizing Rice & Wheat Data Reporting Patterns

Non-Missing	At t				Ever				Pre/Post	
	Rice		Wheat		Rice		Wheat		Rice or Wheat	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Suitability	-0.006		0.109		-0.761		0.529		-0.060	
	(0.211)		(0.181)		(0.186)		(0.186)		(0.178)	
Suitability (H)		0.003		0.015		-0.126		0.098		-0.007
		(0.039)		(0.036)		(0.038)		(0.037)		(0.035)
$\overline{Y}$	0.65	0.65	0.66	0.66	0.51	0.51	0.61	0.61	0.70	0.70
R^2	0.05	0.05	0.04	0.04	0.02	0.02	0.01	0.01	0.00	0.00
N	4,272	4,272	5,184	5,184	704	704	704	704	704	704
Clusters	356	356	432	432	704	704	704	704	704	704

Notes: Estimation results for linear probability models as a function of sparrow suitability (continuous score of above-median score). In columns 1 to 4 the oucome is whether the crop (rice or wheat) is not missing in a specific year. In columns 5 to 8 the outcome is whether the county ever has a non-missing value. In columns 9 and 10 the outcome is whether the county has non-missiong data for rice *or* wheat in the pre- *and* post-FPC periods (during 1954-1957 and 1958-1965).

A.3 Comparing Death Rates Between Province-Level & County-Level Data

Table A2
Effects on Rice and Wheat Output, Weighted by Baseline Population

	Rice Output			Wheat Output		
Panel A. Continous Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
CSS×1958-1961	-29.91	-39.44	-28.35	-10.29**	-11.75**	-10.91**
	(28.62)	(26.61)	(20.31)	(4.58)	(4.63)	(4.61)
CSS×1962-1965	-52.42*	-45.34*	-53.04	-10.17**	-12.21***	-10.57***
	(31.75)	(25.27)	(32.51)	(3.96)	(3.89)	(3.99)
R^2	0.91	0.91	0.91	0.86	0.87	0.87
Dep. Var. Mean	55.28	55.28	55.28	11.41	11.41	11.41
N	2,712	2,712	2,712	3,290	3,290	3,290
Clusters	336	336	336	407	407	407
Panel B. High Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
HSS×1958-1961	-9.29*	-12.45**	-5.57	-1.15	-1.34	-1.27
	(5.59)	(5.44)	(5.07)	(0.87)	(0.93)	(0.88)
HSS×1962-1965	-13.25	-11.76	-13.16	-2.20**	-2.54***	-2.32***
	(8.08)	(7.39)	(8.22)	(0.86)	(0.91)	(0.87)
R^2	0.91	0.91	0.91	0.86	0.87	0.87
Dep. Var. Mean	55.28	55.28	55.28	11.41	11.41	11.41
N	2,712	2,712	2,712	3,290	3,290	3,290
Clusters	336	336	336	407	407	407
Baseline Population-by-Year FE	N	Y	N	N	Y	N
Crop Suitability-by-Year FE	N	N	Y	N	N	Y

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

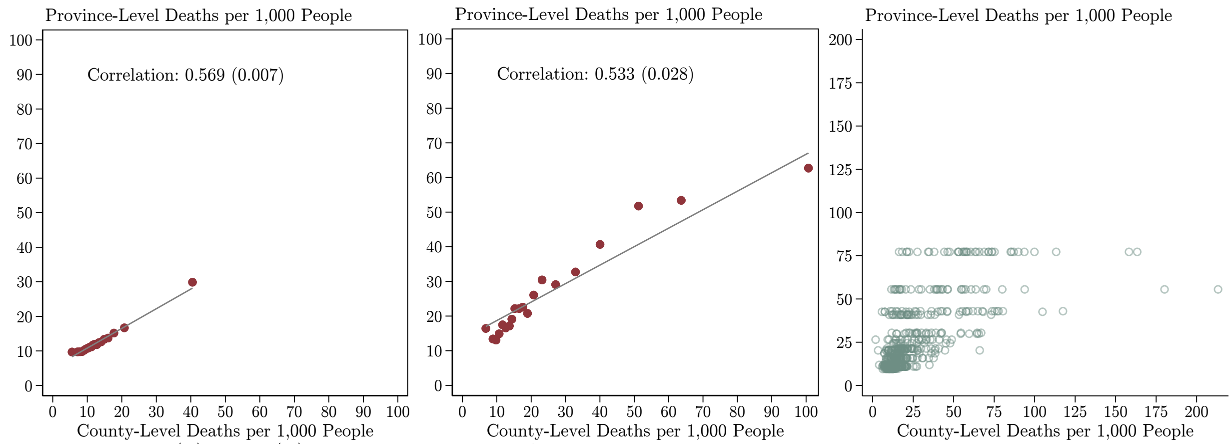
Table A3
Effects on Death and Birth Rate, Unweighted

	Death Rate			Birth Rate		
Panel A. Continous Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
CSS×1958-1961	3.18	4.80	0.17	-0.67	-1.99	-1.39
	(6.20)	(6.24)	(5.77)	(3.34)	(3.27)	(3.38)
CSS×1962-1965	4.29**	3.82**	2.61	0.73	0.92	-0.58
	(1.89)	(1.80)	(1.87)	(3.79)	(3.82)	(3.49)
R^2	0.43	0.45	0.47	0.67	0.67	0.69
Dep. Var. Mean	14.62	14.65	14.62	31.68	31.63	31.68
N	3,733	3,699	3,733	3,688	3,654	3,688
Clusters	492	486	492	488	482	488
Panel B. High Suitability Score						
	(1)	(2)	(3)	(4)	(5)	(6)
HSS×1958-1961	4.28***	4.52***	3.36**	-0.30	-0.48	-0.45
	(1.57)	(1.58)	(1.49)	(0.72)	(0.71)	(0.73)
HSS×1962-1965	1.17***	1.13***	0.75*	1.82**	1.83**	1.39*
	(0.39)	(0.38)	(0.39)	(0.77)	(0.78)	(0.71)
R^2	0.44	0.45	0.47	0.67	0.68	0.69
Dep. Var. Mean	14.62	14.65	14.62	31.68	31.63	31.68
N	3,733	3,699	3,733	3,688	3,654	3,688
Clusters	492	486	492	488	482	488
Baseline Population-by-Year FE	N	Y	N	N	Y	N
Crop Suitability-by-Year FE	N	N	Y	N	N	Y

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

Figure A3: Summarizing Correlations Between Province & County Mortality

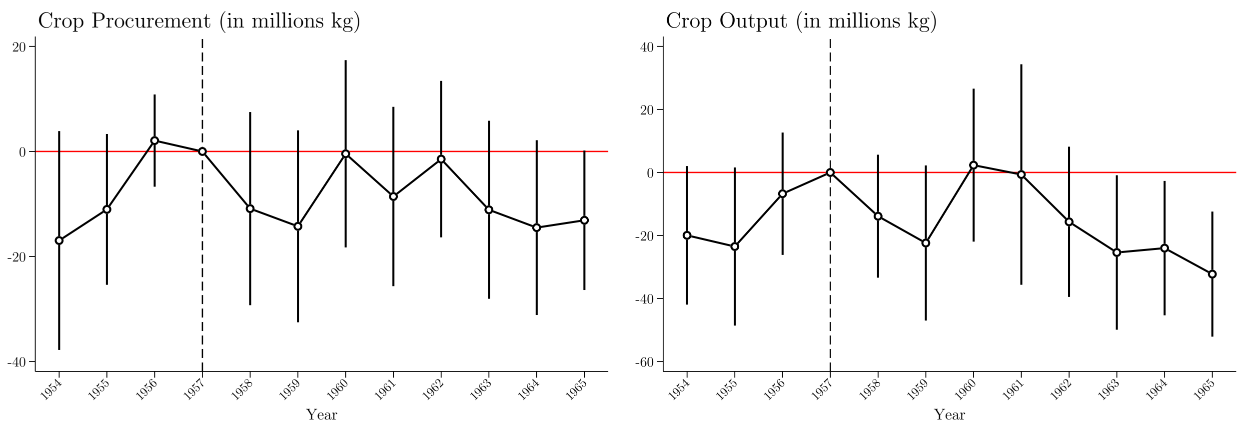
(a) 1954-1965 (b) 1960 (c) 1960



Notes: Panels (a) and (b) plot binscatters of the province-level death rate versus the county-level death rates. Panel (c) plots the full distribution of province death rates versus county death rates. Correlation numbers report the slope and standard error from a regression of province-level on county-level death rates (with no fixed effects or adjustment to standard errors).

Figure A4: Decomposition of Procurement Rate

(a) Procured Amount (Numerator) (b) Total Output (Denominator)



Notes:

Table A4: Other Species

Table A5
Effects on Agriculture with Balanced Sample

	Rice		Wheat		Sweet Potato		Procurement Rate	
Panel A. Continous Suitability Score								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CSS×1955	-5.15	16.69	5.28	8.12	-1.07	-5.58	0.03	-0.05
	(24.45)	(21.05)	(5.53)	(5.40)	(6.64)	(5.61)	(0.04)	(0.04)
CSS×1956	-40.09	-10.07	9.83*	10.94***	-8.78	-13.63**	0.08*	0.01
	(26.88)	(10.29)	(5.22)	(4.03)	(7.06)	(5.48)	(0.05)	(0.04)
CSS×1958	-30.44	-8.10	-0.61	4.35	12.33	11.45	0.14**	0.11*
	(23.70)	(20.68)	(5.38)	(5.25)	(10.10)	(10.84)	(0.06)	(0.06)
CSS×1959	-41.06*	-27.80	-5.54	-3.69	-4.35	-3.49	0.16**	0.11
	(22.40)	(18.94)	(4.76)	(4.52)	(10.55)	(11.94)	(0.07)	(0.08)
CSS×1960	-56.96**	-54.78**	-6.14	-5.33	8.11	14.71	0.10	0.04
	(25.68)	(26.35)	(5.80)	(5.93)	(8.25)	(9.97)	(0.07)	(0.07)
CSS×1961	-74.64**	-62.19**	-20.08***	-19.12**	19.09**	20.87	-0.17***	-0.22***
	(33.05)	(30.60)	(7.60)	(8.66)	(9.53)	(12.84)	(0.06)	(0.06)
CSS×1962	-77.32**	-56.09**	-12.38***	-9.82**	8.43	12.06	-0.00	-0.07
	(32.05)	(23.56)	(4.74)	(4.96)	(6.93)	(8.75)	(0.05)	(0.06)
R^2	0.88	0.95	0.91	0.90	0.88	0.89	0.76	0.73
Dep. Var. Mean	56.33	56.70	12.86	13.69	17.13	18.00	0.27	0.26
N	2,324	1,832	2,713	2,128	1,051	816	2,248	1,608
Clusters	396	229	458	266	184	102	391	201
Panel B. High Suitability Score								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HSS×1955	-2.12	7.02**	1.01	1.28	0.92	-0.83	-0.00	-0.02**
	(8.08)	(3.08)	(1.00)	(1.01)	(1.57)	(1.08)	(0.01)	(0.01)
HSS×1956	-13.00	-0.77	0.70	0.89	-1.36	-2.42**	0.01	-0.01
	(11.37)	(2.55)	(1.26)	(1.14)	(1.35)	(1.10)	(0.01)	(0.01)
HSS×1958	-10.52	-1.55	0.55	1.15	0.95	0.75	0.01	0.00
	(8.11)	(3.25)	(0.86)	(0.80)	(1.76)	(1.90)	(0.01)	(0.01)
HSS×1959	-14.61*	-7.17*	-1.05	-0.80	-2.64	-3.10	0.03**	0.03*
	(8.25)	(4.10)	(0.85)	(0.78)	(2.34)	(2.60)	(0.01)	(0.01)
HSS×1960	-14.51**	-9.23*	-0.94	-1.03	-0.07	1.19	0.01	0.00
	(7.36)	(5.15)	(0.97)	(1.00)	(1.82)	(1.97)	(0.01)	(0.02)
HSS×1961	-20.45*	-10.83*	-2.74**	-2.50**	3.59**	3.04	-0.04***	-0.05***
	(11.26)	(5.94)	(1.11)	(1.24)	(1.72)	(2.15)	(0.01)	(0.01)
HSS×1962	-21.13*	-9.47**	-1.31	-1.09	1.91	1.48	-0.01	-0.02
	(11.95)	(4.52)	(0.86)	(0.90)	(1.21)	(1.60)	(0.01)	(0.01)
R^2	0.88	0.95	0.91	0.90	0.88	0.89	0.76	0.73
Dep. Var. Mean	56.33	56.70	12.86	13.69	17.13	18.00	0.27	0.26
N	2,324	1,832	2,713	2,128	1,051	816	2,248	1,608
Clusters	396	229	458	266	184	102	391	201
Balanced	N	Y	N	Y	N	Y	N	Y

