Productivity and Knowledge Transfer: Evidence from Prisoner Employment*

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Abstract

Worker mobility can facilitate the transmission of knowledge and ultimately increase productivity. Yet isolating such productivity effects is challenging because of worker sorting, labor market adjustments, and assimilation processes. We exploit quasi-experimental variation arising from the temporary employment of Italian prisoners of war in Australian agriculture during World War II to isolate the effects of worker mobility on productivity. We find that this inflow of workers increased agricultural output in the short run and generated productivity gains that persisted after the workers' departure. Examining mechanisms, we show that the employment of foreign workers led to a shift toward crops better suited to local conditions and to greater mechanization in areas that received workers from Italian provinces where such crops and technologies were more common. These origin-specific effects are stronger in areas with lower ex-ante productivity and where the mismatch between cultivated and suitable crops is greater. Overall, our findings point to the transfer of origin-specific knowledge as a key channel through which worker mobility generates lasting productivity gains in the host economy.

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1 Introduction

A long-standing literature in economics debates the effects of worker mobility across countries, or across regions within a country, on destination economies. Most of this literature focuses on the impact of increased labor supply, resulting from worker mobility, on labor markets (e.g., Borjas et al., 1997; Card, 2001, 2009). Less is known about whether an inflow of workers also affects productivity *per se*, independently of adjustments induced by labor markets, and, if so, whether these productivity effects outlast the workers who originated them. Such persistent effects may arise through the transfer of technology know-how (e.g., Bloom et al., 2013) or origin-specific skills that new workers may bring with them (Bazzi et al., 2016), which are valuable in the destination economy but otherwise difficult to transfer.

Isolating the productivity effects of a labor inflow is challenging in most settings for several reasons. First, workers may select destinations according to their skills (Obolensky et al., 2024), creating an identification problem that is challenging to address. Second, even when workers are allocated to regions independently of their skills, changes in labor supply typically induce shifts in the relative cost of labor versus other production inputs, which themselves influence production and productivity (e.g., Lewis, 2011; Ottaviano and Peri, 2012; Ottaviano et al., 2013). Third, workers often remain in the destination economy for long periods, so that productivity effects may be shaped by long-run factors such as immigrant assimilation into society and production (e.g., Abramitzky and Boustan, 2017).

This paper isolates the causal effects of an inflow of foreign workers, and their origin-specific knowledge, on agricultural productivity. We draw on newly digitized data linking agricultural productivity to detailed records of Italian prisoners of war (POWs) held in Australia during World War II and exploit the variation arising from the POW employment program. The unique features of this program, in which workers were quasi-randomly allowed to work only in certain areas and only temporarily until the end of the war, allocated independently of their skills, and employed under wages and hours set by the government to match those of local workers, allow us to overcome the challenges typically associated with isolating the effects of knowledge transfer through worker mobility on productivity. We find that this inflow of foreign workers increased both agricultural production and productivity. While output gains peaked when foreign labor utilization was highest, productivity gains persisted after their departure, indicating longer-lasting effects. By linking workers' Italian provinces of origin to pre-war Italian agricultural data and Australian soil characteristics, we show that areas where POW employment was permitted experienced greater mechanization and a shift toward crops better suited to local conditions. These productivity-enhancing adjustments were concentrated in areas that received POWs from Italian regions where such

crops were more common and mechanization was more advanced before the war. These origin-specific effects were stronger in areas with lower ex-ante productivity and where the mismatch between cultivated and suitable crops was greater. Taken together, these findings point to the transfer of origin-specific knowledge as an important mechanism through which foreign workers raise productivity.

The Australian POW employment program serves as an ideal setting for our study for several reasons. First, detailed historical agricultural and prisoner records allow us to measure agricultural outcomes, including productivity, at the parish level and link them to prisoners' pre-war agricultural conditions in their Italian provinces of origin. This allows us to study both the effects of POW employment and the mechanisms underlying them. Second, the rule restricting POW employment to farms within 40 kilometers of the nearest prisoner camp generates plausibly exogenous variation in labor inflows across areas. Third, within farms, prisoners faced no restrictions on tasks or production methods, closely resembling regular agricultural employment, while wages and hours were fixed by the government to match those of local workers, isolating productivity effects from labor-market price adjustments. Fourth, agricultural work was the most common pre-war occupation among Italian prisoners and assignment to farms was independent of origin-specific skills, two features that together allow us to investigate the role of knowledge transfer. Finally, because all prisoners were repatriated after the war, the program offers a uniquely clean setting to test whether productivity gains persist once the workers who generated them are no longer present.

Although the Australian POW employment program provides a particularly suitable setting to address our research question, the employment of POWs is not unique to Australia. During WWII alone, thousands of POWs were employed in agriculture across Allied countries, including the United States and the United Kingdom, making our findings potentially relevant to other contexts too.[1]

We focus on the Australian state of Victoria, for which complete records from all relevant sources are available. Victoria held nearly 40% of Italian prisoners of war during WWII, only marginally below the largest state share, and accounted for the second-largest share of the nation's cultivated area. In Victorian parishes that received Italian POW labor under the employment program, prisoner labor accounted, on average, for 12% of pre-war employment, representing a substantial increase in local labor supply. Prisoners originated from virtually every Italian province, and farming was by far their most common pre-war occupation, making them a potential source of diverse agricultural knowledge.

[1]See, for instance, Moore (1997) and Custodis (2012) for discussions of POW employment in agriculture in the UK, Ward (2007) for a discussion of POW labor on cotton plantations in the US, and Moore and Fedorowich (2002) for a discussion of Italian POW employment across the British Empire.

Our empirical strategy employs a difference-in-differences design comparing agricultural outcomes in parishes located within a 40-kilometer radius of the nearest POW camp to those in parishes outside that radius. The approach relies on the assumption that parishes within the 40-kilometer radius that received prisoners (the treatment group) and parishes outside the radius that did not (the control group) would have evolved similarly in the absence of the POW employment program. Consistent with this assumption, we find no significant differences between treatment and control parishes in pre-war agricultural production or productivity trends, nor in wartime labor shortages, as proxied by enlistment counts.

In the first part of our analysis, we examine the effects of POW labor on agricultural output and productivity, measured as output per worker. If prisoners had merely contributed to production without leaving a more lasting impact, any effects would be expected to disappear once they were repatriated after the war. While we observe a sharp increase in production when POW employment was at its peak, productivity remains higher in parishes that hosted prisoners years after their departure. Specifically, we estimate that production rose by approximately 27% in treatment relative to the mean of control parishes in 1944–45, before declining in 1946–47 and 1950–51 after the prisoners left Australia. In contrast, productivity increased by approximately 40% during POW employment and remained 18% higher than the control mean in treated parishes in 1950–51.

These persistent productivity gains raise the question of which changes in production choices generated them. In the second part of the analysis, we investigate two broad sets of mechanisms: a shift toward more productive crops and greater use of productivity-enhancing technologies. For each mechanism, we first examine whether it was induced by the POW employment program and then investigate whether the resulting effects were driven by prisoners' origin-specific knowledge.

Turning first to the shift toward more productive crops, we find that POW labor led treated parishes to expand potato production, which was better suited to local soils, and reduce maize production, which was relatively less suitable. This reallocation toward a more productive crop was concentrated near camps that held larger numbers of prisoners from Italian provinces in which potatoes or maize were the most widely produced crops before the war. We find similar evidence for technology use. The number of tractors, the most productivity-enhancing technology available at the time, increased significantly in parishes eligible to employ prisoners relative to ineligible parishes. This increase was concentrated in parishes that received prisoners from Italian provinces where tractors were more widely used before the war. Across both mechanisms, these origin-driven effects were larger in parishes with greater scope for productivity improvements, as reflected in lower ex-ante productivity and a greater mismatch between suitable and cultivated crops. The effects were also greater

in areas exposed to POWs from Italian provinces with higher literacy rates, consistent with the hypothesis that greater human capital facilitated knowledge transfer.

