Land Reform and the Taiwanese Miracle *

Oliver Kim and Jen Kuan Wang

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Abstract

Taiwan's 1950s land reform, which redistributed land to tenant farmers, has long been thought of as central to its growth miracle, but this claim has never been tested with modern empirical tools. By assembling a novel dataset from historical archives and exploiting a natural experiment in the second phase of the reform program, we study land reform's effect on Taiwan's economic development. We have three main findings. First, land reform reduced tenancy and increased the share of smallholder farmers. Second, land reform significantly increased the yields of rice, Taiwan's main staple crop. Finally, agricultural productivity growth pulled labor from the manufacturing sector, consistent with a standard neoclassical growth model. Considering the large boon to agricultural productivity, these results strongly suggest that land reform had a large and positive impact on Taiwan's economic development.

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1 Introduction

The Taiwanese miracle ranks among the most dramatic examples of modern economic development. In 1950, Taiwan was a poor, primarily agrarian economy, with a real GDP per capita lower than Ghana or Afghanistan. Today, after 50 years of over 5% growth in GDP per capita, it is a manufacturing powerhouse with living standards comparable to France or Germany. What policies were responsible for this remarkable transformation?

A strong contender is land reform. In the 1950s, Taiwan enacted one of the most extensive non-communist land redistributions in East Asia. The reform proceeded over three stages. First, in 1949, rents were capped at 37.5% of yields; second, in 1951, public lands formerly held by Japanese colonists were given out to tenants; and finally, in 1953, large landholdings were broken up and redistributed to the tenants who farmed them. Ultimately, these programs redistributed over 71% of the island's rented land to landless tenant farmers (Kuo 1983). In the following years, agricultural productivity increased dramatically—in particular, rice yields rose by more than 40% from 1950-61.

Based on these patterns, economists and historians have long believed that land reform was essential for Taiwan's economic takeoff, but there has been no modern, causally identified evidence to support these claims. We fill this gap by digitizing historical records for the first time and using a natural experiment in the second phase of land distribution to estimate the causal effects of land reform on Taiwan's economic development.

We have three main findings. First, we find that land reform reduced tenancy and increased the share of smallholder farmers. Second, we find that land reform had a major positive effect on the yields of rice, Taiwan's main staple crop. In addition, as tenants were rendered the freedom of crop choice, rice area as a share of total arable lands increased. Finally, we do not find that land reform boosted local industrialization—if anything, increased agricultural productivity pulled labor from the manufacturing sector, consistent with a standard neoclassical growth model. However, considered against the large boon to agricultural productivity, these results strongly suggest that land reform had a large and positive impact on Taiwan's economic development.

Large-scale land redistributions in Japan (1946), South Korea (1948), and Taiwan (1950-3)

preceded rapid economic growth, leading many scholars to argue that land reform was a crucial ingredient for the East Asian Miracle (Wade 1990; Amsden 1988). But even among the Miracle countries, Taiwan's reform is considered "the one to beat"—considering the share of households who received land, the program was the most ambitious of its kind in a non-communist country (Studwell 2014).

The conventional view, articulated by Kuo (1983), Studwell (2014), and Mao and Schive (n.d.), among others, asserts that land reform raised agricultural yields—most of all in rice, the main staple crop. Land reform thus directly boosted agricultural incomes, growing overall economic output, and reducing rural poverty. Larger yields may have also aided industrialization at the macroeconomic level by creating an exportable agricultural surplus, creating a valuable source of foreign exchange with which to import capital goods.

Critically, however, in a neoclassical two-sector model where agricultural labor is paid its marginal product, standard theory predicts that rising agricultural productivity should pull labor from manufacturing back to agriculture. This view clashes with alternative theories arguing that Taiwan's land reform also had positive *local* spillovers for industrialization. Taiwan had a noteworthy pattern of rural industrialization—roughly half of manufacturing value-added came from rural areas in 1971—making such arguments *prima facie* compelling (Ho 1979). For instance, Hamilton and Kao (2018) argue that land reform gave households an important form of capital, which they could use to start up small manufacturing firms in rural areas. Wade (1990) stresses that land reform fostered manufacturing by encouraging forward linkages between agriculture and infant industries like food processing. With our newly digitized data, we can bring new evidence to the table to distinguish between these competing theories.

In addition, there has been greater recent skepticism—particularly among Taiwanese scholars—that land reform was an unalloyed success, even for agriculture. Land reform was an important pillar of legitimacy for the authoritarian Nationalist regime, and with the advent of democratization in the late 1980s, old claims about the effects of land reform are being critically re-examined. For instance, Z.-Y. Chen (2011) contends that the three-stage reform was not a deliberate policy to promote land productivity and tenants' welfare, but simply a tool for the Nationalist Party to procure rice for its armies and (post-1950) to win local elections.[1] Hsu and Liao (2017) take this

1. "Nationalist Party" is the common translation of the party's Chinese name, Kuomintang, or KMT. We will use

line of argument a step further, and present the revisionist view that land tenure relations before the reform were not as exploitative as the Nationalist government claimed.[2] Our paper also aims to bring new evidence to this debate.

Finally, we contribute to the broader debate of land reform, which remains one of the oldest and hotly debated topics in development economics. The evidence on the success of land reform as a developmental policy is mixed, with a range of effects found in different contexts—from poverty reduction in India (Besley and Burgess 2000) to efficiency losses in a 1988 reform in the Philippines (Adamopoulos and Restuccia 2020). Recent work by Kitamura (2022) finds that Japan's land reform increased the adoption of farming machinery and caused the outmigration of young people to the cities. As Taiwan is considered one of the model land reforms, we hope to reintroduce the important data point back to the ongoing land reform debate.

We proceed as follows. Section 2 outlines the historical context around land reform. Section 3 explains our data sources. Section 4 presents our empirical strategy. Section 5 presents our main results. Finally, Section 6 concludes.

2 Historical Context

2.1 Prelude to Reform

Taiwan was colonized by Japan in 1895. From the start, the colonial regime invested considerable effort into developing Taiwan's administrative and physical infrastructure. For instance, from 1898 to 1905, the colonial government conducted a cadastral survey to delineate property rights and collect taxes.[3] Starting in 1900, the colonial regime also began developing Taiwan's sugar industry, building the factories and laying down the infrastructure that allowed the island to eventually become one of the key suppliers to Japan's domestic market.[4] By the 1930s, Taiwan and its sister colony Korea supplied more than 90% of the sugar and 98% of the rice imported by

the two names interchangeably.

2. Chu (2017) summarizes all the rebuttals, challenging their failure to capture the essensial motivation for the Nationalist to implement land reform ——the survival crisis and the need to develop Taiwan. Some earlier works, such as Liu (1992), take a similar stand with this argument.

3. Koo (2011) studies this particular institutional change, and finds that it resulted in a significant increase in land prices as well as greater investment in organic fertilizer.

4. According to Wu (2016), though, Japan's protectionist and subsidy policy to the sugar industry accounted for the bulk part of its success.

Japan (Ho 1984).

In 1945, after Japan lost the Second World War, control of Taiwan passed to the Republic of China, a one-party state run by Chiang Kai-shek's Nationalist Party. Any optimism about the handover to China was quickly dashed, as the Nationalist government brought over its reputation for graft and incompetence from the mainland. Hyperinflation ensued, and tensions between the local Taiwanese and the mainlanders grew. On February 28, 1947, after Nationalist troops fired into a crowd, killing several civilians, the Taiwanese rose up across the island, taking control of urban areas (Minns and Tierney 2003). The Nationalist regime rushed in reinforcements from the mainland and violently crushed the uprising, killing thousands. Martial law was then imposed, and was not lifted for another forty years.