Notes: Estimation results from Equation 1 for the main sample spanning 1955 to 1962. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

Table A6
Effects on Agriculture with Winsorized Sample

	Rice				Wheat				Sweet Potato				Procurement Rate			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
CSS×1954	-39.69	-31.57*	-29.73*	-14.39	2.45	5.71	4.42	3.79	-9.86	-13.52*	-16.46**	-12.49	-0.02	-0.03	-0.04	-0.02
	(24.66)	(18.33)	(16.35)	(10.06)	(5.10)	(5.07)	(3.47)	(3.33)	(8.33)	(8.01)	(8.08)	(7.74)	(0.05)	(0.05)	(0.04)	(0.04)
CSS×1955	-7.51	0.10	-21.88	-2.84	5.59	5.85*	6.26**	3.63	-3.41	-3.81	0.09	1.09	0.03	-0.00	-0.00	-0.02
	(24.52)	(18.86)	(13.56)	(9.74)	(5.30)	(2.99)	(2.98)	(2.74)	(6.72)	(6.51)	(5.70)	(5.77)	(0.04)	(0.04)	(0.04)	(0.04)
CSS×1956	-44.61*	-22.33**	-16.02*	-0.87	8.58*	13.32***	13.43***	7.81**	-9.26	-7.77	-3.13	-1.33	0.08*	0.05	0.06	0.04
	(26.78)	(9.52)	(8.74)	(7.63)	(5.04)	(3.73)	(3.77)	(3.02)	(7.16)	(6.61)	(6.05)	(6.09)	(0.05)	(0.04)	(0.04)	(0.04)
CSS×1958	-32.53	-19.80	-28.45*	-9.43	-0.69	3.83	-0.54	-0.27	11.14	19.53***	18.20**	21.38***	0.14***	0.18***	0.21***	0.21***
	(24.02)	(17.62)	(15.68)	(8.11)	(5.24)	(4.70)	(2.71)	(2.79)	(9.53)	(7.18)	(7.44)	(7.59)	(0.06)	(0.05)	(0.04)	(0.04)
CSS×1959	-43.36*	-32.58**	-35.52**	-16.60	-5.40	-1.43	-2.15	-3.78	-6.06	0.26	1.54	3.94	0.17**	0.17***	0.19***	0.14**
	(22.55)	(16.01)	(14.38)	(10.20)	(4.62)	(3.68)	(2.69)	(2.62)	(10.27)	(6.29)	(6.15)	(6.38)	(0.07)	(0.07)	(0.06)	(0.06)
CSS×1960	-59.23**	-59.51***	-60.93***	-40.40***	-6.01	-2.62	1.16	1.20	5.93	4.95	2.72	3.73	0.11*	0.11*	0.13**	0.12**
	(25.77)	(21.44)	(19.28)	(13.04)	(5.72)	(4.70)	(3.18)	(2.91)	(8.33)	(8.18)	(7.36)	(7.01)	(0.06)	(0.06)	(0.06)	(0.05)
CSS×1961	-76.33**	-62.52**	-66.85***	-39.77**	-19.37**	-15.58**	-9.87*	-11.64***	18.15*	11.60	11.00	4.38	-0.16***	-0.18***	-0.14***	-0.08
	(33.51)	(25.90)	(24.22)	(16.82)	(7.68)	(7.08)	(5.80)	(3.20)	(9.21)	(8.82)	(8.47)	(7.05)	(0.06)	(0.06)	(0.05)	(0.05)
CSS×1962	-85.63***	-63.61***	-62.43***	-32.44***	-13.57***	-10.71***	-5.33	-5.10**	7.65	4.57	2.97	3.98	-0.00	-0.03	-0.03	-0.03
	(32.75)	(19.20)	(17.66)	(11.54)	(4.79)	(3.65)	(3.38)	(2.46)	(6.58)	(5.52)	(5.53)	(5.57)	(0.05)	(0.04)	(0.04)	(0.04)
CSS×1963	-23.83	-11.18	-21.02	-2.28	-10.57***	-6.63**	-5.77**	-4.77**	14.39	4.07	4.39	6.55	-0.01	-0.04	-0.05	-0.06
	(25.77)	(17.24)	(14.28)	(11.18)	(3.85)	(2.66)	(2.72)	(2.39)	(11.97)	(6.11)	(6.09)	(6.12)	(0.05)	(0.05)	(0.04)	(0.04)
CSS×1964	-30.49	-5.61	-33.78**	-15.39*	-6.22	-4.34	-8.02**	-10.88***	36.78***	24.34***	24.78***	24.00***	-0.13***	-0.17***	-0.15***	-0.17***
	(25.27)	(14.21)	(14.35)	(9.24)	(7.79)	(7.34)	(3.55)	(2.42)	(13.84)	(8.32)	(8.11)	(7.80)	(0.05)	(0.05)	(0.04)	(0.04)
CSS×1965	-29.00	-17.82	-50.52***	-30.95***	4.93	7.26*	7.35**	3.10	31.87***	28.25***	24.74***	23.15***	-0.04	-0.05	-0.04	-0.04
	(22.57)	(19.59)	(14.10)	(8.69)	(4.68)	(3.77)	(3.39)	(2.55)	(9.28)	(7.84)	(5.71)	(5.57)	(0.04)	(0.04)	(0.04)	(0.04)
R^2	0.89	0.90	0.89	0.90	0.90	0.87	0.88	0.89	0.86	0.89	0.89	0.89	0.75	0.75	0.75	0.73
Dep. Var. Mean	59.54	52.09	47.76	44.15	13.22	11.95	10.90	9.86	17.02	16.33	15.50	14.40	0.25	0.25	0.25	0.25
N	3,473	3,403	3,297	3,117	4,081	3,996	3,874	3,656	1,588	1,557	1,505	1,424	3,388	3,320	3,214	3,042
Clusters	421	416	408	395	495	489	482	462	206	204	199	193	440	440	435	426
Winsorized	0-100	1-99	2.5-97.5	5-95	0-100	1-99	2.5-97.5	5-95	0-100	1-99	2.5-97.5	5-95	0-100	1-99	2.5-97.5	5-95

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

Table A7
Effects on Agriculture with Winsorized Sample

	Rice				Wheat				Sweet Potato				Procurement Rate			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
HSS×1954	-14.61*	-8.53**	-7.40**	-4.85*	0.43	0.71	0.70	0.12	-2.75	-2.73*	-3.27**	-2.89*	-0.01	-0.01	-0.02	-0.01
	(8.40)	(3.76)	(3.47)	(2.66)	(1.04)	(0.97)	(0.62)	(0.55)	(1.79)	(1.52)	(1.53)	(1.50)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1955	-2.58	2.54	-0.80	1.93	1.19	1.67**	1.42**	0.41	0.34	-0.30	0.44	0.44	0.00	-0.01	-0.01	-0.01
	(7.93)	(2.99)	(2.38)	(2.02)	(0.97)	(0.83)	(0.63)	(0.48)	(1.32)	(1.16)	(1.08)	(1.08)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1956	-13.76	-3.88*	-2.34	0.10	0.64	2.02**	1.74**	0.99	-1.29	-1.14	-0.21	-0.21	0.01	0.00	0.00	0.00
	(11.25)	(2.15)	(2.17)	(1.71)	(1.21)	(0.82)	(0.78)	(0.62)	(1.35)	(1.28)	(1.16)	(1.13)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1958	-10.68	-3.77	-5.12**	-2.79*	0.61	1.28*	0.72	0.33	0.77	2.66*	2.46*	3.17**	0.01	0.02**	0.03***	0.03***
	(7.90)	(2.66)	(2.60)	(1.62)	(0.84)	(0.71)	(0.52)	(0.52)	(1.69)	(1.35)	(1.38)	(1.40)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1959	-14.73*	-8.05**	-8.75***	-5.78**	-0.97	-0.29	-0.00	-0.27	-3.00	-1.31	-1.04	-0.56	0.03***	0.03**	0.04***	0.03***
	(8.12)	(3.36)	(3.11)	(2.43)	(0.82)	(0.67)	(0.60)	(0.59)	(2.33)	(1.56)	(1.46)	(1.45)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1960	-14.79**	-11.17***	-11.33***	-9.78***	-0.79	-0.24	0.47	0.48	-0.48	0.17	-0.38	-0.11	0.01	0.01	0.01	0.01
	(7.21)	(4.10)	(3.53)	(3.16)	(0.95)	(0.81)	(0.60)	(0.55)	(2.05)	(1.63)	(1.49)	(1.30)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1961	-20.62*	-11.85**	-12.13***	-9.45**	-2.63**	-2.45***	-1.82**	-1.68**	3.39**	2.13	1.88	0.73	-0.04***	-0.04***	-0.03***	-0.02**
	(11.23)	(4.93)	(4.26)	(3.66)	(1.13)	(0.93)	(0.82)	(0.66)	(1.69)	(1.61)	(1.47)	(1.34)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1962	-23.23*	-12.65***	-11.53***	-7.97***	-1.44*	-1.27*	-0.61	-0.64	1.75	1.26	0.95	1.50	-0.01	-0.01	-0.01	-0.01
	(11.96)	(3.82)	(3.05)	(2.43)	(0.85)	(0.69)	(0.68)	(0.51)	(1.19)	(1.04)	(1.07)	(1.05)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1963	-8.73	-1.09	-3.19	-0.10	-1.68**	-0.92	-0.97*	-0.66	0.91	0.07	0.27	0.92	-0.01	-0.02	-0.02*	-0.02**
	(9.75)	(4.19)	(3.47)	(2.47)	(0.76)	(0.60)	(0.57)	(0.49)	(1.94)	(1.36)	(1.37)	(1.34)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1964	-13.22	-3.28	-6.25*	-3.83*	-0.86	-0.79	-1.30*	-1.69***	5.36**	3.75**	4.10**	3.72**	-0.03***	-0.03***	-0.03***	-0.03***
	(10.19)	(3.57)	(3.25)	(2.29)	(1.13)	(0.98)	(0.70)	(0.52)	(2.21)	(1.68)	(1.69)	(1.54)	(0.01)	(0.01)	(0.01)	(0.01)
HSS×1965	-10.45*	-6.87*	-11.02***	-7.80***	1.45	1.78**	1.95***	1.05**	5.95***	5.04***	4.52***	4.31***	-0.02	-0.02*	-0.02*	-0.02*
	(5.70)	(3.60)	(3.22)	(2.00)	(1.03)	(0.77)	(0.67)	(0.48)	(1.61)	(1.32)	(1.18)	(1.18)	(0.01)	(0.01)	(0.01)	(0.01)
R^2	0.89	0.90	0.89	0.90	0.90	0.87	0.88	0.89	0.86	0.89	0.89	0.89	0.75	0.75	0.75	0.73
Dep. Var. Mean	59.54	52.09	47.76	44.15	13.22	11.95	10.90	9.86	17.02	16.33	15.50	14.40	0.25	0.25	0.25	0.25
N	3,473	3,403	3,297	3,117	4,081	3,996	3,874	3,656	1,588	1,557	1,505	1,424	3,388	3,320	3,214	3,042
Clusters	421	416	408	395	495	489	482	462	206	204	199	193	440	440	435	426
Winsorized	0-100	1-99	2.5-97.5	5-95	0-100	1-99	2.5-97.5	5-95	0-100	1-99	2.5-97.5	5-95	0-100	1-99	2.5-97.5	5-95