We investigate alternative mechanisms but find little empirical support for them. First, we find no significant relationship between pre-war parish productivity and the quantity or composition—in terms of prior farming experience—of POW labor allocated to a parish. We also find no significant correlation between crop production or tractor use in prisoners' Italian provinces of origin and corresponding measures in their destination parishes in Victoria. Taken together, these results indicate that selective prisoner allocation across eligible parishes was not a major driver of our findings. Finally, we show that the differential effects associated with prisoners' origin-specific knowledge are robust to North–South differences in relevant crop production and tractor use, as well as differences in literacy rates and population across Italian provinces. This suggests that underlying regional differences in Italy are unlikely to play a major role in our setting.

Our findings have several implications for the design of modern development policy. First, exposure to workers from regions with different production practices catalyzed enduring improvements, suggesting the importance of leveraging skill diversity when designing migration programs. Second, productivity gains are more likely to persist when paired with appropriate capital investments. Third, peer learning may play an important role in supporting productivity improvements. Policies that promote horizontal knowledge diffusion may, therefore, serve as effective tools to increase productivity.

This paper contributes to the literature on worker mobility, knowledge diffusion, and productivity (e.g., Hornung, 2014; Moser et al., 2014; Bazzi et al., 2016; Giorcelli, 2019) by showing that temporary inflows of workers can generate persistent productivity gains through the transfer of productive knowledge, even when standard labor-market adjustment channels are limited or absent. Importantly, we show that the productivity gains associated with knowledge transfer can outlast the workers who generate them. Our setting allows us to distinguish knowledge transfer from labor-supply effects because prisoner employment was assigned independently of prisoners' knowledge, it was tightly regulated in ways that limited labor-market price adjustments, and because all POW workers left employment regions within a few months after the end of the war.

We also contribute to the limited literature on prisoners of war. Existing studies focus primarily on the consequences of wartime imprisonment for prisoners and their families (e.g., Costa and Kahn, 2007; Costa et al., 2018). Historical accounts of POW labor, however, emphasize its importance for wartime economies but rely largely on qualitative or descriptive evidence (e.g., see Moore, 1997; Davis, 1977; Custodis, 2012 for WWII). We provide quantitative and causal evidence of the effects of POW employment on local economies in

the detaining country, both during prisoners' employment and after their repatriation, and document the underlying mechanisms.[2]

As in much of the literature on the effects of forced migration (see Becker and Ferrara, 2019 for a review), we study a forced labor-supply shock and its consequences for the local economy. Unlike most studies in this literature, however, we focus on a temporary labor-supply shock, which allows us to abstract from the longer-run dynamics induced by permanent migration.[3] Relative to the limited literature on temporary migration episodes (e.g., Dustmann et al., 2017; Labanca, 2020) and the related literature on labor-supply reductions driven by out-migration (e.g., Hornbeck and Naidu, 2014; Clemens et al., 2018; Lee et al., 2022; Lin and Peri, 2025), our setting features heavily regulated employment conditions. In particular, prisoners' wages and hours were set by the government to match those of local workers. These features effectively limit, if not eliminate entirely, the labor market competition between incoming and incumbent workers that is central to much of the migration literature. By largely abstracting from these labor market adjustments and related effects, we uncover positive productivity effects of worker mobility that persist following prisoners' repatriation, suggesting that knowledge transfer can mitigate the adverse effects (e.g., Lin and Peri, 2025) or reinforce the positive effects (e.g., Hornbeck and Naidu, 2014) associated with out-migration observed when labor markets can adjust.

The remainder of the paper is organized as follows. Section 2 provides the historical background and describes the prisoner employment program. Section 3 introduces the data, while Section 4 outlines the empirical strategy. Section 5 presents the main results, and Section 6 explores the underlying mechanisms. Section 7 presents a series of robustness checks on both the main results and the proposed mechanisms. Finally, Section 8 concludes.

[2]Related studies of civilian internment primarily investigate the consequences of internment for internees and their families (e.g., Chin, 2005; Arellano-Bover, 2022). In these settings, internment removed from the labor market workers who were already embedded in the local economy and production practices. In contrast, we study the inflow and subsequent withdrawal of newly arrived foreign workers, allowing us to examine the productivity effects of their origin-specific knowledge. Moreover, in our setting, civilian internees were barred from working on civilian farms on security grounds and therefore, as shown in Section 7, played no role in the effects or mechanisms that we study. Our findings also relate to work on coerced labor (e.g., Fogel and Engerman, 1977; Nunn and Wantchekon, 2011; Beckert, 2014; Nunn, 2017; Naidu, 2020; Hornbeck and Logan, 2023; Bleakley and Rhode, 2024), although important institutional differences limit direct comparisons. In our setting, wages and hours were government regulated, and working conditions were comparable to those of local workers. In these respects, POW employment was closer to standard employment than to the forms of coerced labor typically studied in the literature, potentially facilitating knowledge transfer and productivity gains.

[3]In the Australian context, for instance, a literature documents the persistent cultural and socioeconomic consequences of the forced transportation and subsequent settlement of British convicts during the eighteenth and nineteenth centuries (e.g., Grosjean and Khattar, 2019). Because all POWs in our setting were repatriated, we can abstract from the demographic and intergenerational dynamics associated with permanent settlement and examine the role of knowledge transfer in generating persistent productivity gains.

2 The Employment of Italian Prisoners of War in Australia during WWII

This section describes the historical and institutional setting that led to the employment of Italian POWs on civilian farms in Australia during WWII.

2.1 Italian Prisoners of War in Australia

On June 10, 1940, despite opposition from the Foreign Minister and his military leaders, dictator Benito Mussolini took Italy into the Second World War on the side of the Axis powers and against the Allied forces. Italian troops, however, were largely unprepared for the war: soldiers were poorly equipped and had little or no military experience. Many were employed in agriculture before the war. These factors contributed to the rapid collapse of Italian forces in several theaters of operation. Between December 1940 and May 1941 alone, approximately 140,000 Italian soldiers were captured or surrendered to Allied forces (Long, 1952; Playfair et al., 1954). By September 1943, when Italy signed the Armistice of Cassibile with the Allies, the number of Italian POWs had reached 591,000 (Ministero della Guerra, 1947).

The growing number of prisoners rapidly became a logistical and administrative concern for the Allies. The 1929 Geneva Convention provided a legal framework to address the problem by recognizing the British Empire as a single legal entity, thereby allowing prisoners to be relocated across British territories, including Australia. Relying on this provision, in March 1941, the British War Office submitted a request to Australian authorities for assistance in urgently relocating POWs. On April 30, 1941, the Australian War Cabinet approved the request, while insisting that only a small number of Germans would be included. Behind this request was the "well-entrenched stereotype that Italian POWs were docile, less demanding than their more ideologically driven German allies and either possessed simple tastes or had lower expectations while in captivity" (Moore and Fedorowich, 2002, p. 76). As a result, out of the 25,727 POWs held in Australia between 1941 and 1947, 18,432 (71%) were Italian, compared with 1,658 Germans and 5,637 Japanese who were captured after Japan entered the war in late 1941.[4] The great majority (95%) of Italian POWs held in Australia had been captured in North or East Africa during the early stages of the conflict.

[4]NAA, Series Number A7711/1, p. 106.