Meanwhile, the Nationalists were losing control of the Chinese mainland to Mao Zedong's Communists, who won vast support in the countryside with their promises of land reform. In 1949, the mainland regime collapsed, and around 1.2 million Nationalist soldiers and supporters fled to Taiwan. As the party regrouped, Nationalist leaders recognized that they had been defeated on the mainland largely because they had lost the support of China's peasantry (Myers 2009). Moreover, after the February 28 incident, which had been led by urban elites, it was clear they needed a local base of support. To secure its hold on Taiwan, the Nationalist government began an ambitious land reform program—among the most extensive of its kind in a non-communist country.

2.2 Land Reform

When Taiwan was a Japanese colony, the standard rental agreement was based around a fixed rent paid in-kind at the end of the year, which the landlord would set based on the land's potential output.[5] Rents of paddy (rice) land were around 50%, and those of dry land around 35% (Yeh 1996, 2001, 2007).

However, by the time the KMT took over in 1945, the disruption of the war had caused rural conditions to deteriorate rapidly (Booth and Deng 2017). With scarce arable land and a rapidly growing population, pressure to feed the population was immense. Agricultural rents

5. Some sources, such as Cheung (1969) and Hsiao (1975), erroneously claim that Taiwan operated under a share-cropping system, but Barrett (1984) shows that this is based on a misreading of rental agreements.

rose dramatically—averaging 56.8% of yields in a 1948 household survey, and reaching as high as 70% in some counties—as did rates of landlessness (C. Chen 1961). By global standards, even the largest Taiwanese farms were not particularly large—over 60 percent of owner-cultivators owned less than 1 *chia* (around 1 hectare). But tenants were vulnerable to eviction, as contracts were rarely written down and often indefinite in length. Wolf Ladejinsky, an American agricultural economist who had helped to design Japan's land reform, described the appalling conditions in a 1949 field visit:

> Of all the farmyards I have seen in the Far East, Southeast Asia, and in the Middle East, that of the average Taiwanese tenant is among the worst, both in appearance and in equipment. Tenants' huts, so-called barnyards, equipment, and livestock, as well as their health point to nothing but poverty. (Ladejinsky and Walinsky 1977)

To address these conditions and shore up its support among Taiwan's farmers, the Nationalist government passed three major land reform laws starting in the late 1940s. These reforms were funded in large part by aid from the United States, which set up the Sino-American Joint Commission on Rural Reconstruction (JCRR) to oversee implementation and provide technical assistance.

The first stage of land reform, passed in 1949, established fixed rents based on 15 possible grades of land productivity, with a maximum rent of 37.5% of the annual yield. (This law is thus commonly called the 375 reform.) In addition to reducing rents, the law required that all contracts exist in writing, and last for at least six years. Tenancy committees, consisting of both tenant farmers and landlords, were set up to supervise the new contracts and adjudicate any disputes. By the end of 1949, 302,000 farm households had signed 393,000 new lease contracts, representing around 256,000 *chia* (248,300 hectares) of land.[6] However, there was still a widespread recognition that rent reduction alone was not enough to address the problems of Taiwan's rural inequality.

The second stage of land reform, passed in 1951, redistributed the majority of public lands, around 20% of all arable land on Taiwan (C. Chen 1961). Most of these lands were confiscated from private Japanese colonists who had been expelled from Taiwan, while a minority had been inherited from local colonial governments. After a trial run in 1948, land was sold in six lots from

6. 1 *chia*, the standard area unit in Taiwan, is 0.96992 hectares.

1952 to 1958, starting with land owned by local governments, then proceeding to land owned by public enterprises like the Taiwan Sugar Corporation.[7] Much of this sugar company land had already been leased to tenants by a 1947 law; pressure from American advisors, including an appeal from the development economist Wolf Ladejinsky to President Chiang Kai-shek, eventually led the government to order the outright transfer of the Company's land as part of the broader land reform program in 1952 (Huang 1992).[8] Prices were set at 2.5 times the total annual yield of the cropland, and were to be paid in-kind in twenty biannual installments. Ultimately, 139,688 households bought land as part of the program, with an average purchase size of around 0.5 hectares. This paper's analysis will focus on the second stage of land reform, as its design lends itself to causal identification, as will be discussed in Section 4.

The third stage of land reform, passed in 1953, was the largest in scope. Dubbed the "land-to-the-tiller" law, the reform broke up landholdings over cutoffs determined roughly by land quality (around 3 hectares for paddy land, 6 for dry land, of average fertility), and distributed the land to the tenants who tilled it. Landlords were compensated with either claims on agricultural output or shares of state-owned industrial enterprises, both of which were undervalued. A cadastral survey in 1952, supervised by the Sino-American JCRR, helped identify the owners of plots for this redistribution. Through this last stage of reform, around 143,568 *chia* of arable land was transfered to 194,823 farming households (C. Chen (1961), pg 69).[9] To prevent the re-consolidation of large holdings, recipients were banned from selling their land for 10 years, unless the price of the land was paid off early. The government also instituted regular follow-ups to ensure that the redistribution would not be reversed.

Figure 1 shows the transformative change in Taiwan's land ownership distribution between 1950 and 1961. The overall distribution shifts rightward: in the median township, the share of households who fully owned their land doubled, from 32% in 1950 to 64% in 1961. All told, the three stages of land reform directly redistributed 215,231 hectares of land, or 24% of Taiwan's

7. C. Chen (1961) notes that the first (small) public land sale occurred in 1948, but the remainder of the program was put on hold until 1951 to concentrate on implementing the 375 rent reduction. There was also an additional seventh public land sale in 1964, after our study period.

8. Chung (2002) analyze the influences the letter from Ladejinsky had on the way the Nationalists dealt with the land of Taiwan Sugar Company.

9. Nearly 100,000 chia of arable land transfered was confiscated from around 87,000 joint owners, according to Land Tenure Statistics in Taiwan (1952, 1955).

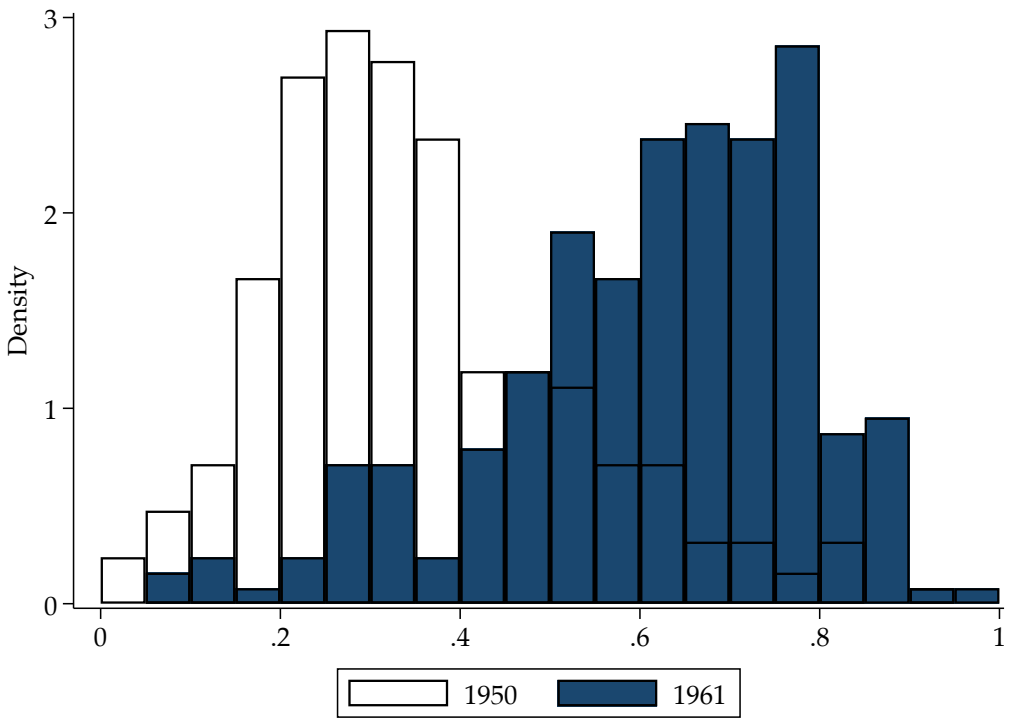

Figure 1: Share of township households who fully own their land, 1950 and 1961

This figures shows the change in the township distribution of the share of full-landowning households by township.