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

Table A8
Effects on Population with Balanced Sample

	Mortality		Fertility	
Panel A. Continous Suitability Score				
	(1)	(2)	(3)	(4)
CSS×1955	-2.03	-0.78	-1.48	-7.12
	(4.14)	(2.80)	(6.03)	(6.77)
CSS×1956	0.33	3.19	7.56	4.88
	(4.22)	(4.26)	(4.88)	(4.50)
CSS×1958	2.85	-2.22	6.59	4.28
	(5.22)	(5.66)	(4.77)	(4.88)
CSS×1959	3.75	-4.03	5.16	4.97
	(11.45)	(13.39)	(4.66)	(5.30)
CSS×1960	32.71*	29.68	-18.06***	-20.69***
	(17.06)	(18.24)	(5.24)	(5.56)
CSS×1961	-12.94**	-12.32*	4.52	0.92
	(5.78)	(6.90)	(5.37)	(6.53)
CSS×1962	-2.58	-1.35	7.80	10.73*
	(2.88)	(3.27)	(5.74)	(6.06)
R^2	0.51	0.47	0.65	0.62
Dep. Var. Mean	16.00	16.87	27.21	26.00
N	2,431	1,608	2,389	1,480
Clusters	436	201	430	185
Panel B. High Suitability Score				
	(1)	(2)	(3)	(4)
HSS×1955	0.82	-0.00	0.49	-1.38
	(1.26)	(0.64)	(1.55)	(1.88)
HSS×1956	0.85	0.30	1.52	0.36
	(1.31)	(1.05)	(1.10)	(1.07)
HSS×1958	2.36	0.71	1.96*	0.86
	(1.47)	(1.49)	(1.07)	(1.13)
HSS×1959	8.01**	6.37	1.55	1.23
	(3.44)	(3.91)	(1.05)	(1.21)
HSS×1960	13.05***	9.35**	-4.21***	-4.86***
	(4.22)	(3.92)	(1.19)	(1.39)
HSS×1961	-0.56	-1.39	1.55	0.06
	(1.88)	(2.15)	(1.20)	(1.53)
HSS×1962	-0.77	-0.15	3.60**	3.64***
	(0.62)	(0.72)	(1.52)	(1.34)
R^2	0.52	0.48	0.66	0.63
Dep. Var. Mean	16.00	16.87	27.21	26.00
N	2,431	1,608	2,389	1,480
Clusters	436	201	430	185
Balanced	N	Y	N	Y

Notes: Estimation results from Equation 1 for the main sample spanning 1955 to 1962. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

Table A9
Effects on Population with Winsorized Sample

	Mortality				Fertility			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CSS×1954	3.72	0.63	1.53	2.30	-10.48*	-10.16	-11.04*	-10.00*
	(3.86)	(3.50)	(3.04)	(2.57)	(6.12)	(6.17)	(6.14)	(5.72)
CSS×1955	-1.84	-2.48	-1.71	1.10	-0.91	0.55	-0.17	-1.24
	(3.57)	(3.51)	(3.00)	(2.87)	(5.86)	(5.21)	(5.20)	(5.24)
CSS×1956	1.13	-0.76	0.53	1.34	8.10*	9.12*	8.30*	9.06**
	(3.80)	(3.75)	(3.60)	(2.20)	(4.91)	(4.90)	(4.86)	(4.59)
CSS×1958	2.56	0.96	4.15	3.95	6.80	5.27	3.93	3.93
	(4.92)	(4.83)	(4.57)	(4.40)	(4.84)	(4.55)	(4.46)	(4.48)
CSS×1959	4.12	4.97	5.46	4.55	6.19	6.22	5.50	3.67
	(11.26)	(6.62)	(6.54)	(5.37)	(4.80)	(4.76)	(4.71)	(4.73)
CSS×1960	33.42*	25.32**	29.42***	20.64***	-16.68***	-16.07***	-15.84***	-11.45*
	(17.03)	(11.53)	(7.91)	(6.53)	(5.33)	(5.23)	(5.55)	(6.12)
CSS×1961	-13.06**	-13.87**	-7.00	-6.96*	5.40	6.25	5.10	7.07
	(5.65)	(5.51)	(4.65)	(4.15)	(5.50)	(5.59)	(5.60)	(6.09)
CSS×1962	-1.61	-1.12	0.22	-0.04	7.78	8.11	7.10	5.32
	(2.70)	(2.66)	(2.55)	(2.55)	(5.67)	(5.42)	(5.25)	(5.16)
CSS×1963	9.66***	8.72**	9.87***	5.98**	-0.74	0.53	3.48	2.51
	(3.69)	(3.52)	(3.39)	(2.40)	(5.32)	(5.13)	(4.45)	(4.27)
CSS×1964	7.31*	6.47*	7.04**	6.75**	3.57	2.44	0.21	-0.90
	(3.83)	(3.64)	(3.39)	(3.22)	(5.00)	(4.97)	(4.86)	(4.96)
CSS×1965	5.35**	4.88**	5.57**	5.73**	2.03	2.64	1.95	-1.29
	(2.41)	(2.46)	(2.45)	(2.38)	(4.74)	(4.48)	(4.49)	(4.61)
R^2	0.46	0.52	0.50	0.47	0.68	0.71	0.69	0.68
Dep. Var. Mean	14.65	13.96	13.39	12.86	31.63	31.58	31.55	31.56
N	3,699	3,622	3,505	3,310	3,654	3,581	3,464	3,268
Clusters	486	483	476	463	482	480	475	462
Winsorized	0-100	1-99	2.5-97.5	5-95	0-100	1-99	2.5-97.5	5-95

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

Table A10

Effects on Population with Winsorized Sample

	Mortality				Fertility			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HSS×1954	0.36	0.39	0.08	0.20	-2.74*	-2.57*	-2.78*	-2.60*
	(1.12)	(1.12)	(1.03)	(0.78)	(1.53)	(1.54)	(1.53)	(1.48)
HSS×1955	0.53	0.00	0.20	0.33	0.75	1.10	0.64	0.45
	(0.99)	(0.86)	(0.70)	(0.64)	(1.50)	(1.23)	(1.22)	(1.24)
HSS×1956	0.58	-0.48	-0.13	0.10	1.72	2.21**	1.75*	1.41
	(1.06)	(0.92)	(0.85)	(0.52)	(1.08)	(1.05)	(1.03)	(1.01)
HSS×1958	1.99	1.06	1.97*	0.95	2.15**	1.99**	1.35	1.24
	(1.30)	(1.23)	(1.14)	(1.02)	(1.06)	(1.00)	(0.98)	(0.99)
HSS×1959	7.67**	2.56	0.41	0.46	1.87*	2.05*	1.63	1.21
	(3.39)	(1.82)	(1.36)	(0.91)	(1.07)	(1.05)	(1.04)	(1.05)
HSS×1960	13.14***	5.89**	6.57***	3.61***	-3.76***	-3.09***	-2.98**	-1.95
	(4.20)	(2.70)	(1.80)	(1.25)	(1.19)	(1.19)	(1.28)	(1.35)
HSS×1961	-0.92	-3.12**	-1.71	-1.88**	1.88	2.27*	1.97	2.20*
	(1.77)	(1.28)	(1.07)	(0.93)	(1.22)	(1.21)	(1.20)	(1.29)
HSS×1962	-0.57	-0.28	-0.05	0.04	3.70**	3.94***	2.90**	2.25*
	(0.58)	(0.56)	(0.53)	(0.52)	(1.50)	(1.23)	(1.16)	(1.15)
HSS×1963	2.48***	1.74***	1.99***	1.51***	1.20	0.90	0.49	-0.10
	(0.85)	(0.66)	(0.58)	(0.50)	(1.35)	(1.23)	(1.01)	(0.97)
HSS×1964	2.52***	1.79**	1.98***	1.95***	2.35*	1.54	-0.03	-1.36
	(0.92)	(0.76)	(0.66)	(0.60)	(1.39)	(1.34)	(1.27)	(1.23)
HSS×1965	1.42**	1.20*	1.43**	1.76***	1.84*	1.82*	1.55	-0.02
	(0.57)	(0.62)	(0.57)	(0.55)	(0.98)	(0.96)	(0.96)	(0.96)
R^2	0.47	0.53	0.51	0.48	0.69	0.71	0.70	0.68
Dep. Var. Mean	14.65	13.96	13.39	12.86	31.63	31.58	31.55	31.56
N	3,699	3,622	3,505	3,310	3,654	3,581	3,464	3,268
Clusters	486	483	476	463	482	480	475	462
Winsorized	0-100	1-99	2.5-97.5	5-95	0-100	1-99	2.5-97.5	5-95