2.2 The Prisoner-of-War Employment Program

The Start of the Program. The Geneva Convention permitted the employment of prisoners in non-military activities. However, security concerns in 1941 and 1942 led Australian authorities to restrict prisoner labor to within camp boundaries. Some camps were located at pre-existing military sites, many originally built during the First World War. As prisoner numbers increased, additional camps were established. Their locations were chosen primarily for security reasons, favoring inland areas far from the coast, but also for practical considerations such as access to water, electricity, sewage infrastructure, and existing structures that could be quickly adapted for camp use (Moore and Fedorowich, 2002).

By the end of 1942, the labor shortage caused by the enlistment of Australian citizens and the increased demand for food from Allied troops fighting in the Pacific led to growing pressure to allow prisoner labor outside camps, particularly in agriculture. In response, in May 1943, the Australian War Cabinet launched the prisoner-of-war employment program. The program permitted prisoners to work on civilian premises located outside POW camps subject to specified conditions. In the next section, we describe these conditions in detail, as they are central to our empirical approach (Moore and Fedorowich, 2002; Fitzgerald, 1981).

Conditions of POW Employment. The program formally allowed POWs to be employed in agriculture and on national works, such as infrastructure projects. In practice, however, POW employment on civilian premises was restricted to agriculture. This motivates our focus on agricultural production and productivity as the main outcomes of the analysis.

Among agricultural employers, the key condition governing access to POW labor was proximity to the nearest prisoner camp. For security reasons, in fact, POW employment on civilian farms was permitted only within a 40-kilometer (25-mile) radius of an army-administered prisoner control camp (NAA, Series Number A7711/1, p. 226; Fitzgerald, 1981, p. 33).[5] This rule was a core feature of the program and is central to our empirical strategy.

Prisoners also had to be carefully screened to ensure they posed no security risk. In practice, this meant that nearly all prisoners selected for unguarded work outside camps were Italians, as Germans and Japanese were considered greater security risks. For similar security reasons, Italian internees were also not authorized to work outside internment camps. Authorities were concerned that their pre-existing connections to Australia could make employment in the community a security risk. These features motivate our focus on

[5]This feature distinguishes our setting from other settings studied in the POW literature. For example, POW employment by German coal mines during WWI was voluntary (Jopp, 2021), making causal identification challenging.

Italian POWs for the analysis.[6]

To address concerns raised by local unions, the government tightly regulated POW working hours and pay rates to minimize competition with local workers. In particular, POW working hours had to correspond to those ordinarily worked in the relevant industry, which in agriculture typically meant a six-day workweek. With respect to pay rates, employers were required to pay the standard award rate, that is, the rate established by the relevant collective labor agreement.[7] These conditions mirrored those applying to most agricultural workers at the time, effectively eliminating incentives for local farmers to employ prisoners over incumbent workers.[8] The fact that working hours and wage rates matched those of local workers, with both set by the government rather than determined in the labor market, makes our setting well suited to isolating the effects of labor mobility on productivity from labor market price adjustments.

Payments made by employers were collected by the government and used in large part to cover expenses associated with POW detention and employment. Although prisoners received only a small allowance,[9] historical accounts suggest that access to farm employment was valuable to prisoners in its own right. This is because farm work offered greater autonomy and time outside POW camps, often without guards and, in some cases, while living with their employers (Fitzgerald, 1981, Chs. 8–9). Poor work or misconduct could result in exclusion from farm employment, providing an incentive to exert effort.

Within these general employment conditions, POW work closely resembled regular agricultural employment and thus differed from conditions typically associated with coerced labor. In letters to their families in Italy, POWs generally described their employment positively, often noting that they were treated "as a member of the family" rather than as prisoners (Fitzgerald, 1981, Ch. 9). Farmers also widely regarded the program as a success, consistent with the sharp rise in POW employment, which reached 13,000 in March 1945,

[6] As a robustness check, we exclude camps that also held internees and obtain similar results (see Section 7 for details).

[7] Where no award rate existed, employers were required to pay £1 (Australian) per week, plus keep. Any departure from these rules had to be justified and negotiated directly with the Department of Labour and National Service. Such departures most commonly applied when prisoners could not perform at the level of a fully capable worker or when employers faced severe financial difficulties.

[8] The program included other conditions surrounding the treatment of prisoners that are, however, not directly relevant for our empirical strategy. These were broadly aimed at avoiding congregations of prisoners. First, no more than three prisoners could be assigned to a single farm. Second, on Sundays, prisoners were allowed to move freely up to 1.6 kilometers from the farm, provided they wore POW clothing, but they were not permitted to enter any village, town, shop, or house (NAA, MP729/6, item 6/3/401/666, "Report of inter-departmental conference chaired by McCahon", 12 Feb. 1943; NAA CRS A1308/1, item 712/1/11, "War Cabinet Agendum no. 118/1943", 14 March 1943).

[9] Historical records and accounts describe prisoners as receiving keep and a small allowance, typically 15 pence per day, which was considerably lower than the award rate for agricultural work (Department of Veterans' Affairs, 2025; Hyles, 2024).

equivalent to 84% of all Italian prisoners held at the time (NAA, Series Number A7711/1). Overall, about 14,000 Italian POWs worked during the war, virtually all those deemed eligible for outside employment, substantially increasing local labor supply in affected areas (see Section 3.4 for specific figures).

According to Fitzgerald (1981), the program's success stemmed from "the fair treatment of prisoners by the majority of employers and the willingness of Italians to work hard" (p. 93). Numerous accounts point to positive relationships between Australian farmers and Italian POWs. Farmers commonly described the Italians as "trustworthy and hard-working men" as well as "cheerful" and "well-behaved" (Fitzgerald, 1981, Ch. 8). Consistent with these generally positive working conditions and with the hypothesis that POW employment may have facilitated an exchange of knowledge, historical accounts contain examples of prisoners' agricultural knowledge contributing to changes in local farming practices.[10]

The End of the Program. The repatriation of Italian prisoners had been debated since Italy's surrender in September 1943. However, it was not seriously considered until early 1945, when the liberation of northern Italy, the part still under Nazi control, was in sight. In November 1945, at a meeting of the Allied Control Commission, it was agreed that Italians held outside Italy should be repatriated. As a result, Italian POWs in Australia were gradually withdrawn from farms, a process completed by May 1946, effectively ending the prisoner employment program. Due to a shortage of suitable ships, repatriation began only in late 1946 and was completed by 1947.

The temporary nature of the program is central to our approach. It provides an unusually clean setting to study whether effects induced by the employment of foreign labor persist after the workers who generated them have left. Unlike in most other episodes of labor mobility, all foreign workers in our setting left Australia after the end of the program.

3 Data

We combine several new datasets collected and digitized from primary sources. First, we use newly digitized individual-level records of Italian POWs detained in Australia during WWII. Second, we draw on newly digitized data from the Australian Agricultural Census to construct parish-level measures of agricultural production, productivity, labor, and capital use. We complement these data with parish-level information on soil suitability, the geographic locations of parishes and POW camps, and WWII enlistment in Australia. Finally,

[10]For instance, two Tuscan POWs employed in South Australia introduced the Italian practice of reusing manure and dairy washings as fertilizer, which, according to Fitzgerald (1981), became "in force in most Australian dairies" (p. 95). See Appendix B for details and further anecdotes.

we digitize pre-war census data on agricultural production in Italy. In what follows, we describe each data source separately and then present descriptive statistics on the prisoners and their areas of origin and destination.

3.1 Italian Prisoners of War Records

We collected and digitized individual military records for Italian POWs detained in Australia during WWII from the Australian National Archives (NAA).