1950 total arable land area, and the share of tenant households fell from 36.3% to 21.5%.[10] (Note that this does not include indirect effects of the reform, like additional land sales caused by falling land prices.) The third stage of reform, the Land-to-the-Tiller law, was roughly double the size of the second stage public land redistribution in terms of area redistributed, and around 40% larger in terms of the number of households affected.

Figure 2 maps the second and third stage redistributions. The second stage of reform was concentrated in the south, in the counties of Changhua, Chiayi, and Pingtung, while the third-stage land-to-the-tiller redistribution was concentrated more in the north. We should also note that we still have some missing data, shaded on the map in white. The missing areas in the interior of the island are mountainous, thinly populated, and unlikely to alter our basic results.

10. Data are based on Tang (1954) and C. Chen (1961).

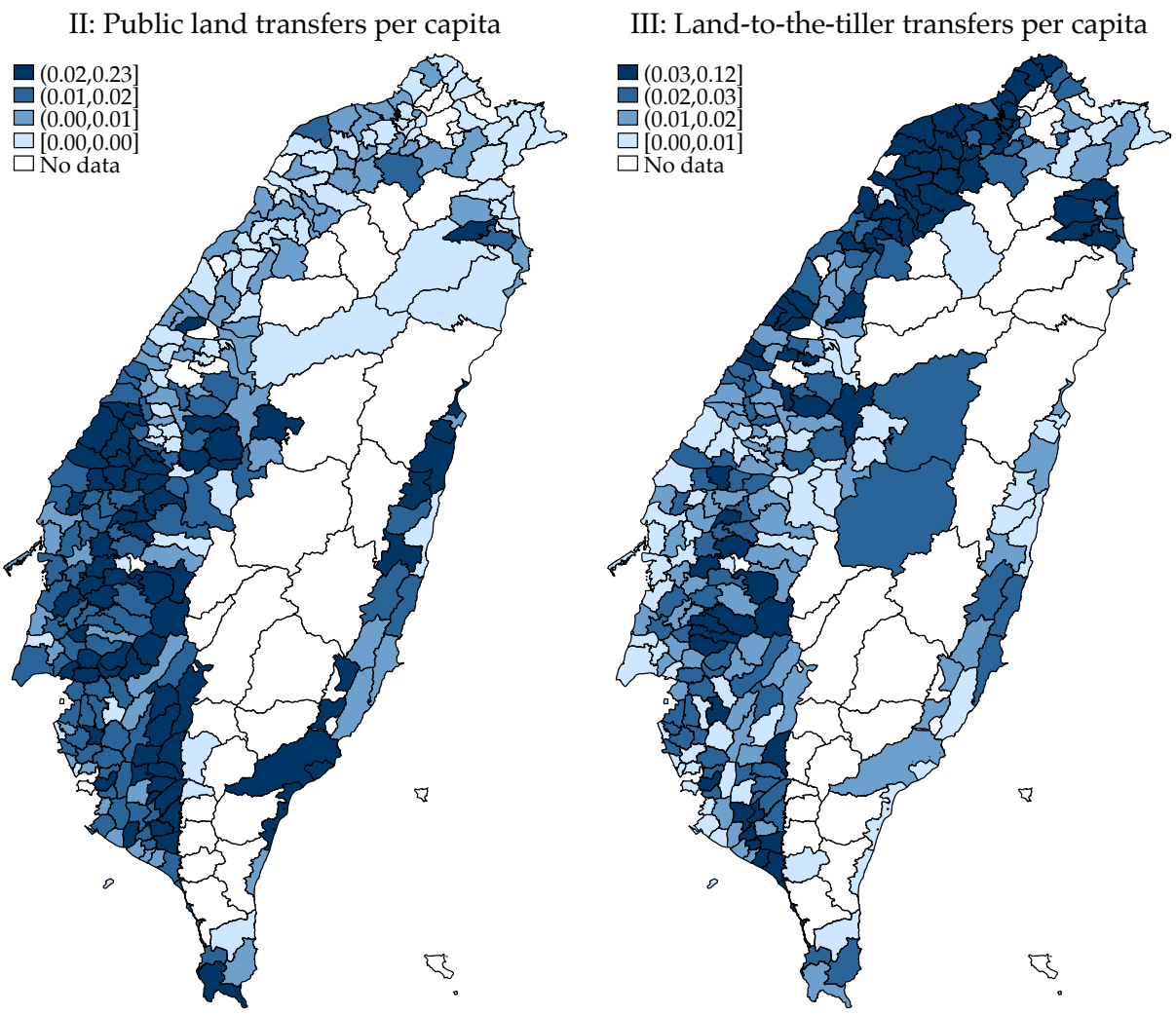

Figure 2: The Geography of Phase II and III land reforms

This figures shows the geographic distribution of the amount of land transferred by 1960 under the second stage public land redistribution (left panel) and the third stage land-to-the-tiller law (right panel), as a share of total arable land in that township.

3 Data

3.1 Sources

Our main source of data is Taiwan's county guidebooks, which we have digitized for the first time. In 1950, Taiwan was divided into 21 counties and municipalities, which were further sub-divided into 361 townships. Every year, each county or municipal government compiled a guidebook that summarized socio-economic statistics at the township level, such as population, agricultural output, and employment by industry. In particular, a detailed household registration system, akin to the *hukou* on the mainland, recorded statistics on births, deaths, and internal migration.

One concern with this kind of historical data is the consistency of geographical units over time. The administrative divisions of postwar Taiwan mostly followed those of the 1920 Japanese colonial system, when the main island and the Penghu archipelago were divided into 342 townships. After 1945, the Nationalist government simply changed the names of Japanese divisions. Although there were some township splits during our study time period, the overall number of townships remained stable (370 in 1952-1960; 371 in the 1960s). We track name changes as well as splits and merges, treating 1956's set of divisions as authoritative.[11] We then pair our administrative data with open source Geographic Information System (GIS) data on the 1955 township borders from the Center for GIS, RCHSS, Academia Sinica.[12]

We supplement the county guidebooks data with more detailed demographic data from Taiwan's 1956 and 1966 population censuses.[13] The 1956 and 1966 censuses contain township-level population counts broken down by gender and place of origin, while the 1966 census also contains detailed age distributions, education statistics, and labor participation by industry. Both also contain data on occupation by sector, which we use to measure structural transformation.

We combine several sources of data to measure the effects of land reform on tenancy. We digitized the JCRR's 1950 *Report of Investigation on Ownership and Operation of Arable Land* as a basis for the pre-reform distribution of land. For the post-reform distribution, the 1961 agricultural

11. We thank Kelly Olds of National Taiwan University for providing a comprehensive locality coding system that tracks the division changes from 1905 to 1966.