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

Table A11
Effects on Procurement Rate

	Procurement Rate		
Panel A. Continous Suitability Score			
	(1)	(2)	(3)
CSS×1958-1961	0.04	0.03	0.04
	(0.05)	(0.05)	(0.05)
CSS×1962-1965	-0.06*	-0.06	-0.05
	(0.03)	(0.04)	(0.03)
R^2	0.75	0.75	0.76
Dep. Var. Mean	0.25	0.25	0.25
N	3,388	3,043	3,388
Clusters	440	403	440
Panel B. High Suitability Score			
	(1)	(2)	(3)
HSS×1958-1961	0.01	0.00	0.01
	(0.01)	(0.01)	(0.01)
HSS×1962-1965	-0.01*	-0.01	-0.01
	(0.01)	(0.01)	(0.01)
R^2	0.75	0.75	0.76
Dep. Var. Mean	0.25	0.25	0.25
N	3,388	3,043	3,388
Clusters	440	403	440
Baseline Population-by-Year FE	N	Y	N
Crop Suitability-by-Year FE	N	N	Y

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression is weighted by the mean population between 1954 and 1957. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A12
Effects on Rice, Wheat and Sweet Potato Yield

	Rice Yield			Wheat Yield			Sweet Potato Yield		
Panel A. Continous Suitability Score	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CSS×1958-1961	-57.33**	-42.42*	-54.88**	-5.49	-13.35	-5.94	1.38	-4.57	3.81
	(23.06)	(24.70)	(22.76)	(7.37)	(8.70)	(7.39)	(27.39)	(30.19)	(28.43)
CSS×1962-1965	-11.23	-1.68	-2.70	-3.32	-17.04*	-4.51	37.53	33.53	22.19
	(22.28)	(25.61)	(20.97)	(8.60)	(9.72)	(8.56)	(26.79)	(31.96)	(28.94)
R^2	0.75	0.73	0.76	0.76	0.76	0.76	0.74	0.71	0.75
Dep. Var. Mean	161.04	165.84	161.04	55.13	54.13	55.13	116.47	121.98	116.47
N	2,732	2,140	2,732	3,503	2,804	3,503	1,395	1,059	1,395
Clusters	338	272	338	433	353	433	187	148	187
Panel B. High Suitability Score	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
HSS×1958-1961	-5.81	-3.54	-5.73	0.16	-1.26	0.11	-0.59	0.44	-0.18
	(5.18)	(5.20)	(5.17)	(1.53)	(1.83)	(1.54)	(5.58)	(6.34)	(5.40)
HSS×1962-1965	0.10	3.71	0.40	0.87	-2.31	0.62	16.20***	17.69***	14.53***
	(4.95)	(5.33)	(4.81)	(1.68)	(1.80)	(1.68)	(5.36)	(6.45)	(5.38)
R^2	0.75	0.73	0.76	0.76	0.76	0.76	0.75	0.72	0.75
Dep. Var. Mean	161.04	165.84	161.04	55.13	54.13	55.13	116.47	121.98	116.47
N	2,732	2,140	2,732	3,503	2,804	3,503	1,395	1,059	1,395
Clusters	338	272	338	433	353	433	187	148	187
Baseline Population-by-Year FE	N	Y	N	N	Y	N	N	Y	N
Crop Suitability-by-Year FE	N	N	Y	N	N	Y	N	N	Y

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county and year fixed effects. Standard errors are clustered at the county level.

Table A13
Effects on Rice Output, Detailed

	Rice Output									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CSS×1954	-39.69	-48.90*	-52.11*	-20.54	-125.43**	-22.47	-51.96*	-32.37	-48.82	-23.91
	(24.66)	(26.77)	(28.33)	(21.37)	(54.35)	(24.75)	(29.36)	(53.41)	(46.48)	(66.64)
CSS×1955	-7.51	-15.89	-7.09	1.72	8.49	9.37	-10.36	22.15	-10.01	22.97
	(24.52)	(26.81)	(27.35)	(23.82)	(56.61)	(26.07)	(29.31)	(46.05)	(45.52)	(56.78)
CSS×1956	-44.61*	-47.87*	-52.84	-29.30	-69.87	-45.01	-51.33	-46.98	-50.48	-39.91
	(26.78)	(27.85)	(32.52)	(25.00)	(50.99)	(34.31)	(32.86)	(45.33)	(50.97)	(49.21)
CSS×1958	-32.53	-26.74	-35.55	-1.91	-63.83	-15.72	-40.20	-8.68	-9.07	-15.31
	(24.02)	(23.11)	(27.46)	(19.88)	(45.87)	(25.07)	(28.59)	(41.86)	(37.24)	(40.00)
CSS×1959	-43.36*	-32.58	-31.09	-29.86	-78.30**	-19.74	-56.05**	-28.32	-34.38	-51.59*
	(22.55)	(22.63)	(25.82)	(19.45)	(37.87)	(25.68)	(26.08)	(31.25)	(32.76)	(28.07)
CSS×1960	-59.23**	-45.56	-42.98	-46.35**	-107.27**	-24.94	-74.57***	-69.08**	-55.07**	-98.08***
	(25.77)	(28.81)	(29.97)	(18.55)	(41.84)	(28.76)	(26.97)	(29.08)	(26.40)	(27.98)
CSS×1961	-76.33**	-58.11	-63.30*	-58.61**	-127.89***	-46.62	-93.52***	-81.40*	-73.47*	-104.80***
	(33.51)	(36.94)	(38.00)	(28.32)	(48.31)	(38.20)	(35.89)	(42.43)	(42.66)	(38.56)
CSS×1962	-85.63***	-59.82*	-83.34**	-62.71**	-132.61**	-64.03	-104.83***	-91.00*	-76.51	-115.53**
	(32.75)	(36.07)	(38.46)	(28.63)	(52.75)	(38.85)	(39.17)	(53.32)	(47.77)	(47.02)
CSS×1963	-23.83	4.49	-8.79	-16.65	-69.78	-5.60	-29.30	-31.78	-9.80	-49.38
	(25.77)	(26.73)	(29.33)	(25.78)	(42.31)	(32.56)	(31.41)	(45.78)	(37.46)	(37.93)
CSS×1964	-30.49	0.94	-22.43	-31.42	-68.04	-34.97	-34.74	-49.38	-34.49	-70.51*
	(25.27)	(23.15)	(28.73)	(25.64)	(42.43)	(31.68)	(31.29)	(46.09)	(36.70)	(39.25)
CSS×1965	-29.00	13.53	-21.76	-48.56***	-53.47	-46.22**	-21.24	-57.38**	-26.80	-76.46**
	(22.57)	(22.69)	(20.38)	(16.65)	(36.42)	(19.97)	(23.91)	(25.41)	(18.43)	(33.12)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.89	0.89	0.89	0.90	0.88	0.89	0.89	0.89	0.91	0.89
Dep. Var. Mean	59.54	59.54	59.54	55.28	61.30	61.10	59.54	58.40	54.62	58.40
N	3,473	3,473	3,473	2,712	2,180	3,050	3,473	1,720	2,565	1,720
Clusters	421	421	421	336	319	379	421	260	321	260

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A14
Effects on Rice Output, Detailed

	Rice Output									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HSS×1954	-14.61*	-17.74**	-17.98*	-15.94*	-38.41**	-15.39	-14.11*	-27.23*	-21.41*	-30.68**
	(8.40)	(8.59)	(9.99)	(9.41)	(17.06)	(10.08)	(8.20)	(14.41)	(12.41)	(15.28)
HSS×1955	-2.58	-4.70	-3.28	-5.02	-4.63	-1.50	-2.19	-5.80	-6.88	-8.65
	(7.93)	(8.07)	(9.54)	(9.24)	(16.12)	(9.51)	(7.91)	(14.42)	(12.04)	(14.67)
HSS×1956	-13.76	-14.68	-16.61	-13.78	-26.20	-16.20	-13.09	-21.41	-17.20	-22.78
	(11.25)	(11.38)	(13.68)	(13.03)	(23.38)	(14.06)	(10.90)	(19.27)	(16.68)	(19.69)
HSS×1958	-10.68	-9.02	-12.16	-8.50	-21.73	-10.83	-10.42	-10.79	-7.74	-11.40
	(7.90)	(7.91)	(9.64)	(8.94)	(16.41)	(9.69)	(7.87)	(15.03)	(11.66)	(15.20)
HSS×1959	-14.73*	-11.60	-12.70	-16.62*	-26.86*	-12.06	-14.17*	-13.01	-11.96	-14.72
	(8.12)	(8.15)	(9.74)	(9.02)	(16.09)	(9.88)	(7.97)	(13.40)	(11.31)	(13.19)
HSS×1960	-14.79**	-10.54	-11.55	-17.87**	-30.11**	-10.73	-14.08**	-18.91	-12.92	-19.94*
	(7.21)	(7.44)	(8.84)	(7.41)	(15.00)	(8.91)	(6.94)	(11.70)	(9.09)	(11.70)
HSS×1961	-20.62*	-15.03	-18.07	-24.71**	-38.74*	-17.61	-19.27*	-24.28	-18.94	-23.00
	(11.23)	(11.47)	(13.51)	(12.35)	(20.09)	(13.74)	(10.73)	(17.76)	(15.30)	(17.62)
HSS×1962	-23.23*	-15.82	-23.99	-22.63*	-39.18*	-22.45	-23.17*	-25.32	-18.09	-22.02
	(11.96)	(12.13)	(14.82)	(13.19)	(21.80)	(14.70)	(11.85)	(20.38)	(16.71)	(20.26)
HSS×1963	-8.73	-0.65	-7.16	-12.56	-23.01	-7.06	-8.76	-16.21	-5.90	-9.93
	(9.75)	(9.58)	(11.68)	(11.18)	(18.27)	(12.09)	(9.71)	(16.49)	(13.51)	(16.42)
HSS×1964	-13.22	-3.46	-13.90	-17.77	-26.06	-15.20	-13.13	-23.73	-12.20	-15.75
	(10.19)	(9.83)	(12.36)	(11.72)	(19.11)	(12.61)	(10.04)	(17.12)	(13.88)	(17.18)
HSS×1965	-10.45*	1.23	-9.53	-14.88**	-19.60	-12.30*	-9.49	-17.56*	-5.12	-9.06
	(5.70)	(5.00)	(6.05)	(6.01)	(12.17)	(6.75)	(5.77)	(9.14)	(6.07)	(9.52)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.89	0.89	0.90	0.90	0.88	0.89	0.90	0.89	0.91	0.89
Dep. Var. Mean	59.54	59.54	59.54	55.28	61.30	61.10	59.54	58.40	54.62	58.40
N	3,473	3,473	3,473	2,712	2,180	3,050	3,473	1,720	2,565	1,720
Clusters	421	421	421	336	319	379	421	260	321	260