For the vast majority of prisoners, these records consist of two files. The first file (NAA Series MP1103/1) contains the *Service and Casualty Form*, which provides detailed demographic information, including occupation prior to the war, and records of capture, detention and camp assignments, which allow us to identify which POWs were present in each camp. The second file (NAA Series MP1103/2) includes the *Report on Prisoner of War*, which reports, among other information, the POW's pre-war address. This allows us to identify the province of origin in Italy for approximately 87% of prisoners in our sample. The resulting dataset includes 18,411 Italian POWs, covering nearly the entire universe of the 18,432 Italian POWs held in Australia during WWII according to official government statistics (NAA Series A7711/1, p. 106) and secondary sources (Fitzgerald, 1981, p. 172; Moore and Fedorowich, 2002, p. 72). We refer to Appendix C.1 for a detailed description of the two forms.

3.2 Agricultural and Related Data in Victoria

We compile data on agricultural inputs and outputs from the *Agricultural, Dairying, and Pastoral Statistics* for the state of Victoria, creating the first digitized version of an Australian agricultural census. Victoria is the only state for which geographic units of observation in the agricultural census can be consistently tracked before and after the war. It ranked second among Australian states in both the share of POWs held (38.5%, only slightly below New South Wales at 39.5%; see Appendix Figure A.1) and the share of cultivated land before the war (21.4%).

Our analysis covers the census years 1935–36, 1939–40, 1944–45, 1946–47, and 1950–51, for which complete volumes are available for all counties in Victoria. We use records at the parish level, the most geographically disaggregated unit that can be traced over time. We geolocate each parish using coordinates obtained from the National Library of Australia's Map Search database.[11]

[11]The database is available at: https://mapsearch.nla.gov.au/.

The *Agricultural, Dairying, and Pastoral Statistics* provide rich information on agricultural production. Relevant for our analysis, they report output for major crops—predominantly cereals—as well as key inputs, including the number of agricultural workers in all years and the number of tractors used in production in all years except 1944–45. In 1944–45 only, coinciding with the peak of prisoner employment, the census also records the number of prisoners of war employed in each parish. We measure productivity for each crop, or group of crops, as the ratio of output to the number of workers employed.[12] For crops for which output is not directly available, we use the area cultivated under that crop as a proxy for output. This measure can be constructed consistently across crops and years throughout the sample period. Table 1 presents descriptive statistics for all agricultural census variables used in the analysis, while Appendix C.2 provides a more detailed description of the data, including their collection and construction.

Prisoner-of-War Facilities. To distinguish between parishes that could and could not employ prisoners under the rules of the POW employment program, we first obtained from Fitzgerald (1981) the complete list of the 45 POW detention camps located within 40 kilometers of at least one Victorian parish. This includes a small number of camps located just outside Victoria. We then geolocated each camp and combined this information with parish locations to identify the nearest camp to each parish and calculate the corresponding distance. Appendix Figure A.2 maps the locations of prisoner camps (blue stars) and the parishes that reported employing at least one prisoner in the 1944–45 agricultural census (19% of all parishes; red dots). Camps were spread throughout the state, with the main uncovered areas largely corresponding to mountainous regions.

For the analysis of mechanisms, we link the camps recorded in prisoners' *Service and Casualty Forms* to the list of 45 camps described above. We assign each prisoner to the camp in which they spent the most time in each year. We then construct the camp-level measures of expertise in specific crops or technologies described in Section 6, using all prisoners for whom a given camp was the primary camp in at least one year. Appendix C.5 provides further details on the matching and assignment procedures.

Crop Suitability: GAEZ Data. To identify the crops most suitable to local soil, we assembled a parish-level dataset containing information on crop suitability for the major crops produced in Victoria. Specifically, using the Global Agro-Ecological Zones (GAEZ) database, we extracted pixel-level data on crop suitability across Victoria for various crop

[12]The censuses do not report comprehensive information on farm capital or intermediate inputs that would allow us to construct measures of productivity, such as TFP, that are most often used in nonhistorical settings.

types. We then aggregated this information to the parish level by averaging crop suitability within a 15-kilometer radius around each parish centroid (see Appendix C.4 for more details).[13]

Enlistment Data. To measure the extent to which each parish experienced war-induced labor shortages, we collected Australian WWII enlistment data from the Department of Veterans' Affairs. Using enlisted individuals' place of residence, we construct a measure of WWII enlistment at the Statistical Area Level 2 (SA2), the most geographically disaggregated level available. We then match SA2-level enlistment figures to the agricultural parish-level data based on the shire associated with each parish in the agricultural censuses (see Appendix C.3 for additional details).

3.3 Historical Agricultural Records from Italy

We combine the above datasets with two additional sources of data from Italy. First, we digitize the 1930 Italian Agricultural Census from the historical archive of the Italian Statistical Office (ISTAT). This is the last agricultural census available before the war. We extract the top crop cultivated in each province, along with the corresponding output levels. We then match this information to individual prisoner records based on province of residence.

Following the same approach, we link prisoner records to province-level data on tractor use from the 1938 Census of Agricultural Machinery, the last pre-war census containing detailed information on agricultural machinery, sourced from Bianchi and Giorcelli (2023). Finally, we complement these data with province-level population aged over five years and literacy rates, the only available measure of education, from the 1931 Italian Population Census–the last pre-war census to collect information on literacy– sourced from Bianchi and Giorcelli (2023).

3.4 From Italian to Australian Farms: POW Characteristics, Origins, and Employment

Many of the Italian prisoners held in Australia were already familiar with farm work. Panel (a) of Table 1 presents descriptive statistics for these prisoners. On average, they were in their late twenties when they arrived in Australia; about 60% were unmarried, and almost all had been captured by the end of 1941, consistent with the large number of Italian troops captured early in the conflict. Approximately half reported having worked in agriculture before the war, making it by far the most common pre-war occupation among Italian

[13]Unreported results based on 5- and 10-kilometer radii are similar.

POWs (see also Appendix Figure A.3). This suggests that many prisoners likely had farming knowledge that could have been useful to their employment on Australian farms.[14]

This farming knowledge was also diverse. POWs originated from nearly every Italian province (see Appendix Figure A.4), spanning areas that differed substantially in agricultural production and expertise (Bianchi and Giorcelli, 2023). Consistent with Italian military deployment patterns, a larger share of POWs came from central and southern Italy. Specifically, several divisions deployed to North and East Africa, where many of the Italian POWs later held in Australia were captured (see Section 2), drew their soldiers from southern regimental depots, while alpine troops recruited primarily in northern Italy formed a large share of the forces sent to the Eastern Front (Rochat, 2005; Montanari, 1985).

Through prisoners' allocation to camps and their subsequent employment, this varied expertise was distributed across Victoria. Panel (a) of Figure 1 shows that the share of prisoners previously employed in agriculture varied considerably across camps, ranging from roughly 4% to 85%. Panel (b) further shows that prisoners' agricultural backgrounds differed in the crops to which they had likely been exposed. It classifies prisoners according to the main crop produced in their province of origin, defined as the crop that ranked first in terms of production in 1930. The composition of prisoners by crop exposure varied substantially both across and within camps. Similarly, Panel (c) shows sizable variation across camps in the average number of tractors used in prisoners' provinces of origin, pointing to heterogeneity in their exposure to relevant agricultural technologies. Panel (d) reports the distribution of prisoners within each camp by their Italian macro-region of origin. Most camps housed prisoners from all macro-regions,[15] providing little evidence of clustering and further emphasizing the diversity of prisoners' backgrounds across camps. Taken together, these figures suggest that the employment of Italian POWs brought Australian farms not only additional labor, but also workers with varied agricultural expertise.

This expertise entered an agricultural economy with scope for productivity improvements. Average agricultural productivity, measured as output per hectare across the five most widely cultivated crops in Italy, was nearly three times higher in Italy than in Australia prior to the war (5.915 versus 2.033). Similarly, in 1938, Italian provinces had substantially more tractors per unit of agricultural land than Australia (0.142 versus 0.0117 tractors per 100 hectares).[16]

[14] Table 1 reports statistics for the entire sample of Italian prisoners for whom data are available. Appendix Table A.1 compares the characteristics of prisoners held in Victoria with those held in other states, showing the two groups to be remarkably similar.