12. This data is publicly accessible at http://gissrv4.sinica.edu.tw/gis/twhgis/

13. We thank Kelly Olds again for generously sharing digitized versions of these censuses, as well as the 1947, 1951, and 1954 establishment-level directories.

census provides a comprehensive set of variables on land ownership, farming labor inputs, and crop yields. We use data from Taiwan's Food Statbook from 1950 through 1961 for additional data on agricultural production.

For industrial outcomes, we use Taiwan's 1954 industrial census, which has data at the township level. To suppplement this source, we also use establishment-level directories of manufacturing enterprises from 1947, 1951, and 1954. We are also in the process of digitizing the equivalent survey from 1968 as well as another census in 1971.

To test the balance of key socio-economic characteristics between areas with more and less public land, we bring in Japanese colonial data from the 1941 *Agricultural Basic Survey*, and the 1943 *Taiwan Rice Highlights* report.

3.2 Summary Statistics

Table 1 summarizes our key variables, measured at the township level. For our dependent variables, we show the sample means for rural townships (called *xiang*) and urban townships or cities (*zhen* or *shi*) separately.

Taiwan saw rapid economic progress during the 1950s, with real GDP growing by over 7% a year from 1950 to 1961. A major contributor was the agricultural sector: from 1950 to 1961, rice output in the average township grew by 0.39 log-points (48%), almost entirely attributable to a 0.36 log-point (43%) increase in yields, rather than area cultivated. The population of the average township grew by 0.41 log-points (51%), although the growth of urban areas barely outpaced those of rural areas. In education, the share of the population with at least primary level schooling also grew by 12 percentage points, but the gains in middle school, high school, and higher education were relatively modest. In terms of employment, the share of those with occupations in the primary sector (primarily farming, fishing, and mining) fell by 16 percentage points, a major structural change. However, most of this labor reallocated to the tertiary (services) sector, not secondary sector (manufacturing, construction, and utilities)—even in urban areas.

The major institutional change during this period, of course, is that the share of tenant farmer households collapsed by 23 percentage points, while the share of full landowner households rose correspondingly by 25 percentage points. To what extent can land reform explain these other

	N	Mean	SD
Treatment variables			
Phase II: Share of land transferred	259	0.08	0.10
Phase III: Share of land transferred	258	0.16	0.12
Land transfers p.c.	271	0.04	0.03
Share of Japanese-owned land (1941)	288	0.11	0.15
Japanese-owned land, p.c. (1941)	313	0.02	0.04
Dependent variables			
A. Rural			
Δ Share of full landowners 1950-61	252	0.26	0.20
Δ Share of partial landowners 1950-61	252	-0.02	0.14
Δ Share of tenants 1950-61	252	-0.24	0.17
Δ Median farm size 1950-61	252	0.02	0.30
Δ Log-Pop change, 1951-66	304	0.41	0.16
Δ ln Rice output 1950-61	298	0.39	0.47
Δ ln Rice yield 1950-61	293	0.36	0.18
Δ ln Rice area 1950-61	293	0.04	0.43
Δ Share primary school or above, 1961-51	298	0.12	0.07
Δ Share middle school or above, 1961-51	298	0.03	0.02
Δ Share high school or above, 1961-51	298	0.01	0.01
Δ Share higher education, 1961-51	298	0.00	0.00
B. Urban			
Δ Factories, 1954-76	82	0.93	0.84
Δ Manuf. Labor, 1954-76	82	3.24	1.14
Δ Manuf. Capital, 1954-76	82	-0.81	0.99
Δ occupation share: primary sector, 1956-66	80	-0.16	0.06
Δ occupation share: secondary sector, 1956-6	80	0.01	0.04
Δ occupation share: tertiary sector, 1956-6	80	0.15	0.07
Δ Log-Pop change, 1951-66	82	0.45	0.20
Δ Log-Pop change, 1955-66	86	0.32	0.13
Δ Birth rate, 1951-66	58	-0.01	0.02
Δ Migrant share, 1955-70	73	0.03	0.03
Δ Migrant share, 1955-80	73	0.07	0.09
Δ Share primary school or above, 1961-51	77	0.12	0.06
Δ Share middle school or above, 1961-51	77	0.04	0.02
Δ Share high school or above, 1961-51	77	0.02	0.01
Δ Share higher education, 1961-51	77	0.00	0.00
Control variables			
Δ share of tenants, 1941-50	252	0.03	0.10
Δ log population, 1942-50	299	-0.04	0.52
Δ Attainable rice yield, low-to-high inputs	308	4075.23	1509.72

Table 1: Summary Statistics

developments? The following sections will systematically explore the empirical link between these patterns.

4 Empirical Strategy

In this paper, we focus on the effects of the second phase of Taiwan's land reform—the redistribution of public lands, most of which had been confiscated from Japanese colonists.

This redistribution was the product of two policy shocks. The first was Japan's sudden surrender to the Allies on September 2, 1945, which led to the repatriation of the 300,000 Japanese on Taiwan by May 1947 and the confiscation of their property by the incoming Nationalist government. The second shock was the Nationalists' 1952 decision to distribute ownership of this land, rather than extend existing tenancy arrangements.

These twin shocks created the conditions of a natural experiment to study the causal effect of land reform. Prior to these policy shocks, Japanese-owned lands were worked in a way similar to Taiwanese-held lands—even those producing sugar for export. Ka (1995) describes how sugar production in colonial Taiwan came to follow a rather unusual model of small-scale farming:

> In the early twentieth century, Western colonial powers established extensive sugar plantations in Latin America, Indonesia, and elsewhere... In colonial Taiwan, however, the Japanese acquired sugarcane largely via contractual arrangements with small family farms... In the beginning stages of colonial rule, Japanese private capital, in the face of persistent family farms, tended to avoid direct involvement in agricultural production, preferring to exploit the peasant producers through market control and the provision of credit. Nevertheless, supported by the colonial state, a modern family-farming agriculture was created in order to facilitate capital accumulation by the Japanese.

Taiwan's relatively strong system of land rights, intended to win the support of local landlords for the colonial regime, made it difficult for sugar companies to amass land through coercion, as the Dutch did on Java. Instead, the Japanese left the basic structure of smallholder farming intact, maximizing profits instead by gaining control of the milling, refining, and marketing of

sugar. Similarly, most rice was also grown on small family farms, where Japanese attempts at vertical integration were less successful (Grabowski 2002).

Thus, the 1951 public land redistribution was a policy shock that separated areas with more and less Japanese-owned land, but were otherwise operating under a similar system of small family farming.

4.1 Specification

Motivated by this historical observation, we use the area of Japanese-owned land in 1941, normalized by the population measured in 1942, as an instrument for the amount redistributed in the second phase. We estimate the following equation:

$$\Delta PhaseIITransfers_i = \beta_0 + \beta_1 JapaneseLand_i + X_i'\delta + \varepsilon_i \tag{1}$$

$$\Delta y_i = \gamma_0 + \gamma_1 \Delta PhaseIITransfers_i + X_i'\Gamma + \eta_i \tag{2}$$

where for township i, Δy_i is the long-differenced outcome, $JapaneseLand_i$ is the amount of Japanese-held land per capita in 1941, and $\Delta LandTransfers_i$ is the change in land transfers between 1950 and 1961 (where the 1950 pre-reform amount is assumed to be 0). Since we are focusing on the effect of the second-stage reform, we also control for the amount of transfers in the third phase of land reform, subsumed in the control vector X. Standard errors η_{it} are clustered following Conley (1999), allowing for spatial autocorrelation up to 50km using a Bartlett kernel.