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A15
Effects on Wheat Output, Detailed

	Wheat Output									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CSS×1954	2.45	0.32	4.62	2.75	-0.75	7.69**	1.67	2.46	1.49	5.06
	(5.10)	(4.93)	(5.87)	(3.86)	(7.56)	(3.87)	(4.90)	(6.04)	(4.31)	(5.86)
CSS×1955	5.59	3.97	3.67	2.26	6.43	1.30	5.30	-2.65	-2.98	-0.30
	(5.30)	(5.07)	(4.98)	(4.10)	(8.96)	(4.11)	(5.32)	(6.94)	(4.26)	(6.84)
CSS×1956	8.58*	7.63	4.92	8.59	7.74	9.97*	7.94	4.87	5.06	3.94
	(5.04)	(5.02)	(4.69)	(5.84)	(6.81)	(5.47)	(5.20)	(8.16)	(6.19)	(8.18)
CSS×1958	-0.69	-0.62	-3.28	1.31	-4.86	-1.38	0.06	-6.98	-1.47	-7.91
	(5.24)	(5.32)	(4.61)	(5.79)	(7.85)	(5.73)	(5.23)	(8.83)	(6.42)	(8.89)
CSS×1959	-5.40	-4.99	-5.25	-5.79	-7.61	-7.07	-5.83	-11.68**	-8.75**	-12.51**
	(4.62)	(4.89)	(4.31)	(3.88)	(6.33)	(4.39)	(4.60)	(5.40)	(4.04)	(5.59)
CSS×1960	-6.01	-5.19	-4.18	-5.65	-8.67	-5.60	-5.15	-11.71**	-8.62	-13.12**
	(5.72)	(6.13)	(5.73)	(5.22)	(6.94)	(5.04)	(5.60)	(5.75)	(5.28)	(5.86)
CSS×1961	-19.37**	-18.17**	-16.48**	-13.25*	-22.85**	-17.64**	-18.34**	-9.58	-12.23	-11.36
	(7.68)	(7.77)	(7.73)	(7.06)	(9.12)	(8.89)	(7.62)	(9.16)	(7.85)	(9.50)
CSS×1962	-13.57***	-11.97**	-13.73***	-12.71***	-15.95***	-14.70***	-12.99***	-14.25**	-13.74***	-16.33***
	(4.79)	(5.20)	(4.79)	(4.70)	(5.66)	(5.24)	(4.75)	(5.87)	(5.19)	(6.27)
CSS×1963	-10.57***	-8.52*	-9.51***	-10.52***	-12.72**	-9.99**	-10.45***	-12.26**	-9.46**	-15.25**
	(3.85)	(4.82)	(3.37)	(3.94)	(5.20)	(4.21)	(3.85)	(5.37)	(4.73)	(6.10)
CSS×1964	-6.22	-3.74	-5.44	-3.84	-9.03	-0.57	-5.85	-0.78	1.22	-4.34
	(7.79)	(8.36)	(8.82)	(8.69)	(9.36)	(9.02)	(7.80)	(13.53)	(10.96)	(13.60)
CSS×1965	4.93	7.04	5.55	2.34	1.79	8.00*	2.77	-1.59	3.26	-5.22
	(4.68)	(5.58)	(4.62)	(4.51)	(6.10)	(4.77)	(4.92)	(6.28)	(5.36)	(6.97)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.90	0.90	0.91	0.88	0.89	0.90	0.90	0.86	0.88	0.86
Dep. Var. Mean	13.22	13.22	13.22	11.41	13.61	12.91	13.22	11.60	11.41	11.60
N	4,081	4,081	4,081	3,290	2,856	3,720	4,081	2,248	3,177	2,248
Clusters	495	495	495	407	394	458	495	322	394	322

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A16
Effects on Wheat Output, Detailed

	Wheat Output									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HSS×1954	0.43	-0.04	0.89	0.52	-0.42	1.70*	0.27	0.21	0.44	0.56
	(1.04)	(1.02)	(1.20)	(0.78)	(1.55)	(0.90)	(1.02)	(1.10)	(0.91)	(1.04)
HSS×1955	1.19	0.85	0.79	1.47	0.71	0.94	1.11	0.54	0.59	0.90
	(0.97)	(1.01)	(0.92)	(1.00)	(1.51)	(0.96)	(0.96)	(1.70)	(0.98)	(1.71)
HSS×1956	0.64	0.44	-0.28	0.49	0.62	0.84	0.50	-0.27	-0.41	-0.50
	(1.21)	(1.23)	(1.20)	(1.48)	(1.99)	(1.30)	(1.26)	(2.63)	(1.67)	(2.65)
HSS×1958	0.61	0.65	0.14	0.88	-0.11	0.62	0.76	-0.66	0.37	-0.73
	(0.84)	(0.85)	(0.75)	(0.89)	(1.37)	(0.89)	(0.83)	(1.49)	(0.96)	(1.49)
HSS×1959	-0.97	-0.83	-0.82	-0.24	-1.72	-0.94	-1.08	-1.32	-0.64	-1.23
	(0.82)	(0.84)	(0.80)	(0.77)	(1.25)	(0.90)	(0.81)	(1.22)	(0.79)	(1.23)
HSS×1960	-0.79	-0.52	-0.57	-0.39	-1.74	-0.45	-0.68	-2.20*	-0.97	-2.32*
	(0.95)	(1.00)	(0.92)	(0.90)	(1.34)	(0.84)	(0.92)	(1.27)	(0.86)	(1.23)
HSS×1961	-2.63**	-2.27*	-1.96*	-2.26**	-3.72**	-2.51*	-2.45**	-1.89	-1.97	-2.01
	(1.13)	(1.16)	(1.10)	(1.13)	(1.54)	(1.34)	(1.11)	(1.58)	(1.27)	(1.62)
HSS×1962	-1.44*	-0.96	-1.26	-1.89**	-1.86	-1.60*	-1.33	-2.15*	-1.90**	-2.29*
	(0.85)	(0.91)	(0.85)	(0.88)	(1.18)	(0.93)	(0.84)	(1.24)	(0.96)	(1.29)
HSS×1963	-1.68**	-1.07	-1.34*	-2.05**	-2.18*	-1.33*	-1.68**	-2.43**	-1.58*	-2.74**
	(0.76)	(0.88)	(0.71)	(0.79)	(1.13)	(0.81)	(0.76)	(1.20)	(0.92)	(1.33)
HSS×1964	-0.86	-0.14	-0.77	-1.38	-1.29	0.26	-0.81	-0.67	-0.12	-1.02
	(1.13)	(1.15)	(1.17)	(1.12)	(1.59)	(1.31)	(1.11)	(1.99)	(1.41)	(1.91)
HSS×1965	1.45	2.15**	1.65	0.69	1.14	2.65**	0.92	0.33	1.28	0.00
	(1.03)	(1.07)	(1.08)	(1.11)	(1.44)	(1.13)	(1.12)	(1.82)	(1.36)	(1.99)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.90	0.90	0.90	0.88	0.89	0.90	0.90	0.86	0.88	0.86
Dep. Var. Mean	13.22	13.22	13.22	11.41	13.61	12.91	13.22	11.60	11.41	11.60
N	4,081	4,081	4,081	3,290	2,856	3,720	4,081	2,248	3,177	2,248
Clusters	495	495	495	407	394	458	495	322	394	322

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A17
Effects on Sweet Potato Output, Detailed

	Sweet Potato Output									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CSS×1954	-9.86	-5.11	-8.24	-2.74	-43.67**	-16.86*	-10.90	-10.09	1.43	-11.34
	(8.33)	(9.87)	(9.14)	(5.16)	(20.57)	(9.25)	(8.35)	(11.59)	(10.78)	(13.62)
CSS×1955	-3.41	-0.58	-3.60	2.84	-21.14	-8.37	-1.66	-2.77	-1.60	-3.17
	(6.72)	(6.52)	(7.02)	(5.61)	(16.77)	(7.24)	(6.51)	(8.98)	(6.61)	(10.19)
CSS×1956	-9.26	-5.94	-7.68	0.25	-16.23	-8.39	-4.13	1.22	2.85	0.25
	(7.16)	(8.09)	(8.15)	(5.63)	(14.09)	(7.65)	(6.63)	(12.09)	(7.02)	(11.30)
CSS×1958	11.14	8.82	9.65	11.25*	7.07	5.10	12.68	3.92	9.18	6.36
	(9.53)	(9.85)	(11.21)	(6.41)	(18.45)	(10.06)	(9.12)	(9.52)	(6.98)	(8.77)
CSS×1959	-6.06	-11.02	-5.21	-11.15*	-7.41	-7.44	-13.29	-6.14	-12.91*	1.24
	(10.27)	(11.16)	(11.69)	(6.64)	(14.12)	(10.97)	(11.49)	(8.36)	(7.72)	(9.74)
CSS×1960	5.93	-1.21	9.21	-9.36	-8.33	4.98	1.84	-8.87	-13.25	-4.33
	(8.33)	(9.90)	(9.24)	(8.67)	(11.49)	(9.03)	(8.91)	(9.65)	(9.73)	(10.98)
CSS×1961	18.15*	8.26	22.77**	3.81	7.25	16.82*	7.08	-1.24	-4.93	-2.65
	(9.21)	(11.16)	(10.69)	(8.17)	(13.23)	(9.26)	(9.50)	(6.78)	(8.19)	(9.42)
CSS×1962	7.65	-4.92	7.56	1.45	1.98	3.21	1.83	-5.92	-8.58	-8.28
	(6.58)	(8.15)	(6.89)	(4.89)	(8.91)	(5.34)	(5.91)	(6.51)	(6.86)	(9.62)
CSS×1963	14.39	-0.27	14.68	-0.88	18.64	6.59	13.86	0.41	-8.15	-7.12
	(11.97)	(13.86)	(13.89)	(5.64)	(17.87)	(11.68)	(9.91)	(8.34)	(7.58)	(10.07)
CSS×1964	36.78***	18.82	39.11***	17.61***	39.68**	30.67**	26.78**	16.40*	4.79	6.51
	(13.84)	(15.21)	(14.76)	(6.30)	(19.97)	(12.50)	(12.00)	(9.70)	(9.25)	(11.21)
CSS×1965	31.87***	10.23	32.80***	22.20***	29.55**	21.42***	23.04***	11.52	3.97	-5.69
	(9.28)	(11.87)	(10.72)	(5.12)	(13.98)	(7.17)	(7.49)	(8.05)	(9.97)	(14.15)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.86	0.86	0.87	0.88	0.84	0.87	0.86	0.88	0.88	0.88
Dep. Var. Mean	17.02	17.02	17.21	14.11	15.35	15.90	17.02	12.34	12.73	12.34
N	1,588	1,588	1,571	1,219	872	1,421	1,588	690	1,114	690
Clusters	206	206	206	164	142	188	206	116	153	116