[15] The only exceptions were small camps, such as Camps 44 and 45, each of which hosted at most three prisoners.

[16] The five most widely cultivated crops in Italy in 1930 were wheat, maize, potatoes, beets, and grapes. Data on the overall production in Australia of the five main Italian crops in 1930 are from the *Commonwealth Bureau of Census and Statistics, Official Year Book No. 25 (1932), Chapter XX, p. 627.* Data on tractors

Taken together, these comparisons suggest that prisoners' origin-specific knowledge had the potential to improve agricultural productivity in Australia.

How this knowledge was distributed across Victorian farms was shaped by the security-driven rules governing the prisoner employment program. Panel (a) of Figure 2 displays the cumulative distribution of POW employment in 1944–45 as a function of the distance between each parish and the nearest camp. Consistent with the program's rules, approximately 95% of prisoners were employed within 40 kilometers of the nearest camp. Panel (b) of Figure 2 further documents this pattern. The number of prisoners was highest in parishes located 10 to 20 kilometers from the nearest POW camp and declined substantially as distance approached the 40-kilometer threshold, falling to nearly zero beyond 50 kilometers. The small number of prisoners observed beyond 40 kilometers may reflect measurement error arising from our use of parish and camp centroids, a potential issue that we take into account in the design of the empirical strategy in Section 4.

The resulting increase in labor supply in areas employing prisoners was economically meaningful. At the peak of the employment program in 1944–45, prisoners of war accounted for approximately 12% of the pre-war workforce in parishes that employed at least one prisoner (see Panel (b) of Table 1), an increase comparable to other well-known labor supply shocks (e.g., 7% in Card, 1990, 10% in Dustmann et al., 2017).

4 Empirical Strategy

Our empirical strategy employs a difference-in-differences (DiD) approach that compares outcomes in parishes eligible to employ prisoners with those in ineligible parishes. Our static specification takes the following form:

$$y_{pt} = \alpha_p + \lambda_{r(p)t} + \gamma \, \text{POW Eligible}_p \times Post_t + \varepsilon_{pt}, \tag{1}$$

where y_{pt} denotes the agricultural outcome of parish p measured in year t. The variable POW Eligible_p equals 1 if parish p is located within 40 kilometers of the nearest POW camp, and 0 if it is more than 60 kilometers away, while $Post_t$ takes the value 1 in years after 1943 and 0 otherwise. We include parish fixed effects (α_p) and region-by-year fixed effects ($\lambda_{r(p)t}$) to control for parish-specific characteristics that are constant over time, and

per hectare in Australia in 1938 are from *Commonwealth Tractor Statistics* and *Commonwealth Crop Statistics*. To ensure comparability, we use data for Australia as a whole because comparable data on crop output and tractor use for Victoria, the focus of our analysis, are not available for 1930 and 1938, respectively, the years for which corresponding data are available for Italy. We refer to Appendix Section C.2 for more details about these comparisons.

for differences across Victoria's regions that may vary over time.[17]

Our main outcome variables of interest are agricultural output and productivity, measured as output per worker. Our choice of the treatment group is motivated by the features of the prisoner employment program in Australia, which allowed prisoners to work only within a 40-kilometer radius of the nearest camp. The choice of the control group is guided by two main considerations. First, the probability of employing at least one prisoner in 1944–45 is close to zero (1.6 percent) for parishes located more than 60 kilometers from the nearest camp, making it unlikely that these parishes were affected by the program. This probability is higher (10 percent) for parishes located between 40 and 60 kilometers, possibly due to measurement error in the recorded distances from the main camps, as discussed in earlier sections. Second, even abstracting from measurement error, parishes farther from the 40-kilometer threshold are less likely to be indirectly affected by prisoner employment through spillovers from treated parishes. In a robustness check, we vary the minimum distance required for a parish to be included in the control group and obtain similar results across alternative control groups (see Section 7).

The coefficient of interest in equation (1), γ, captures the average change in outcome (y) following the introduction of the prisoner employment program in parishes eligible to employ POW labor, relative to the corresponding change in ineligible parishes.

To shed light on the evolution of the effects over time, we also estimate a dynamic (event-study) version of the above difference-in-differences specification:

$$y_{pt} = \alpha_p + \lambda_{r(p)t} + \sum_{\tau \neq 1939} \beta_\tau \, \text{POW Eligible}_p \times \mathbf{1}\{t = \tau\} + \upsilon_{pt}. \tag{2}$$

In this specification, the coefficient β_τ captures the difference in outcomes between treatment and control parishes in each year t, relative to the corresponding difference in the last year of data before POW employment, 1939–40, conditional on parish (α_p) and region-by-year ($\lambda_{r(p)t}$) fixed effects. Coefficients for pre-treatment years provide evidence about differential pre-trends, while post-treatment coefficients trace the evolution of the estimated treatment effect over time.

Examining the dynamics of the effects is particularly important in our setting. Effects driven solely by the temporary increase in labor supply should dissipate once all prisoners were repatriated in 1946–47. By contrast, if POW employment changed production choices, for instance through the transmission of agricultural knowledge, productivity gains could persist after POW labor was no longer available. Analyzing these dynamics therefore allows

[17] Following the standard classification, we consider the following five regions: *Melbourne Metropolitan Area, Western Victoria, Northwestern Victoria, Eastern Victoria, Northeastern Victoria.*

us to investigate whether the productivity effects outlasted the labor-supply shock.[18]

4.1 Assessing the Identification Assumptions

Causal identification in these DiD specifications requires that, in the absence of the prisoner employment program, parishes eligible and ineligible to employ prisoners would have followed similar trends in agricultural output and productivity. We assess these assumptions using complementary pieces of evidence.

Parallel Trends. Following standard practice in the DiD literature, we test for differential trends in POW-eligible (treatment) and POW-ineligible (control) parishes in the years preceding the employment of Italian prisoners. Specifically, Panel (a) of Table 2 presents estimates obtained from equation (2) restricting the analysis to pre-POW employment years and using our main measures of agricultural production and productivity as outcomes. Columns 1 and 2 focus on grain production and productivity, while columns 3 and 4 consider broader measures that include all crops for which production is recorded. Reassuringly, we find no evidence of significant or economically sizable pre-trends in agricultural output or productivity. Figure 3 provides a graphical presentation of these tests.

In Section 7, we conduct two additional exercises, motivated by recent developments in the DiD literature, to assess the sensitivity of our results to violations of the parallel-trends assumption. First, we examine whether the absence of detectable pre-trends in our baseline estimates could reflect limited statistical power. Second, we conduct a sensitivity analysis allowing for potential violations of parallel trends. Our main results remain robust in both exercises.

Wartime Enlistment and Labor Shortages. A potential threat to identification specific to our setting is that camp locations, and therefore the surrounding parishes, may have been selected for prisoner employment based on the severity of the labor shortages they experienced during the war. Such shortages could have placed treated parishes on different trajectories from control parishes even before prisoners were employed. To assess this possibility, in Panel (b) of Table 2 we regress enlistment numbers, which we use as a proxy for the severity of parish-level labor shortages, on an indicator for whether the parish was

[18] An alternative to the difference-in-differences approach described so far would be to use a spatial regression discontinuity design (RDD). This approach is not best suited for our setting for multiple reasons. First, our distance measure is potentially subject to measurement error, making a sharp RDD around the 40-kilometer cutoff unreliable. Second, even abstracting from measurement issues, spillovers across parishes above the employment cutoff could bias the estimated effects. Third, relatively few parishes are located near the cutoff, which would likely result in imprecise estimates that could be sensitive to bandwidth selection.

eligible to receive POW labor (below 40 kilometers) or not (above 60 kilometers). Column 1 includes no controls, while column 2 adds available parish-level controls to partially account for the characteristics absorbed by parish fixed effects in our main DiD specifications. Reassuringly, we do not find significant differences in enlistment between the treatment and control parishes.