The key identifying assumption is the exclusion restriction: that a township's public land is correlated with changes in outcomes Δy_i only through the channel of changes in land transfers $\Delta LandTransfers_i$. Since we are estimating the second stage in first-differences, equivalent in a two-period panel to estimating with township fixed effects, these remaining threats to identification must be time-varying—we have already controlled for all fixed unobservable characteristics of townships.

Balance Tests To support our exclusion restriction, Table 2 studies the relationship between our Japanese land instrument and the growth of several key outcomes before reform.

	N	Japanese land p.c. (SE)
Δ share of tenants, 1941-50	252	0.12
		(0.10)
Δ median hhld farm size, 1941-50	252	0.04
		(0.17)
Δ Attainable rice yield, low-to-high inputs	285	61.37
		(523.79)
Δ log rice yield, 1950-52	262	0.08
		(0.06)
Δ log population, 1942-50	271	-0.07
		(0.14)

Table 2: This balance table shows the coefficient estimate of a regressing several key pre-reform socio-economic characteristics on the amount of Japanese-owned land.

First and foremost, changes in land tenure outcomes appear similar between areas with more and less Japanese-owned land: the change in the median farm size was essentially zero, and while the coefficient on the changing share of tenant households is positive, the relationship is not statistically significant. To proxy for the potential gains from Green Revolution, we look at the change in attainable rice yield of moving from low-inputs traditional agriculture to a high-input modern model, as measured by the FAO's Global Agricultural Ecological Zones dataset, and find little difference for areas with more Japanese-owned land. There is also no statistically significant difference in the growth of rice yields just before the implementation of reform, from 1950 to 1952. Finally, townships with more Japanese-owned land did not experience faster population growth from 1942 (the last data point for colonial population) to the eve of land reform in 1950. Overall, we conclude that townships with more and less Japanese land were growing in similar fashion prior to the policy shock of land reform.

Instrumental Relevance Finally, Figure 3 demonstrates that our instrument—the amount of Japanese land in 1941, per capita—can strongly predict the amount of per-capita transfers in the second stage of land reform. As the sample size changes due to data availability for the outcome variables, we also list the first-stage F-statistic for each outcome in the regression tables to follow. The F-statistic is around 30, ranging from a minimum of 28.09 to a maximum of 31.21. The first-stage relationship remains strong even after controlling for third-degree polynomials for latitude and longitude (appendix Table 7), indicating that Japanese-owned land was dispersed

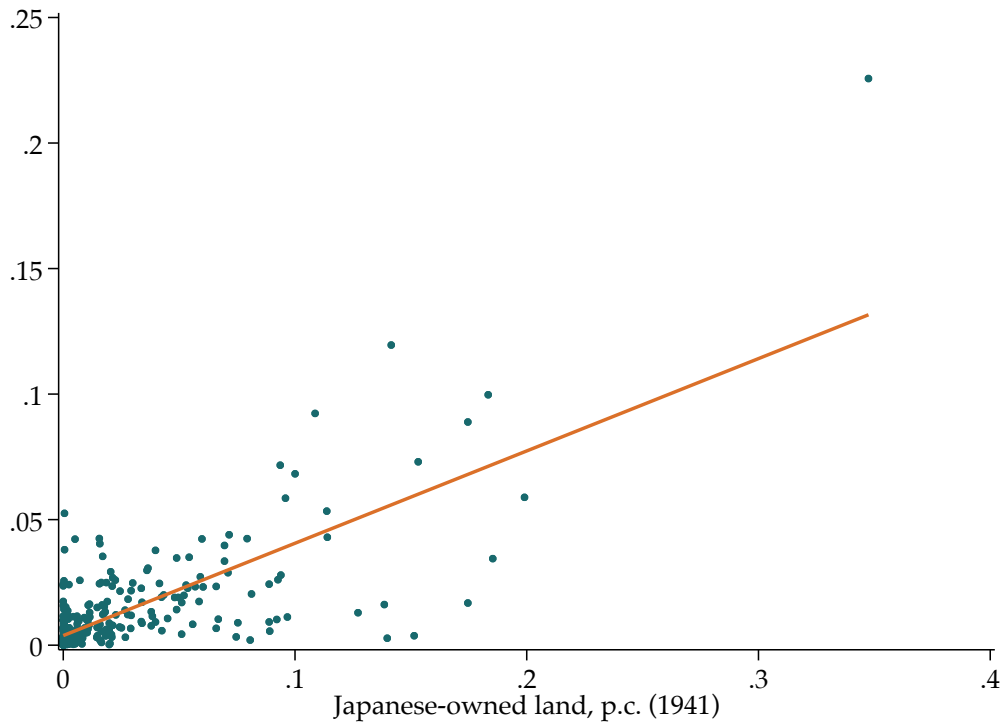

Figure 3: First Stage: Japanese Land per capita (1941) and Phase II Land Transfers

This figures shows the strength of the first-stage relationship between the instrument (Japanese land per capita in 1941) and the instrumented (phase II land transfers) variables.

across Taiwan in a way that cannot be predicted by a simple function of geography, such as a north-south axis.

5 Empirical Results

5.1 Land Tenure

We begin by studying land reform's effects on tenancy, ownership, and farm sizes. It is not a given that land reform altered the actual institutions on the ground, as reform efforts in other developing countries have often been co-opted by landed elites (Albertus 2015). Necessary condition

Table 3 estimates the effect of land reform on the share of households who owned their land. We report both OLS estimates (left) and IV estimates based on Equation 2 (right). Using the 1950

	OLS (SE)	N	IV (SE)	N (F)	Mean effect
Δ Share of tenants 1950-61	-0.53***	247	-1.22***	244	-0.10
	(0.09)	.	(0.31)	28.09	
Δ Share of partial landowners 1950-61	0.13	247	0.40	244	0.03
	(0.13)	.	(0.32)	28.09	
Δ Share of full landowners 1950-61	0.40***	247	0.82**	244	0.07
	(0.15)	.	(0.41)	28.09	
Δ Median farm size 1950-61	0.00	247	-0.18	244	-0.01
	(0.19)	.	(0.42)	28.09	

Table 3: Land Reform and Land Tenure

This table estimates the effect of the second stage of land reform on land tenure arrangements using equation 2. All outcome variables are expressed in changes from 1950 to 1961. "Median farm size" is the median farm size operated (not necessarily owned) by households in a township. "Full" landowners are households who owned all of the land that they worked; "partial" landowners were those who owned some of their land, and rented the rest; and tenants were households who do not own any land. Data is from the 1950 JCRR landownership report and the 1961 agricultural census.

and 1961 agricultural surveys, we consider the change in the share of households who fall under mutually exclusive categories: "full" landowners, who owned all of the land that they worked; "partial" landowners, who owned some of their land and rented the rest; and tenants, who did not own any land. We also examine the effect on the median farm size operated (not necessarily owned) by households in a township.

Land reform caused a dramatic decrease in the share of tenant households—for every 10% increase in the share of township land transferred, the share of tenants fell by 12.2%. Moreover, given the average of around 8% of each township's land transferred under the second phase of land reform, this translates to a sizable average effect—a 10 percentage point decrease in tenancy, almost 40% of the overall decline from 1950 to 1961. We observe little effect of land reform on partial landowner households, but we see a large positive effect on the share of full landowning households, translating to a 7 percentage point increase in full ownership for the average township, mirroring the fall in tenancy. There was, however, little effect of land reform on the median operating size of farms.

This suggests that if second phase of land reform had a decisive effect on Taiwan's land tenure institutions, this came through altering tenancy, not by changing farm operating sizes.