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A18
Effects on Sweet Potato Output, Detailed

	Sweet Potato Output									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HSS×1954	-2.75	-1.99	-2.53	-2.40	-6.41**	-3.69*	-3.11*	-1.05	-1.98	-2.13
	(1.79)	(1.77)	(2.10)	(1.68)	(3.03)	(1.87)	(1.62)	(3.01)	(1.36)	(3.16)
HSS×1955	0.34	0.78	0.52	0.90	-1.82	-0.47	0.66	0.62	0.02	0.01
	(1.32)	(1.23)	(1.33)	(1.39)	(2.43)	(1.40)	(1.32)	(2.09)	(1.26)	(2.17)
HSS×1956	-1.29	-0.91	-0.87	0.19	-3.10	-1.36	-0.46	0.63	0.43	0.35
	(1.35)	(1.37)	(1.50)	(1.18)	(2.35)	(1.43)	(1.18)	(2.78)	(1.28)	(2.62)
HSS×1958	0.77	0.43	0.38	0.99	-1.57	-0.65	0.81	-0.27	0.57	0.65
	(1.69)	(1.74)	(1.76)	(1.37)	(2.97)	(1.71)	(1.53)	(2.19)	(1.51)	(2.13)
HSS×1959	-3.00	-3.72	-3.29	-3.84**	-4.21	-2.13	-4.58*	-2.58	-2.89	-0.23
	(2.33)	(2.54)	(2.73)	(1.80)	(3.55)	(2.51)	(2.65)	(1.88)	(1.80)	(1.71)
HSS×1960	-0.48	-1.63	-0.23	-3.83	-4.04	0.24	-1.53	-2.78	-3.65	-0.98
	(2.05)	(2.25)	(2.07)	(2.43)	(2.84)	(2.09)	(2.19)	(2.66)	(2.37)	(2.57)
HSS×1961	3.39**	1.79	4.05**	0.41	0.98	4.21**	1.23	1.30	0.34	2.77
	(1.69)	(1.91)	(1.80)	(1.34)	(2.59)	(1.71)	(1.76)	(1.41)	(1.37)	(1.86)
HSS×1962	1.75	-0.22	1.66	0.09	0.53	1.42	0.66	-1.03	-0.68	0.58
	(1.19)	(1.32)	(1.22)	(0.99)	(2.13)	(1.08)	(1.12)	(1.63)	(1.28)	(2.04)
HSS×1963	0.91	-1.40	0.62	-1.37	0.88	-0.58	0.47	-1.61	-1.82	-0.78
	(1.94)	(2.11)	(2.25)	(1.38)	(3.03)	(2.01)	(1.45)	(1.97)	(1.62)	(2.26)
HSS×1964	5.36**	2.51	5.64**	3.02*	5.92	4.63**	3.24	4.46	2.05	4.97
	(2.21)	(2.19)	(2.44)	(1.73)	(3.72)	(2.19)	(1.97)	(3.33)	(2.14)	(3.19)
HSS×1965	5.95***	2.60	6.08***	4.53***	5.89**	4.28***	4.20***	3.91*	2.63*	3.22
	(1.61)	(1.67)	(1.82)	(1.32)	(2.89)	(1.34)	(1.33)	(2.12)	(1.47)	(2.17)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.86	0.86	0.86	0.88	0.84	0.87	0.86	0.88	0.88	0.88
Dep. Var. Mean	17.02	17.02	17.21	14.11	15.35	15.90	17.02	12.34	12.73	12.34
N	1,588	1,588	1,571	1,219	872	1,421	1,588	690	1,114	690
Clusters	206	206	206	164	142	188	206	116	153	116

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A19
Effects on Crop Procurement, Detailed

	Crop Procurement									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CSS×1954	-16.96	-17.14	-9.77*	-20.20	-9.57	-9.11	-17.28	-1.04	-6.13	5.22
	(10.60)	(10.64)	(5.16)	(12.32)	(8.69)	(7.65)	(10.97)	(8.23)	(9.35)	(7.69)
CSS×1955	-11.03	-11.26	1.34	-14.96*	-3.51	-4.79	-11.70	-6.76	-5.43	-3.13
	(7.31)	(7.27)	(4.05)	(7.96)	(7.05)	(5.45)	(7.54)	(7.53)	(6.12)	(6.60)
CSS×1956	2.07	1.98	-5.39	2.85	5.55	2.34	1.96	3.35	2.34	6.05
	(4.47)	(4.83)	(4.58)	(4.95)	(7.13)	(4.13)	(4.62)	(7.38)	(4.97)	(7.49)
CSS×1958	-10.88	-11.31	10.88*	-15.77	-14.08	-0.94	-12.84	-6.47	-6.40	-8.62
	(9.36)	(9.38)	(5.73)	(10.09)	(10.18)	(7.14)	(9.46)	(8.70)	(7.73)	(8.23)
CSS×1959	-14.25	-14.65	-2.33	-18.45*	-6.38	-7.60	-17.59*	-10.24	-17.12*	-17.66*
	(9.30)	(9.55)	(4.97)	(10.41)	(7.95)	(7.37)	(9.87)	(8.36)	(8.76)	(9.04)
CSS×1960	-0.44	-0.53	1.62	-2.77	12.20	4.54	0.77	7.77	1.13	-1.62
	(9.07)	(9.11)	(5.90)	(10.01)	(7.74)	(7.41)	(10.10)	(7.71)	(8.19)	(7.14)
CSS×1961	-8.57	-9.06	-16.52**	-13.44	-1.84	-3.05	-8.09	1.96	-6.44	-7.28
	(8.68)	(8.68)	(7.59)	(9.25)	(8.21)	(7.37)	(9.27)	(8.71)	(8.10)	(7.73)
CSS×1962	-1.46	-1.58	-11.98**	-3.56	5.31	1.16	-0.32	4.37	-2.86	-6.55
	(7.58)	(7.41)	(6.09)	(8.08)	(7.55)	(6.33)	(8.43)	(7.54)	(6.66)	(6.77)
CSS×1963	-11.10	-9.59	-18.12***	-9.37	-4.94	-9.59	-10.39	-9.51	-12.10*	-20.37***
	(8.62)	(8.40)	(6.83)	(9.10)	(9.35)	(7.63)	(9.19)	(8.76)	(7.21)	(7.75)
CSS×1964	-14.50*	-13.87	-17.78***	-18.60**	-7.61	-10.44	-14.21	-13.30*	-17.43**	-25.81***
	(8.47)	(8.44)	(5.68)	(9.34)	(7.88)	(6.80)	(9.10)	(7.38)	(6.99)	(7.01)
CSS×1965	-13.10*	-12.89*	-14.68***	-14.36**	-8.44	-9.03	-12.92*	-12.04	-16.98***	-27.19***
	(6.76)	(7.03)	(5.09)	(7.21)	(8.09)	(5.99)	(7.30)	(7.78)	(6.09)	(7.27)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.86	0.87	0.88	0.86	0.89	0.87	0.87	0.90	0.88	0.91
Dep. Var. Mean	22.15	22.15	22.15	21.60	22.95	21.80	22.15	22.46	21.09	22.46
N	3,476	3,476	3,476	3,112	2,345	3,311	3,476	2,171	3,034	2,171
Clusters	449	449	449	410	354	428	449	329	397	329

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A20
Effects on Crop Procurement, Detailed

	Crop Procurement									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HSS×1954	-6.03**	-7.04***	-4.51***	-7.46**	-5.21**	-4.47***	-5.99**	-3.21*	-5.47**	-3.27
	(2.36)	(2.44)	(1.36)	(2.96)	(2.39)	(1.70)	(2.43)	(1.94)	(2.20)	(2.04)
HSS×1955	-2.60	-3.20*	0.06	-3.76**	0.15	-1.21	-2.71	-0.40	-1.98	-0.40
	(1.63)	(1.66)	(1.03)	(1.88)	(1.73)	(1.24)	(1.70)	(1.59)	(1.53)	(1.70)
HSS×1956	-1.22	-1.82	-3.08**	-1.06	-0.64	-1.52	-1.27	-0.52	-2.25*	-0.74
	(1.16)	(1.24)	(1.28)	(1.28)	(1.97)	(1.04)	(1.19)	(1.88)	(1.27)	(1.98)
HSS×1958	-3.17	-3.12	1.64	-4.79**	-3.16	-1.18	-3.60*	-1.44	-2.74	-1.55
	(2.06)	(2.07)	(1.24)	(2.42)	(2.46)	(1.54)	(2.11)	(2.13)	(1.91)	(2.05)
HSS×1959	-4.93**	-4.54**	-2.07*	-6.27***	-3.66*	-3.40**	-5.46**	-3.39*	-5.27**	-4.19**
	(2.02)	(2.07)	(1.21)	(2.39)	(2.05)	(1.62)	(2.13)	(2.01)	(2.04)	(2.08)
HSS×1960	-2.21	-1.48	-1.98	-2.78	0.76	-1.33	-1.97	1.26	-1.42	0.50
	(2.02)	(2.09)	(1.47)	(2.36)	(2.08)	(1.69)	(2.26)	(2.22)	(2.12)	(2.29)
HSS×1961	-3.88*	-2.97	-5.22**	-5.13**	-2.46	-2.40	-3.83*	-0.53	-2.53	-1.06
	(2.16)	(2.28)	(2.03)	(2.37)	(2.60)	(1.95)	(2.30)	(2.89)	(2.45)	(3.19)
HSS×1962	-2.07	-0.77	-4.16**	-2.49	-1.06	-1.66	-1.80	0.23	-1.13	-0.25
	(1.83)	(1.95)	(1.71)	(2.02)	(2.30)	(1.60)	(2.02)	(2.36)	(2.03)	(2.75)
HSS×1963	-3.44*	-1.53	-4.60***	-3.33	-2.56	-3.29*	-3.38	-2.26	-2.45	-2.14
	(1.93)	(1.99)	(1.61)	(2.16)	(2.45)	(1.73)	(2.07)	(2.45)	(1.95)	(2.53)
HSS×1964	-3.77*	-1.59	-4.06**	-4.75**	-2.66	-2.99*	-3.74*	-2.29	-2.28	-1.78
	(1.97)	(2.14)	(1.58)	(2.27)	(2.25)	(1.65)	(2.12)	(2.30)	(2.10)	(2.80)
HSS×1965	-3.62**	-1.67	-3.75**	-3.95**	-3.18	-2.79*	-3.60**	-2.15	-2.64	-2.99
	(1.61)	(1.93)	(1.49)	(1.79)	(2.25)	(1.47)	(1.77)	(2.37)	(2.06)	(3.09)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.86	0.87	0.88	0.87	0.89	0.87	0.87	0.90	0.88	0.91
Dep. Var. Mean	22.15	22.15	22.15	21.60	22.95	21.80	22.15	22.46	21.09	22.46
N	3,476	3,476	3,476	3,112	2,345	3,311	3,476	2,171	3,034	2,171
Clusters	449	449	449	410	354	428	449	329	397	329