Additional Supporting Evidence. Another concern, particularly relevant for the mechanism analysis in Section 6, is that prisoners, especially those with relevant farming skills, may have been selectively allocated among eligible parishes, for instance to those with higher productivity. Provided that parallel trends hold between eligible and ineligible parishes, this would not violate our identifying assumptions but it would affect the interpretation of our findings. In Section 6, we investigate this potential mechanism in detail and find no evidence of selective prisoner allocation.

Finally, even if parishes were not selectively targeted for the prisoner employment program, farms may have been established closer to POW camps in anticipation of, or in response to, the availability of prisoner labor. Although the agricultural census data do not identify individual farms, we can test whether the number of census entries within a parish, which likely correspond to individual farms or groups of farms, changed differentially in treated relative to control parishes before and after the introduction of the prisoner employment program.[19] Appendix Figure A.5 shows no evidence of differential trends in the number of entries across the two groups.

5 Results: POW Employment, Agricultural Output, and Productivity

Table 3 presents DiD estimates of the effects of POW employment on agricultural output and productivity. Panel (a) reports the effects obtained from the static DiD specification in equation (1), while Panel (b) traces the dynamics of these effects using equation (2). In columns 1 and 2, we focus on all grains available in the data: wheat, oats, barley, and rye. Together, these grains accounted for the largest share of pre-war crop production (84%) in Australia. In columns 3 and 4, we broaden the measure to include all crops whose output is either reported in tons or can be converted to tons using additional conversion assumptions (see Appendix C.2 for details).

[19] Census entries do not have a time-consistent identifier and therefore cannot be tracked over time, see Appendix C.2 for details.

Turning first to the static, overall effects, Panel (a) shows a significant increase in productivity (output per worker) following the introduction of the prisoner employment program in parishes eligible to employ prisoners relative to ineligible parishes (columns 2 and 4). The effect is economically sizable, amounting to approximately 20% of average productivity in the control group, and is of similar magnitude whether we restrict the analysis to grains (column 2) or consider the broader set of crops (column 4). By contrast, we find no significant overall effects on output in columns 1 and 3.

This absence of an average output effect, however, masks substantial variation over time. The estimates in Panel (b), also shown graphically in Figure 3, uncover these dynamics. In 1944–45, when prisoners were still in Australia and their employment was at its peak, both output and productivity increased substantially in parishes eligible to employ prisoners relative to ineligible parishes. Using our broader measure of agricultural production, we estimate that output increased by approximately 27% relative to the average in control parishes (column 3), while productivity increased by approximately 40% (column 4).

After 1944–45, output declined following prisoner repatriation in parishes that had benefited from prisoner labor and gradually returned toward pre-war levels. Productivity, by contrast, exhibits greater persistence. Although the estimated effect becomes smaller and statistically insignificant immediately after repatriation, productivity gains remain positive and increase again by 1950–51, four years after prisoners were withdrawn from farms. By 1950–51, we estimate that productivity remained approximately 18% higher in parishes eligible to employ prisoners relative to the average in ineligible parishes (column 4). We obtain the same qualitative pattern, with very similar magnitudes, when restricting the analysis to grains (columns 1 and 2).

Appendix Table A.2 replicates the analysis in Table 3 using revenue-based measures rather than physical output. We construct these measures by multiplying crop output by 1939 prices for wheat, oats and barley, the crops for which price information is available (see Appendix C.2 for details). Revenue-based measures of production and productivity are closer to those commonly available, and therefore used, in the literature (see De Loecker and Syverson, 2021 for a review). At the same time, they provide a common value-based metric for aggregating output across heterogeneous agricultural products, accounting for differences in their relative economic value. Using these alternative measures, we obtain qualitatively similar results and effects of comparable magnitude. Overall, we estimate revenue-based productivity to be approximately 23% higher in treated parishes relative to the average in control parishes as a result of prisoner employment (see column 4).

In Section 7 we perform several robustness checks on the findings of this section. These include, for instance, selecting alternative control groups based on distance from the nearest

POW camp and assessing whether limited statistical power could account for the estimated effects. Across these exercises, the results remain robust.

Taken together, the findings of this section indicate that the temporary inflow of foreign labor induced by the POW employment program generated productivity gains that persisted and remained economically sizable years after Italian prisoners had left Australia.

6 Mechanisms: The Transfer of Origin-Specific Knowledge

The results from the previous section leave open the question of what factors may explain the persistence of productivity gains. In what follows, we explore two main mechanisms: a shift toward more productive crops and the use of productivity-enhancing technologies. For each mechanism, we first examine whether it was causally induced by the prisoner employment program. We then investigate whether the effects are driven by relevant knowledge that prisoners brought from their regions of origin. Building on the results of this analysis, in the final part of the section we explore in which settings knowledge was most effective in enhancing productivity, the factors that facilitated the transfer of productivity-enhancing knowledge and, finally, discuss alternative mechanisms.

6.1 Knowledge Transfer and Productive Crops

One potential channel through which POW labor might have enhanced productivity is a shift in the composition of agricultural output toward more productive crops. If such a shift was driven by prisoners' expertise, we would expect it to have occurred in crops with which prisoners were relatively more familiar. To investigate this hypothesis, we estimate the impact of prisoner employment on the cultivation of the five most widely produced crops in Italy prior to the war: wheat, maize, potatoes, grapes, and beet.

Panel (a) of Table 4 presents estimates from equation (1), using the cultivation of these crops as the outcomes of interest. Because the Victorian agricultural census does not report production quantities for all of the crops of interest for this analysis, we use the share of total cultivated area devoted to each crop within a parish as a proxy for production. This share-based measure is also well suited to capturing shifts in the composition of agricultural production across crops.

Table 4 shows a substantial increase in the share of area devoted to potato cultivation, which rose by approximately 70% relative to its pre-war mean. At the same time, the share

devoted to maize declined by approximately 50%. Beet cultivation also declined, although beet accounted for only 0.008% of total cultivated area before the war, implying that the aggregate impact of this shift was small. We find no significant effects on the cultivation of wheat or grapes.[20]

In order to investigate whether the shift from maize to potatoes documented in Panel (a) was productivity enhancing, Figure 4 compares the average area cultivated under each crop prior to the war with land suitability for each crop in treated parishes. If land use were already aligned with productivity potential, we would expect the ranking of crops by cultivated area to coincide with their ranking by suitability. A divergence between the two rankings indicates that some crops are relatively better suited to local soils but cultivated to a lesser extent, leaving scope for productivity-enhancing reallocation toward more suitable crops. In this analysis, we exclude grapes, for which no suitability index is available in the GAEZ data. The figure shows that wheat is both the most suitable and the most cultivated of the four crops considered. Moving down the ranking, potatoes are more suitable than maize, yet prior to the war a smaller area was cultivated with potatoes than with maize. In light of this, the shift from maize to potatoes induced by the prisoner program helped reduce the mismatch between land suitability and crop choice. A similar logic applies to the shift away from beet toward potatoes, although, as already noted, this change was of limited practical size.