	OLS (SE)	N	IV (SE)	N (F)	Mean effect
Δ ln Rice output 1950-61	0.69***	250	1.63***	247	0.14
	(0.24)	.	(0.48)	28.45	
Δ ln Rice yield 1950-61	0.26	250	0.88***	247	0.07
	(0.16)	.	(0.26)	28.45	
Δ ln Rice area 1950-61	0.43*	250	0.76*	247	0.06
	(0.22)	.	(0.44)	28.45	
Δ ln Sweet potato output 1950-61	0.64	202	-0.05	199	-0.00
	(0.42)	.	(0.95)	24.06	
Δ ln Sweet potato yield 1950-61	0.18	202	0.24	199	0.02
	(0.27)	.	(0.49)	24.06	
Δ ln Sweet potato area 1950-61	0.45	202	-0.29	199	-0.02
	(0.30)	.	(0.72)	24.06	
Δ ln Soybean output 1950-61	0.03	92	0.21	92	0.02
	(0.85)	.	(2.21)	11.46	
Δ ln Soybean yield 1950-61	-0.09	91	0.55	91	0.05
	(0.95)	.	(1.39)	11.50	
Δ ln Soybean area 1950-61	0.12	91	-0.45	91	-0.04
	(0.58)	.	(1.70)	11.50	

Table 4: Land Reform and Agricultural Productivity

This table estimates the effect of the second stage of land reform on agricultural yields (output in weight divided by cultivated land area) for several major crops: rice, sweet potato, soy beans, and sugar cane. Outcome variables are expressed in log-changes from 1950 to 1961 (for rice) or 1951 to 1961 (other crops).

5.2 Agriculture

We next turn to the effect of land reform on agricultural production. In Table 4, we consider the effect on two main sets of outcomes: yields, the weight of output divided by cultivated area; and the acreage of arable land dedicated to each type of crop.

Our main result is that for every 1% increase in the share of land transferred, the output of rice, Taiwan's main staple crop, grew by 1.63% from 1950 to 1961. In the mean township, with 8% of land transferred, this translates to a 14 percentage point output increase—roughly a quarter of the 65% increase in rice yields over the decade. By contrast, we find limited evidence that land reform affected the growth of other crops. We cannot distinguish the effect of land reform on the output, yield, and area of sweet potato (the second major staple) and soy bean (a key source of protein) from 0. We note, however, that the point estimates on sweet potato and soybean yields are positive, while the point estimates on area are negative (though the standard errors on these estimates are wide due to missing data). This suggests that land reform's increase of rice yields

and output did not come at the significant expense of the productivity of other crops.

In Appendix Table 10, we consider the effects of land reform on a wider range of specialty vegetables that were introduced to Taiwan in the late 1950s, and find similar null effects.

Mechanisms How did land reform increase rice yields? In Taiwan's case, the conventional view is perhaps best summed up by Kuo (1983):

> The change in tenancy conditions provided a great incentive to produce more, and made possible the more efficient utilization of agricultural labor... The smaller size of the farming unit naturally brought about a more intensive use of labor and, consequently, more intensive multiple cropping farming.

However, this observation folds in two separate mechanisms. The first is that land reform improves efficiency by giving tenants secure ownership rights, which may encourage them to invest more into the land. The second is that land reform improves efficiency by decreasing the operating size of farms—smaller farming units can be worked much more intensively, leading to an inverse relationship between average farm size and yield (Foster and Rosenzweig 2017).[14] Which mechanism occurred in Taiwan?

Crucially, we do not actually observe a significant change in the actual operating size of farms. By global standards, Taiwanese farms started small and remained small, averaging around 0.5 hectares in both 1950 and 1961. Rather, we attribute the rise in yields to the striking decrease in tenancy. With the population rapidly surging and most arable land already in use, eviction was an endemic problem in postwar Taiwan. By giving greater tenurial security, land reform gave farmers the incentive to spend more on inputs like chemical fertilizers, and make longer-run improvements to the land. (Banerjee, Gertler, and Ghatak (2002) observe a similar effect of tenancy reform in West Bengal.)

We can see suggestive evidence for this channel in Appendix Table 9, which estimates the effect of land reform on the growth of credit in local farmers' associations from 1956 to 1966. Taiwanese farmers typically lacked access to banks and other formal financial institutions, making farmers' associations a crucial source of credit (Looney 2012). Areas with more land transfers

14. Farming rice is notably labor-intensive compared to other staple crops, and the diminishing returns to additional labor are relatively modest, making this channel potentially very potent in Taiwan (Vollrath 2011).

	OLS (SE)	N	IV (SE)	N (F)	Mean effect
Δ Log-Pop change, 1951-66	0.30*	252	0.55***	249	0.05
	(0.16)	.	(0.21)	30.92	
Δ occupation share: primary sector,	0.17***	254	0.15**	251	0.01
1956-66	(0.06)	.	(0.07)	31.18	
Δ occupation share: secondary sector,	-0.08***	254	-0.14**	251	-0.01
1956-6	(0.02)	.	(0.06)	31.18	
Δ occupation share: tertiary sector,	-0.08	254	-0.01	251	-0.00
1956-6	(0.06)	.	(0.10)	31.18	
Δ Share primary school or above,	0.03	251	-0.03	248	-0.00
1961-51	(0.04)	.	(0.08)	30.85	
Δ Share middle school or above,	-0.01	251	-0.01	248	-0.00
1961-51	(0.01)	.	(0.02)	30.85	
Δ Share high school or above, 1961-51	-0.00	251	0.00	248	0.00
	(0.01)	.	(0.01)	30.85	
Δ Share higher education, 1961-51	-0.00	251	-0.00	248	-0.00
	(0.00)	.	(0.00)	30.85	

Table 5: Land Reform and Demographic Changes

This table estimates the effect of the second stage of land reform on demographic changes in local townships. Δ log population is the log-change in township population between 1951 and 1966. Δ occupation share is the change in the share of those working who are occupied in the primary (farming, herding, fishing, and mining), secondary (manufacturing, construction, and utilities), or tertiary (services, commerce, or government) sectors. Δ share primary school or above is the change in the share of the population with at least a primary school education.

saw large increases in the capitalization of these associations, indicating that they were financing more and perhaps larger projects. We are currently working on collecting data on chemical fertilizer inputs and irrigation, to directly observe these investments.

5.3 Rural Demographics

Table 5 considers land reform's effects on a broad set of demographic variables in our sample of rural townships. Broadly speaking, we do not find evidence that land reform contributed to structural change in the countryside. Townships with greater second stage land transfers did not see higher population growth from 1951 to 1966. Nor did land reform appear to increase local educational attainment, measured at the primary, middle, high school, and higher education levels. At least at the local level, this is in tension with the theory greater land equality should lead to greater investments in human capital, posited by Galor, Moav, and Vollrath (2009) (though it is still possible that this channel works at the level of national education policy).

We do find, however, that land reform decreased the share of the local population occupied in the secondary sector—manufacturing, construction, and utilities—from 1956 to 1966. On average, townships experienced a 1 percentage point decline in the secondary sector occupation share, which parallels an almost identically-sized increase in the primary sector occupation share. Together, these patterns suggest that, on net, rising agricultural productivity may have pulled labor back to the agricultural sector. We explore this channel further in the following sub-section.

5.4 Urban Spillovers

Finally, we consider the spillover effects of rural land reform on urban areas. We restrict our sample to a set of cities and urban townships (*zhen* in the administrative classification). For urban township i, we can then construct a weighted average of nearby land reform intensity, where the weights vary inversely with distance:

$$LandTransferSpillovers_i = \sum_j \mathbb{1}(\text{Distance}_{i,j} < Cutoff) \frac{\text{Land Transfers p.c.}_j}{\text{Distance}_{i,j}}$$

where we set $Cutoff = 50km$. In the appendix, Table 8 examines the balance of the urban spillover instrument. Finding that the pre-reform growth of several key variables is balanced, we estimate Equation 2, substituting in the distance-weighted versions of Japanese-owned land and land transfers for our instrument and instrumented variables, respectively.