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A21
Effects on Sown Area, Detailed

	Sown Area									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CSS×1954	6.23	6.02	7.84	4.40	4.89	7.77	6.63	2.55	9.53	8.99
	(6.98)	(7.51)	(7.90)	(7.26)	(10.20)	(7.22)	(6.86)	(14.06)	(8.50)	(14.26)
CSS×1955	-3.27	-3.12	3.12	-4.19	-4.32	-1.79	-2.60	-5.73	-1.52	-1.76
	(6.57)	(6.39)	(7.56)	(6.56)	(8.77)	(6.93)	(6.49)	(11.23)	(7.34)	(9.98)
CSS×1956	-5.74	-8.08	2.66	-7.58	-15.52**	-6.54	-5.16	-25.33***	-12.46	-28.80***
	(5.67)	(5.42)	(7.66)	(6.11)	(7.44)	(6.71)	(5.48)	(9.70)	(9.05)	(9.61)
CSS×1958	3.49	0.12	-4.07	0.49	3.52	-0.47	3.71	-4.15	-13.99**	-12.83
	(6.70)	(6.71)	(8.36)	(6.32)	(10.50)	(7.36)	(6.67)	(9.46)	(6.90)	(8.70)
CSS×1959	10.99	8.17	-3.47	2.70	11.90	10.35	11.30	-4.61	-9.98	-14.12
	(8.58)	(8.45)	(10.13)	(7.30)	(12.67)	(9.84)	(8.54)	(12.54)	(8.69)	(11.78)
CSS×1960	18.67**	15.71*	1.50	15.73*	20.86	16.49*	18.76**	5.90	3.58	-7.66
	(9.09)	(8.80)	(10.02)	(9.19)	(13.92)	(9.68)	(8.81)	(13.44)	(9.14)	(13.30)
CSS×1961	19.69**	17.47*	1.51	14.40	17.00	20.73*	19.89**	6.61	8.58	-8.85
	(9.75)	(9.58)	(11.13)	(9.15)	(14.00)	(10.62)	(9.58)	(13.59)	(9.89)	(14.20)
CSS×1962	17.15**	14.92*	-0.98	11.74	17.28	18.26**	17.57**	5.86	3.41	-13.14
	(8.36)	(8.91)	(9.22)	(7.97)	(12.70)	(9.12)	(8.29)	(12.68)	(9.15)	(13.97)
CSS×1963	13.95*	11.93	-5.25	8.49	14.35	14.61	14.42*	4.02	-2.37	-17.17
	(8.12)	(8.77)	(9.51)	(7.21)	(12.34)	(8.96)	(8.02)	(11.11)	(7.53)	(11.40)
CSS×1964	9.01	6.11	-9.17	3.02	8.67	9.09	9.16	-0.60	-9.57	-24.71*
	(9.02)	(9.97)	(10.16)	(7.60)	(13.39)	(10.17)	(8.91)	(11.97)	(8.40)	(12.68)
CSS×1965	4.18	-0.08	-10.65	0.16	4.55	6.20	4.50	-2.25	-14.27	-31.69**
	(8.47)	(10.61)	(9.99)	(7.56)	(12.86)	(9.63)	(8.39)	(11.72)	(9.75)	(14.51)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Dep. Var. Mean	85.15	85.15	85.15	82.89	86.95	84.07	85.15	86.19	81.39	86.19
N	3,741	3,741	3,741	3,345	2,563	3,549	3,741	2,368	3,233	2,368
Clusters	459	459	459	417	368	438	459	343	405	343

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A22
Effects on Sown Area, Detailed

	Sown Area									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HSS×1954	1.58	1.19	2.41	1.11	3.43	2.36	1.74	2.99	2.15	2.34
	(1.76)	(1.66)	(2.10)	(1.67)	(3.05)	(1.75)	(1.75)	(2.47)	(1.58)	(2.27)
HSS×1955	-0.90	-1.04	0.71	-1.09	0.74	-0.26	-0.72	1.12	-0.41	0.60
	(1.55)	(1.45)	(1.68)	(1.53)	(2.50)	(1.65)	(1.55)	(2.87)	(1.62)	(2.32)
HSS×1956	1.95	1.35	4.57**	1.78	3.14	2.35	2.22	0.31	1.24	-1.10
	(1.69)	(1.57)	(2.08)	(1.75)	(2.55)	(1.85)	(1.68)	(2.17)	(2.26)	(2.06)
HSS×1958	0.79	0.28	-0.56	0.61	0.11	-0.29	0.84	-0.49	-2.24	-1.93
	(1.45)	(1.44)	(1.76)	(1.43)	(2.16)	(1.58)	(1.45)	(2.30)	(1.70)	(2.17)
HSS×1959	0.42	0.11	-2.60	-0.78	-0.08	0.60	0.52	-1.92	-2.55	-2.85
	(2.09)	(2.03)	(2.58)	(1.78)	(2.92)	(2.36)	(2.09)	(3.19)	(2.26)	(2.97)
HSS×1960	0.72	0.48	-3.13	0.60	1.50	0.52	0.71	0.04	-0.93	-1.30
	(1.91)	(1.83)	(2.17)	(1.88)	(2.49)	(1.86)	(1.89)	(2.53)	(1.75)	(2.35)
HSS×1961	2.40	2.14	-1.14	1.60	2.42	3.15*	2.42	1.84	1.45	0.36
	(1.86)	(1.81)	(2.13)	(1.75)	(2.56)	(1.88)	(1.84)	(2.55)	(1.71)	(2.46)
HSS×1962	2.12	2.02	-1.35	1.24	2.73	2.56	2.23	1.66	0.75	0.24
	(1.78)	(1.78)	(2.05)	(1.72)	(2.67)	(1.84)	(1.78)	(2.74)	(1.78)	(2.73)
HSS×1963	0.74	0.74	-3.07	0.07	0.99	1.19	0.81	0.30	-0.86	-1.24
	(1.86)	(1.77)	(2.17)	(1.66)	(2.70)	(1.93)	(1.86)	(2.59)	(1.55)	(2.20)
HSS×1964	-0.05	-0.00	-3.33	-1.00	0.07	0.31	-0.02	-0.45	-1.81	-1.75
	(1.84)	(1.84)	(2.04)	(1.61)	(2.65)	(1.91)	(1.83)	(2.61)	(1.56)	(2.37)
HSS×1965	-0.07	-0.73	-3.00	-0.93	0.10	0.56	0.03	-0.09	-2.38	-2.98
	(1.74)	(1.96)	(2.02)	(1.64)	(2.64)	(1.88)	(1.74)	(2.81)	(1.88)	(2.96)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Dep. Var. Mean	85.15	85.15	85.15	82.89	86.95	84.07	85.15	86.19	81.39	86.19
N	3,741	3,741	3,741	3,345	2,563	3,549	3,741	2,368	3,233	2,368
Clusters	459	459	459	417	368	438	459	343	405	343

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A23
Effects on Mortality, Detailed

	Mortality									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CSS×1954	3.72	2.69	1.54	4.54	-2.18	9.34**	9.31*	4.33	8.83**	7.88
	(3.86)	(3.65)	(4.41)	(3.66)	(3.56)	(4.22)	(5.49)	(6.27)	(4.12)	(7.50)
CSS×1955	-1.84	-1.10	2.17	-0.79	-5.24	1.12	-0.53	-1.65	2.55	1.25
	(3.57)	(3.51)	(4.75)	(3.98)	(4.37)	(3.30)	(3.52)	(4.99)	(3.88)	(5.62)
CSS×1956	1.13	1.13	-0.82	2.63	-13.20***	2.49	0.93	-8.09**	3.47	-5.48
	(3.80)	(3.91)	(4.93)	(3.83)	(4.37)	(3.14)	(3.79)	(3.72)	(3.42)	(3.87)
CSS×1958	2.56	2.67	-0.16	4.05	-2.89	-9.12*	1.34	-5.14	-8.61*	-6.46
	(4.92)	(5.02)	(4.84)	(5.17)	(4.68)	(4.72)	(4.78)	(7.15)	(4.90)	(7.27)
CSS×1959	4.12	4.12	6.81	5.14	-4.17	-22.76*	0.54	8.93	-22.79*	6.19
	(11.26)	(11.26)	(11.17)	(12.03)	(6.13)	(11.77)	(11.11)	(5.46)	(12.26)	(5.92)
CSS×1960	33.42*	33.45**	35.65	37.09**	19.02	-11.89	23.69	26.07*	-8.89	22.17
	(17.03)	(16.97)	(22.63)	(18.26)	(12.08)	(15.88)	(16.25)	(14.85)	(15.94)	(14.34)
CSS×1961	-13.06**	-12.84**	-14.15**	-12.58**	-7.08	-19.44***	-13.75**	-2.30	-19.11***	-6.12
	(5.65)	(5.45)	(6.05)	(5.57)	(4.65)	(6.32)	(5.57)	(5.49)	(6.00)	(5.98)
CSS×1962	-1.61	-1.80	-0.58	-2.36	12.40**	-1.06	-1.67	8.79*	-1.52	3.69
	(2.70)	(2.73)	(3.19)	(2.61)	(5.09)	(2.49)	(2.76)	(4.72)	(2.57)	(5.42)
CSS×1963	9.66***	9.88**	11.84**	10.18**	6.66	8.62**	9.38**	7.19	9.00**	1.58
	(3.69)	(3.83)	(5.16)	(3.99)	(4.12)	(3.70)	(3.72)	(4.76)	(4.35)	(5.58)
CSS×1964	7.31*	7.57*	11.81**	7.18*	-0.35	6.48*	7.74**	2.04	5.98	-4.51
	(3.83)	(3.88)	(5.56)	(4.08)	(3.65)	(3.88)	(3.92)	(4.29)	(4.29)	(4.54)
CSS×1965	5.35**	4.91*	6.73**	3.98*	7.21**	4.66*	5.15**	4.41	3.38	-4.07
	(2.41)	(2.88)	(2.69)	(2.34)	(3.22)	(2.51)	(2.37)	(3.64)	(3.07)	(4.90)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.46	0.46	0.60	0.46	0.63	0.56	0.48	0.65	0.57	0.66
Dep. Var. Mean	14.65	14.65	14.65	14.65	13.15	14.24	14.65	13.15	14.24	13.15
N	3,699	3,699	3,699	3,699	2,524	3,550	3,699	2,524	3,550	2,524
Clusters	486	486	486	486	388	470	486	388	470	388

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A24
Effects on Mortality, Detailed