The evidence so far indicates that prisoner employment led to a productivity-enhancing shift from less suitable crops (maize) to more suitable ones (potatoes). To investigate whether this shift was enabled by specific knowledge that prisoners brought with them, in Panel (b) of Table 4 we estimate effects separately for parishes eligible to employ prisoners that were more or less familiar with potatoes and maize. Specifically, we match each prisoner to his province of residence in Italy and, through this, to data on potato and maize production in that province in 1930. For each prisoner camp, we calculate the number of prisoners from provinces where potatoes or maize were the main crops produced prior to the war.[21] Using these measures, we classify camps as having above- or below-median levels of potato or maize expertise. Thus, we re-estimate the main effects distinguishing between parishes

[20] The absence of an effect on wheat may reflect the fact that it was already the most widely cultivated crop in Australia, arguably limiting the scope for prisoners to transmit useful knowledge related to its cultivation. Grapes, by contrast, were not yet widely cultivated in Victoria. However, establishing grape cultivation requires a relatively long-term investment (Strik, 2011), potentially limiting the scope for visible adjustments over the time horizon covered by our data.

[21] With the exception of wheat, the other crops included in the aggregate output measures examined in Section 5 were produced on a relatively limited scale in Italy and were never the leading crop in an Italian province. This leaves us with no variation in the measure of prisoners' exposure to these crops for the analysis.

whose nearest prisoner camp was above versus below the median in crop-specific expertise.

We find stronger effects in parishes with above-median numbers of prisoners with origin-specific expertise in potatoes or maize. For both crops, the effects in these parishes are substantially larger in magnitude than those in parishes with lower origin-specific expertise, suggesting that the transfer of relevant origin-specific knowledge played an important role in shaping the crop shift.

Appendix Figure A.6 shows estimates analogous to those in Panel (b) of Table 4, obtained from a dynamic DiD specification of the type described in equation (2). Reassuringly, the figure shows no evidence of significant pre-trends in the outcomes of interest, suggesting that differential trends between POW-eligible and POW-ineligible parishes are unlikely to drive the results presented in this section.

6.2 Knowledge Transfer and Productivity-Enhancing Technology

The evidence so far points to productivity effects from worker mobility through changes in the composition of output. In this section, we investigate whether worker mobility also induced productivity-enhancing changes in production inputs. In particular, we focus on the use of tractors, which at the time were the main productivity-enhancing technology available in agriculture (Olmstead and Rhode, 2001). Although tractors were already adopted in Victoria, with most (72% of) parishes having at least one tractor in 1939, the extent of their use varied across parishes, with 55% of parishes having more than one (see Table 1), leaving scope for further increases in their use along the intensive margin.[22]

Column (1) in Table 5 presents the estimated effect of the prisoner employment program on the number of tractors recorded in a parish, based on equation (1). The results show a significant and sizable effect of prisoner employment on tractor use. Across the post-repatriation years in our sample, we estimate that the number of tractors increased by approximately five units in treated parishes, corresponding to a 50% increase relative to the control-group average.[23] Appendix Figure A.7 presents analogous dynamic DiD (event-study) estimates from equation (2) and shows no evidence of differential pre-trends between treatment and control groups.

Was the effect of prisoner employment on tractor use induced by the transfer of relevant technological know-how that prisoners brought from their places of origin? Such a mechanism would be consistent with models in which technology use and worker-transmitted

[22] Similarly, disaggregated records within parishes, possibly corresponding to individual farms or groups of farms, indicate that 43% of entries reported no tractors in 1939.

[23] Data on tractors were not recorded in the 1944–45 Agricultural Census, and this year is therefore omitted from the analysis (see also Section 3).

know-how are complements, as documented in other settings (e.g., Giorcelli and Li, 2026). Alternatively, the observed increase in tractor use could reflect greater adoption of labor-saving technologies in response to the decline in available labor following the repatriation of prisoners (e.g., Acemoglu, 2010).

To distinguish between these hypotheses, we use detailed information from prisoner records matched to Italian agricultural census data. Specifically, we match each prisoner to his province of residence in Italy and, through this, to data on tractor use in that province prior to the war (1938). For each prisoner camp, we calculate the average number of tractors used before the war across the provinces of residence of the prisoners held in that camp. This measure serves as a proxy for prisoners' familiarity with the technology. Using it, we classify camps as having above- or below-median levels of tractor-related know-how and re-estimate the main effects, distinguishing between parishes whose nearest prisoner camp was above versus below the median in tractor-related know-how.

Columns 2 and 3 of Table 5 present the results of this analysis. Consistent with the hypothesis that prisoner know-how enabled technology use, we find that the number of tractors used in production increased significantly in parishes eligible to employ prisoners from Italian provinces where tractors were more widely used prior to the war. In contrast, we find neither statistically significant nor positive effects in parishes eligible to employ prisoners with below-median tractor-related know-how. The absence of effects in the latter group suggests that, in our setting, the increase in tractor use is unlikely to be explained by greater adoption of labor-saving technologies in response to the decline in labor supply from prisoners' repatriation.[24]

Taken together, the results of this section identify technology use as a second channel, alongside changes in crop choice, through which worker mobility, by transmitting knowledge, generated productivity-enhancing changes in Australian agriculture.

6.3 Where Knowledge Matters Most

Was origin-specific knowledge equally effective across production environments, or did its effect depend on existing production conditions? To investigate this question, in Table 6 we distinguish between parishes with above- versus below-median pre-war (1939) levels of labor productivity in Panel (a), labor intensity (measured as employment per area) in Panel (b), and capital intensity (measured as the number of tractors per area) in Panel (c). We focus

[24]The larger effects in areas with greater origin-specific know-how are also less consistent with additional investment in tractors made possible solely by the higher production and revenues induced by POW employment. This mechanism should, in fact, operate in all parishes that employed prisoners rather than only in those with greater technology-related know-how.

this analysis on high-expertise (above-median) parishes, for which the previous two sections document significant effects on crop mix and technology use. The estimated effects on both crop shifts and tractor use are larger in parishes with low ex-ante productivity, high labor intensity, and low capital intensity.[25] These results suggest that knowledge transfers were particularly important in settings with greater scope for productivity improvements.

We further investigate this hypothesis in Table 7 by examining whether the effects on crop shifts varied with the extent of the mismatch between the suitability and production of potatoes and maize in a given parish. To do so, we first construct standardized measures of crop suitability and pre-war (1939) production, measured as the share of area cultivated with each crop. We then measure the extent of mismatch between suitability and production in each parish as the absolute value of the difference between these standardized measures. In Panel (a), we distinguish between parishes with greater (above-median) versus lower (below-median) mismatch. Consistent with the findings above, the shift from maize to potatoes is larger in parishes with greater mismatch between what is suitable and what is cultivated.

The analysis in Panel (a) does not distinguish between cases in which crops are over- or under-cultivated relative to their suitability. If the observed crop shifts reflect productivity-enhancing knowledge transfer, however, we would expect potato cultivation to increase more where suitability is high relative to production and maize cultivation to decline more where production is high relative to suitability. Panel (b) explores this heterogeneity.

For potatoes, column 1 reports effects for parishes in which the difference between the standardized suitability and production indexes is positive, identifying areas where potatoes are relatively under-cultivated given their suitability. Column 2 reports effects for the remaining parishes. Columns 3 and 4 perform the corresponding analysis for maize, distinguishing between parishes in which the difference between the standardized suitability and production indexes is negative and maize is therefore relatively over-cultivated and the remaining parishes. Consistent with the broader pattern of stronger effects where there was greater scope for productivity improvement, the positive effects on potato cultivation are larger in relative terms in parishes where potatoes were under-cultivated. In these parishes, the share of area cultivated with potatoes more than doubles relative to its 1939 mean, while the increase elsewhere, although larger in absolute terms, is smaller relative to the corresponding 1939 mean. Similarly, the decline in maize cultivation is larger and statistically

[25] In apparent contrast to this overall pattern, the point estimate of the effect on the number of tractors is larger in absolute terms among parishes with above-median ex ante capital intensity (see columns 5 and 6 in Panel (c) of Table 6). However, the estimate for the above-median capital-intensity group is imprecise and statistically significant only at the 10% level. Moreover, these parishes had more tractors initially. Relative to the respective 1939 means, the estimated effect is larger for parishes with below-median capital intensity than for those with above-median capital intensity (2.130 versus 1.56 times the respective means).

significant only in areas where maize was relatively over-cultivated.