Table 6 estimates the effects of land reform on a broad set of demographic variables in urban areas. The most striking finding is that land reform resulted in significant decreases in the occupation share of the secondary sector (primarily manufacturing) in nearby urban areas: in the average urban township, land reform was responsible for a 2 percentage point decrease in the secondary sector occupation share. Most of this decrease went to the tertiary sector (primarily services), not the primary sector (primarily agriculture).

Mirroring the results in rural townships, we find suggestive evidence that land reform in surrounding rural areas caused population *decreases* in urban areas (though, given the large standard errors, we cannot reject that these estimates are different from 0). One driver of this may be the statistically significant decrease in the migrant share of the township population caused

by nearby land reform—one likely explanation is that greater land transfers in surrounding areas improved relative economic opportunities outside of towns, decreasing the incentive to migrate.

Interestingly, land reform also decreased the share of the population with at least a middle school education in neighboring areas. We do not see similar effects at the high school or higher education levels. The coefficient on the share of the population with at least a primary education is similar, but measured much less precisely, reflecting the much wider variation in primary school attainment across Taiwan (Table 1).

Taken together, these results suggest that, by raising agricultural productivity, land reform may have worked at the local level as a countervailing force against the forces of urbanization and industrialization in Taiwan.

5.5 Robustness

One may still be concerned that townships with more Japanese-owned land differed in unobserved ways from those with less. In particular, the presence of Japanese-era mills and infrastructure may have had a differential effect on development—though it is worth noting that the large-scale Japanese sugar plantations were taken over by the Nationalists under the umbrella of the Taiwan Sugar Company, and ordered in 1947 to lease around 80% of their land to tenant farmers. Table 11 shows that our main results are largely unchanged after adding controls for the presence of a sugar mill in 1947 and railroad access as of 1935.

In a further robustness check, Appendix Figure 4 present the specification curve, examining the coefficient estimates for rice yield growth with different permutations of controls for Japanese colonial institutions and infrastructure: the number of bank branches within 10 kilometers as of 1945; the presence of a sugar factory as of 1947; railroad access as of 1935; and the yield of raw sugar as of 1951. We consider both the OLS and IV estimates with these controls. We find that, overall, the addition of these controls only marginally affects the point estimate, which remains highly economically significant, ranging from around 1.6 to 4.

	OLS		Public IV		
	(SE)	N	(SE)	N	
Δ Log-Pop change, 1951-66	1.27***	78	-1.51	82	-0.04
	(0.48)	.	(1.46)	64.72	
Δ occupation share: primary sector,	-0.22	79	-0.05	79	-0.00
1956-66	(0.23)	.	(0.44)	71.13	
Δ occupation share: secondary sector,	0.25	79	-0.60**	79	-0.02
1956-66	(0.17)	.	(0.27)	71.13	
Δ occupation share: tertiary sector,	-0.04	79	0.65	79	0.02
1956-66	(0.30)	.	(0.45)	71.13	
Δ Migrant share, 1955-70	0.42**	73	-0.54**	73	-0.01
	(0.19)	.	(0.27)	72.78	
Δ Share primary school or above,	0.36	77	-0.31	77	-0.01
1951-61	(0.27)	.	(0.32)	70.82	
Δ Share middle school or above,	0.11	77	-0.34***	77	-0.01
1951-61	(0.11)	.	(0.12)	70.82	
Δ Share high school or above, 1951-61	0.08	77	-0.11	77	-0.00
	(0.07)	.	(0.07)	70.82	
Δ Share higher education, 1951-61	0.02	77	-0.03	77	-0.00
	(0.02)	.	(0.03)	70.82	
Δ Factories, 1954-76	-0.25	77	-10.35***	81	-0.28
	(2.81)	.	(3.13)	58.21	
Δ Manuf. Capital, 1954-76	-0.67	77	-2.26	81	-0.06
	(3.13)	.	(3.70)	58.21	
Δ Manuf. share, 1951-80	0.80	57	-2.94***	57	-0.08
	(0.59)	.	(0.70)	96.15	

Table 6: Land Reform and Urban Spillovers

This table estimates the spillover effects of the second stage of land reform on neighboring urban areas. Δ log population is the log-change in township population between 1951 and 1966. Δ occupation share is the change in the share of those working who are occupied in the primary (farming, herding, fishing, and mining), secondary (manufacturing, construction, and utilities), or tertiary (services, commerce, or government) sectors. Δ share primary school or above is the change in the share of the population with at least a primary school education.

5.6 Discussion

We find evidence in support of the conventional, positive view of Taiwanese land reform. Put simply, land reform improved equality without harming efficiency. Rather, it enhanced it. The scale of land reform's contribution to agricultural growth was economically meaningful. Rice output grew by over 50 percent from 1950 to 1961; in the average township, around a quarter that gain can be attributed to the second-stage land reform.

While we cannot observe labor hours, the amount of farm labor remained relatively unchanged at least on the extensive margin, implying that labor productivity increased because of

land reform. Our finding of workers' movement away from manufacturing in rural and urban areas is consistent with a neoclassical growth model, where a rise in the marginal product of labor leads to an increase in wages, drawing workers back to the farm. Thus, at least at a local level, land reform may have worked against the forces of structural transformation. We cannot find evidence for the alternative theories that land reform was a boon for rural industrialization, either by promoting rural entrepreneurship (Hamilton and Kao 2018; Stites 1982) or by encouraging forward linkages to manufacturing activities (Wade 1990).

6 Conclusion

Occasionally, the conventional wisdom is proven right. We conduct the first study of Taiwan's 1950s land reform using modern empirical tools, and conclude that it indeed worked as long claimed, increasing the share of smallholder farmers and increasing rice yields. Moreover, land reform increased agricultural efficiency by reducing tenancy, not by changing the operating sizes of farms. Before manufacturing growth ever got off the ground, the Taiwanese economic miracle was first and foremost an agricultural miracle—and land reform was a major contributor.

Land reform cannot, however, explain industrialization or structural change at the local level. If anything, within townships, rising agricultural productivity pulled workers back to the farm, consistent with a neoclassical growth model where wages move with the marginal product of labor. This does not, however, rule out a contribution of land reform at the *aggregate* level—for instance, rising agricultural productivity likely contributed to the growth in agricultural exports, providing the foreign exchange to import capital goods for industry. But the broad movement of Taiwanese workers away from agriculture towards manufacturing—in a word, industrialization—will need to be explained by other factors.

Of course, economic miracles rarely have a single cause. We must turn to later developments—among them, export promotion policies, subsidies to strategic industries, and investments in education and human capital—in order to fully understand how Taiwan built upon its early successes with land reform and agriculture. Understanding these policies will likely prove fertile ground for future research.

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Appendix Tables and Figures

	(1) No Controls	(2) Lat/Lon Polynom.
Japanese-owned land, p.c. (1941)	0.368***	0.346***
	(0.072)	(0.077)
Observations	271	271
R^2	0.547	0.571
F-stat	26.18	20.21

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: First Stage Table

	N	Japanese land p.c. (SE)
Δ log population, 1942-50	81	0.95
		(1.32)
Δ log rice yield, 1950-52	79	-0.26
		(0.51)
Δ median hhld farm size, 1941-50	75	0.82
		(0.85)
Δ share of tenants, 1941-50	75	-0.34
		(0.24)
Δ Factories, 1947-54	83	-6.36***
		(1.93)

Table 8: Balance Table

This balance table shows the coefficient estimate of a regressing several key pre-reform socio-economic characteristics on the fraction of Japanese-owned land. Rice yield data for 1943 is only available at the district (*gun*) level.