	Mortality									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HSS×1954	0.36	-0.13	0.09	0.55	0.25	3.09**	1.80	3.57*	2.61**	4.87**
	(1.12)	(1.01)	(1.15)	(1.11)	(1.15)	(1.23)	(1.59)	(1.96)	(1.05)	(2.19)
HSS×1955	0.53	0.79	1.90*	0.74	0.17	1.88**	0.87	0.85	2.37**	1.72
	(0.99)	(1.01)	(1.07)	(1.07)	(1.21)	(0.91)	(0.98)	(1.37)	(1.05)	(1.51)
HSS×1956	0.58	0.74	0.67	0.91	-2.32**	1.43	0.72	-1.47	1.85*	-0.76
	(1.06)	(1.11)	(1.38)	(1.09)	(0.99)	(0.87)	(1.05)	(0.98)	(1.01)	(1.09)
HSS×1958	1.99	2.09	1.35	2.25	-0.05	-0.95	1.93	-1.34	-0.81	-1.60
	(1.30)	(1.34)	(1.36)	(1.39)	(1.38)	(1.22)	(1.29)	(2.13)	(1.34)	(2.17)
HSS×1959	7.67**	7.73**	8.01**	8.34**	-0.25	-2.74	7.09**	2.53*	-2.57	1.96
	(3.39)	(3.40)	(3.39)	(3.70)	(1.24)	(2.20)	(3.34)	(1.40)	(2.31)	(1.64)
HSS×1960	13.14***	13.25***	14.31**	14.32***	5.17**	1.75	11.64***	6.17*	2.70	5.18
	(4.20)	(4.24)	(5.56)	(4.85)	(2.32)	(3.97)	(4.20)	(3.32)	(4.64)	(3.44)
HSS×1961	-0.92	-0.85	-1.78	-0.78	-1.37	-1.88	-0.95	-0.63	-1.61	-1.43
	(1.77)	(1.79)	(1.99)	(1.92)	(1.25)	(1.65)	(1.77)	(1.39)	(1.86)	(1.53)
HSS×1962	-0.57	-0.47	-0.57	-0.62	2.30**	-0.23	-0.54	1.58	0.03	0.58
	(0.58)	(0.58)	(0.70)	(0.56)	(1.13)	(0.53)	(0.58)	(1.00)	(0.57)	(1.09)
HSS×1963	2.48***	2.53***	3.13***	2.61***	1.61	2.55***	2.53***	1.47	2.79***	0.31
	(0.85)	(0.95)	(1.01)	(0.94)	(1.09)	(0.82)	(0.85)	(1.07)	(1.04)	(1.07)
HSS×1964	2.52***	2.54**	3.83***	2.51**	1.00	2.82***	2.71***	1.57	2.87***	0.21
	(0.92)	(1.05)	(1.09)	(1.00)	(1.12)	(0.89)	(0.91)	(1.10)	(1.10)	(1.09)
HSS×1965	1.42**	1.50**	1.69**	1.16**	2.20***	1.37**	1.49***	1.64**	1.52**	0.19
	(0.57)	(0.75)	(0.66)	(0.57)	(0.81)	(0.54)	(0.57)	(0.73)	(0.71)	(0.81)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.47	0.48	0.62	0.48	0.63	0.56	0.49	0.65	0.57	0.66
Dep. Var. Mean	14.65	14.65	14.65	14.65	13.15	14.24	14.65	13.15	14.24	13.15
N	3,699	3,699	3,699	3,699	2,524	3,550	3,699	2,524	3,550	2,524
Clusters	486	486	486	486	388	470	486	388	470	388

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A25
Effects on Fertility, Detailed

	Fertility									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CSS×1954	-10.48*	-15.30**	5.76	-11.34*	-19.63***	1.57	-0.20	-2.35	-8.94	-15.08
	(6.12)	(5.99)	(6.65)	(6.18)	(7.38)	(6.07)	(5.12)	(10.41)	(6.01)	(11.54)
CSS×1955	-0.91	-1.85	8.81	-3.38	-2.68	4.26	2.20	-2.90	-4.24	-3.55
	(5.86)	(5.92)	(5.62)	(5.93)	(7.35)	(5.88)	(5.41)	(7.72)	(6.46)	(7.89)
CSS×1956	8.10*	6.74	9.47*	8.45*	9.21	5.90	8.84*	4.71	4.07	2.49
	(4.91)	(4.82)	(5.73)	(4.79)	(6.45)	(4.81)	(5.01)	(5.91)	(4.81)	(5.66)
CSS×1958	6.80	7.38	10.04	5.99	10.20	10.14*	7.63	11.62	9.89*	12.32*
	(4.84)	(4.87)	(6.10)	(4.86)	(7.43)	(5.66)	(4.89)	(7.23)	(5.77)	(7.11)
CSS×1959	6.19	7.28	5.89	5.33	15.67**	11.85**	8.14*	3.00	10.54*	3.95
	(4.80)	(5.04)	(5.43)	(4.72)	(6.34)	(5.49)	(4.75)	(5.86)	(5.42)	(6.17)
CSS×1960	-16.68***	-14.56**	-11.49**	-19.29***	-3.85	1.44	-12.61**	-6.84	0.77	-4.97
	(5.33)	(5.97)	(4.72)	(5.33)	(5.53)	(5.51)	(5.04)	(5.12)	(5.26)	(5.60)
CSS×1961	5.40	8.78	9.48*	4.19	4.81	12.34**	6.87	6.89	15.92***	8.66
	(5.50)	(6.08)	(5.37)	(5.47)	(5.97)	(5.73)	(5.47)	(5.64)	(5.99)	(6.11)
CSS×1962	7.78	11.22*	8.71	6.77	-4.57	6.03	7.34	-10.30	9.34	-8.57
	(5.67)	(6.32)	(7.43)	(5.52)	(6.09)	(6.45)	(5.61)	(6.49)	(7.13)	(7.55)
CSS×1963	-0.74	4.05	4.17	-1.79	7.20	-4.27	-0.66	1.67	-0.06	2.91
	(5.32)	(5.38)	(5.52)	(5.17)	(5.95)	(4.98)	(5.36)	(5.95)	(5.46)	(6.47)
CSS×1964	3.57	9.61*	9.69**	1.83	10.38**	3.00	2.93	12.66**	7.57	14.55**
	(5.00)	(5.83)	(4.73)	(5.11)	(4.72)	(5.20)	(5.11)	(5.13)	(6.44)	(6.83)
CSS×1965	2.03	6.78	3.94	1.75	-0.20	-0.49	1.23	3.15	5.18	4.13
	(4.74)	(6.25)	(4.17)	(4.92)	(5.23)	(5.04)	(4.79)	(5.89)	(7.14)	(8.75)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.68	0.72	0.76	0.69	0.75	0.71	0.70	0.78	0.74	0.79
Dep. Var. Mean	31.63	31.63	31.63	31.63	32.03	31.70	31.63	32.03	31.70	32.03
N	3,654	3,654	3,654	3,654	2,506	3,505	3,654	2,506	3,505	2,506
Clusters	482	482	482	482	388	466	482	388	466	388

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.

Table A26
Effects on Fertility, Detailed

	Fertility									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
HSS×1954	-2.74*	-3.48**	0.06	-2.90*	-4.06**	-0.00	-0.64	-3.96*	-2.53	-5.78**
	(1.53)	(1.57)	(1.73)	(1.51)	(1.86)	(1.78)	(1.32)	(2.20)	(1.63)	(2.68)
HSS×1955	0.75	0.23	2.29	0.39	-0.06	2.06	1.33	-0.73	-0.15	-0.74
	(1.50)	(1.49)	(1.68)	(1.50)	(2.31)	(1.72)	(1.39)	(2.52)	(1.77)	(2.34)
HSS×1956	1.72	1.40	1.59	1.87*	2.22	1.34	1.84*	0.71	0.77	0.26
	(1.08)	(1.07)	(1.21)	(1.08)	(1.69)	(1.08)	(1.08)	(1.55)	(1.09)	(1.43)
HSS×1958	2.15**	2.02*	3.30***	2.02*	4.52***	3.28***	2.32**	4.78***	2.82**	4.71***
	(1.06)	(1.06)	(1.25)	(1.10)	(1.72)	(1.20)	(1.06)	(1.68)	(1.27)	(1.64)
HSS×1959	1.87*	1.85*	2.24*	1.76	5.52***	3.76***	2.27**	2.71*	3.09***	2.76*
	(1.07)	(1.11)	(1.19)	(1.10)	(1.44)	(1.09)	(1.01)	(1.53)	(1.11)	(1.66)
HSS×1960	-3.76***	-3.64***	-2.83**	-4.35***	1.13	0.17	-3.06***	0.02	-0.65	-0.03
	(1.19)	(1.32)	(1.11)	(1.30)	(1.45)	(1.09)	(1.12)	(1.50)	(1.25)	(1.65)
HSS×1961	1.88	2.24	3.06**	1.66	2.87*	3.55***	2.17*	2.90*	3.69***	2.61
	(1.22)	(1.36)	(1.28)	(1.23)	(1.52)	(1.26)	(1.18)	(1.51)	(1.40)	(1.64)
HSS×1962	3.70**	4.01**	4.61***	3.57**	2.10	3.46**	3.70**	0.64	3.50*	0.05
	(1.50)	(1.62)	(1.59)	(1.50)	(1.76)	(1.75)	(1.49)	(1.93)	(1.91)	(2.07)
HSS×1963	1.20	1.83	1.65	1.07	2.51*	-0.21	1.21	0.75	-0.12	-0.11
	(1.35)	(1.29)	(1.23)	(1.44)	(1.46)	(1.23)	(1.36)	(1.62)	(1.37)	(1.72)
HSS×1964	2.35*	3.19**	2.86**	2.09	2.51*	1.29	2.23	2.19	1.34	1.29
	(1.39)	(1.34)	(1.27)	(1.48)	(1.43)	(1.33)	(1.41)	(1.55)	(1.38)	(1.69)
HSS×1965	1.84*	2.30**	1.87*	1.88*	0.97	0.90	1.81*	0.97	1.04	-0.44
	(0.98)	(1.10)	(0.95)	(1.04)	(1.23)	(0.99)	(0.98)	(1.27)	(1.22)	(1.61)
Baseline Population-by-Year FE	N	N	N	Y	N	N	N	Y	Y	Y
Steel Production Growth	N	N	N	N	Y	N	N	Y	N	Y
GLF Variables	N	N	N	N	N	Y	N	Y	Y	Y
Crop Suitability	N	N	N	N	N	N	Y	Y	Y	Y
Year FE	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
Region-by-Year FE	N	N	Y	N	N	N	N	N	N	N
Provincial Linear Trends	N	Y	N	N	N	N	N	N	Y	Y
R^2	0.69	0.72	0.77	0.69	0.75	0.71	0.70	0.78	0.74	0.79
Dep. Var. Mean	31.63	31.63	31.63	31.63	32.03	31.70	31.63	32.03	31.70	32.03
N	3,654	3,654	3,654	3,654	2,506	3,505	3,654	2,506	3,505	2,506
Clusters	482	482	482	482	388	466	482	388	466	388

Notes: Estimation results from Equation 1 for the main sample spanning 1954 to 1965. Each regression includes county fixed effects. Standard errors are clustered at the county level.