	OLS (SE)	N	IV (SE)	N (F)	Mean effect
Δ FA members, 1956-66	0.30	249	0.39*	246	0.03
	(0.19)	.	(0.22)	30.76	
Δ FA capital, 1956-66	0.72*	248	1.89***	245	0.16
	(0.38)	.	(0.73)	30.70	
Δ FA fixed assets, 1956-66	-0.04	249	1.57	246	0.13
	(0.34)	.	(1.27)	30.76	
Δ FA deposits, 1956-66	1.09	240	-0.98	237	-0.08
	(0.67)	.	(1.49)	24.62	
Δ FA loans, 1956-66	0.78	233	-0.31	230	-0.03
	(0.80)	.	(1.18)	24.23	

Table 9: Land Reform and Farmers Associations

This table estimates the effect of the second stage of land reform on the growth of farmers' associations.

	OLS (SE)	N	IV (SE)	N (F)	Mean effect
Δ ln Cabbage yield 1950-61	0.01	85	-1.13*	84	-0.09
	(0.55)	.	(0.63)	8.42	
Δ ln Sino Cabbage yield 1950-61	-0.48	88	-1.18	87	-0.10
	(0.56)	.	(1.04)	5.15	
Δ ln Leaf mustard yield 1950-61	-0.55	82	-0.74	81	-0.06
	(0.94)	.	(1.40)	6.66	
Δ ln Vegetable yield 1950-61	0.64*	88	-0.32	87	-0.03
	(0.37)	.	(0.70)	3.40	
Δ ln Banana yield 1950-61	0.73	133	1.65	132	0.14
	(0.47)	.	(1.03)	22.78	
Δ ln Pineapple yield 1950-61	-1.04*	77	-1.86	76	-0.15
	(0.59)	.	(1.39)	24.20	

Table 10: Land Reform and Other Crops

This table estimates the effect of the second stage of land reform on the growth of other crops.

	OLS (SE)	N	IV (SE)	N (F)	Mean effect
Δ Share of full landowners 1950-61	0.40***	247	0.82**	244	0.07
	(0.15)	.	(0.41)	28.09	
Δ Share of partial landowners 1950-61	0.13	247	0.40	244	0.03
	(0.13)	.	(0.32)	28.09	
Δ Share of tenants 1950-61	-0.53***	247	-1.22***	244	-0.10
	(0.09)	.	(0.31)	28.09	
Δ Median farm size 1950-61	0.00	247	-0.18	244	-0.01
	(0.19)	.	(0.42)	28.09	
Δ ln Rice output 1950-61	0.69***	250	1.63***	247	0.14
	(0.24)	.	(0.48)	28.45	
Δ ln Rice yield 1950-61	0.26	250	0.88***	247	0.07
	(0.16)	.	(0.26)	28.45	
Δ Log-Pop change, 1951-66	0.30*	252	0.55***	249	0.05
	(0.16)	.	(0.21)	30.92	
Δ occupation share: primary sector,	0.17***	254	0.15**	251	0.01
1956-66	(0.06)	.	(0.07)	31.18	
Δ occupation share: secondary sector,	-0.08***	254	-0.14**	251	-0.01
1956-6	(0.02)	.	(0.06)	31.18	
Δ occupation share: tertiary sector,	-0.08	254	-0.01	251	-0.00
1956-6	(0.06)	.	(0.10)	31.18	
Δ Share primary school or above,	0.03	251	-0.03	248	-0.00
1961-51	(0.04)	.	(0.08)	30.85	
Δ Share middle school or above,	-0.01	251	-0.01	248	-0.00
1961-51	(0.01)	.	(0.02)	30.85	
Δ Share high school or above, 1961-51	-0.00	251	0.00	248	0.00
	(0.01)	.	(0.01)	30.85	
Δ Share higher education, 1961-51	-0.00	251	-0.00	248	-0.00
	(0.00)	.	(0.00)	30.85	

Table 11: Robustness Check

Robustness check.

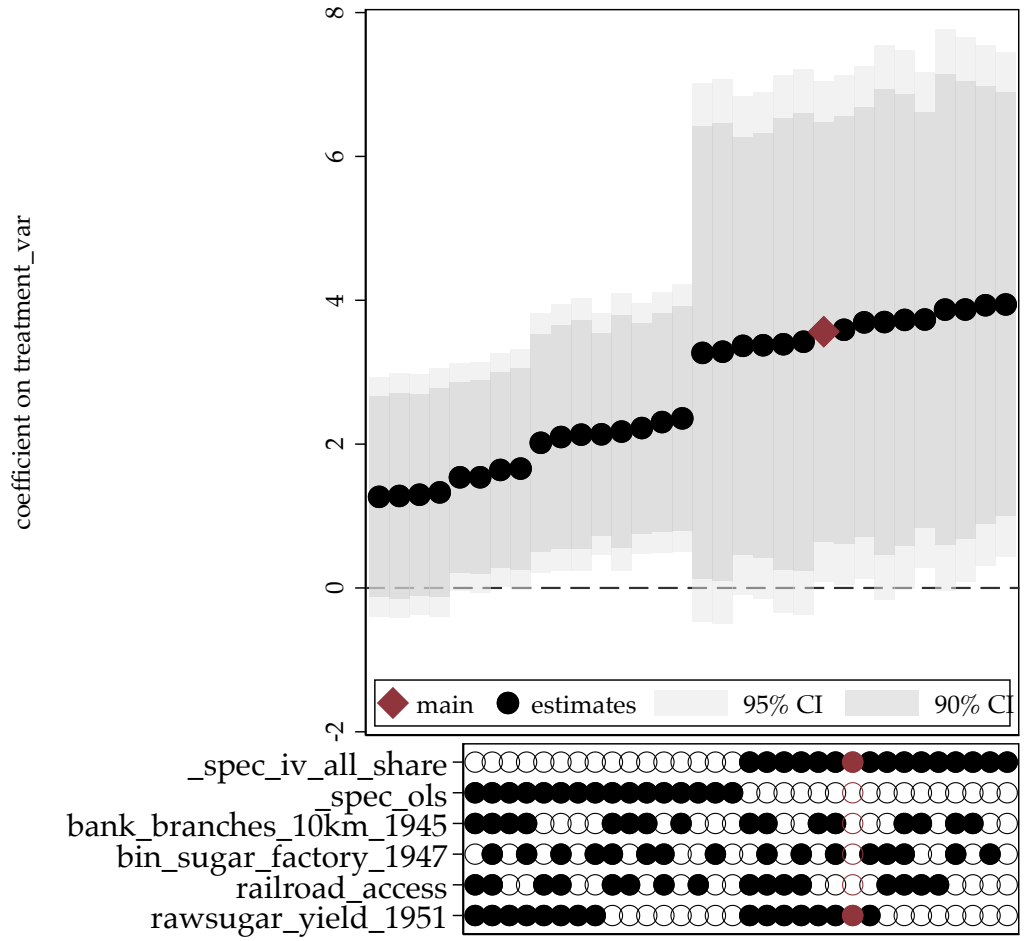

Figure 4: Specification Curve: Rice yield growth, 1950-61

This specification curve shows the coefficient estimate on land transfers under the OLS and IV specification, including every permutation of the following variables: railroad access as of 1935; number of bank branches within 10km as of 1945; whether a sugar factory/mill is present in the township as of 1947; and raw sugar yield as of 1951.