Overall, these findings indicate that knowledge was most effective in generating productivity-enhancing changes in settings with greater scope for improvement. This finding has implications for policies aimed at diffusing productive knowledge through worker mobility, as it indicates that the effectiveness of such policies depends, not only on the knowledge carried by workers, but also on the production conditions of destination areas.

6.4 Human Capital as a Pathway for Knowledge Transfer

Motivated by broader evidence that human capital and communication frictions shape the diffusion of knowledge (e.g., Guillouet et al., 2026; Nelson and Phelps, 1966), in this section we investigate whether human capital, and literacy in particular, facilitated knowledge transfer from prisoners to farmers.

Although the know-how transferred in our setting was likely practical and thus arguably transmissible without full command of English, lower language barriers may have facilitated such transfers. In this respect, literacy is particularly relevant because prisoners had access to, and were often supplied with, books while in detention (see Morel, 1944; Moore and Fedorowich, 2002). Moreover, farmers themselves often provided dictionaries to POWs to help them learn English (Fitzgerald, 1981). The ability to read may therefore have played an important role in facilitating English learning and, in turn, the transfer of knowledge.

Unfortunately, the available data do not provide prisoner-level information on English proficiency or literacy. To test this hypothesis, we instead use pre-war Italian province-level literacy rates as a proxy for prisoners' likely literacy. Specifically, we assign to each prisoner the 1931 literacy rate of his home province, average these values within each camp, and classify camps as above or below the median of this measure. We then re-estimate the mechanism specifications of Sections 6.1 and 6.2, distinguishing between parishes near camps with above- versus below-median literacy rates. For this analysis, we focus on parishes with above-median prisoner technology or crop knowledge, for which the earlier analysis showed stronger and statistically significant effects from knowledge transfer.

Table 8 presents the results. Columns 1 to 4 show effects on potato and maize cultivation, while columns 5 to 6 show effects on tractor use. Consistent with the hypothesis that human capital facilitated productivity-enhancing knowledge transfers, the effects are larger in parishes employing prisoners who were more likely to be literate.

6.5 Alternative Mechanisms

To conclude our discussion of mechanisms, in this section we explore alternative mechanisms for our findings.

Selective Allocation of Prisoners. One possibility is that POWs were selectively allocated to camps near parishes particularly well positioned to benefit from their labor, in which case our estimates might partly capture allocation decisions rather than knowledge transfer. To investigate this possibility, Appendix Table A.3 regresses several measures of POW labor supply in 1944–45 on average pre-program parish productivity (1935–36 and 1939–40), restricting the sample to parishes eligible to receive POW labor. Column 1 measures labor supply using the number of POWs held at the nearest camp. Columns 2 and 3 use, respectively, the number and share of POWs previously employed in agriculture in Italy, thus accounting for differences in farm-relevant experience. Column 4 uses the share of POWs from central and southern Italy to investigate sorting by area of origin in Italy. As discussed in Section 3.4, prisoners from these areas are overrepresented in the sample for historical reasons. The estimated coefficients are small and statistically insignificant, suggesting that selective allocation is unlikely to be an important driver of our results.

The above analysis, however, does not rule out the possibility that prisoners were selectively allocated to farms within parishes. In Appendix Table A.4, we conduct an analysis analogous to that in Appendix Table A.3 using census entry- rather than parish-level data. As discussed in previous sections, to the extent that census entries capture individual farms or groups of farms within a parish, this analysis allows us to examine whether prisoners were systematically matched to particular farms. Consistent with the parish-level evidence, we find little evidence of a systematic relationship between an entry's labor productivity and the number of prisoners employed in that entry.

Taken together, these results suggest that the overall supply of POW labor was not selectively allocated. They do not, however, rule out the possibility that prisoners were assigned to Australian areas based on whether their specific knowledge was particularly relevant for local agriculture. To investigate this possibility, in Appendix Table A.5, we regress the number of prisoners in the closest camp originating from provinces where potatoes or maize were the main crops cultivated before the war (columns 1 to 4) and the average number of tractors in prisoners' provinces of origin (columns 5 and 6)–i.e., the same measures of expertise used to investigate knowledge transfer in Sections 6.1 and 6.2–on pre-war (1939) parish-level measures of potato and maize production and tractor use. We find no statistically significant correlation between prisoners' specific knowledge and crop production or technology use in parishes of employment.

Overall, the evidence suggests that the selective allocation of prisoners and their specific expertise across areas is unlikely to account for the effects we observe. These findings are consistent with the fact that many prisoners had been assigned to camps before the employment program was planned, making it unlikely that their allocation reflected the labor needs or production characteristics of the areas in which they were later employed.

Differences across Italian Areas. A second alternative explanation is that our measures of origin-specific crop and technology expertise may capture broader differences across Italian areas rather than differences in the specific knowledge relevant to agricultural production. This concern is particularly relevant in the Italian context, where substantial and persistent differences in income and economic development between northern and southern Italy predate WWII (Clough and Livi, 1956).[26]

In order to investigate this possibility, in Appendix Table A.6 we construct measures of crop- and tractor-related expertise that account, to the extent possible given the available data, for broader differences across Italian provinces and macro-areas. Specifically, we separately regress potato production, maize production, and tractor use across Italian provinces in 1930 (1938 for tractors) on literacy rates, population, and macro-area fixed effects (north, center, south, and islands). We then use the residuals from these regressions to classify each POW camp as having above- or below-median expertise in potato cultivation, maize cultivation, or tractor use, following the procedures used in Panel (b) of Table 4 and in Table 5. Using these adjusted measures, the estimated effects remain larger in parishes eligible to employ prisoners with above-median origin-specific expertise in the relevant crops or technology. The differences in magnitude between above- and below-median expertise areas are smaller than in Tables 4 and 5, as might be expected given that the additional controls absorb some of the variation, but the estimated effects remain substantially larger in above-median expertise areas.

Overall, these findings suggest that broader differences across Italian regions are unlikely to account for the origin-specific effects documented in the previous sections.

Rybczynski-type Adjustments. Finally, the Rybczynski theorem provides a potential alternative interpretation of the changes in crop mix documented in Table 4. Because potato cultivation is more labor-intensive and maize cultivation more capital-intensive (Blanco and Raurich, 2022), an increase in labor supply, holding output prices and production technology fixed, could have increased potato cultivation and reduced maize cultivation (i.e., Rybczynski

[26]These differences are particularly salient for tractor use in our setting, as tractors were more heavily concentrated in northern regions, which also had higher literacy rates. Appendix Figures C.6 and C.7 provide a graphical view of the pre-war distribution of potato and maize production, tractor use, and literacy rates across Italian provinces.

theorem). This mechanism, however, would not explain why the effects vary with prisoners' origin-specific knowledge in Panel (b) of Table 4, unless high-expertise areas also experienced larger increases in POW labor supply. In Appendix Table A.7, we assess this possibility by re-estimating the specifications in Panel (b) of Table 4 with an additional control for the number of POWs held at the nearest camp–our most direct measure of prisoner labor availability–interacted with an indicator for the POW-employment period. The estimated effects remain qualitatively and quantitatively similar to the baseline estimates, suggesting that Rybczynski-type adjustments are unlikely to drive our findings.

7 Robustness Checks

Alternative Comparison Groups. One potential concern with our results is their sensitivity to the choice of the control group, which is defined based on distance from the closest POW camp. Appendix Figure A.8 specifically tests for this sensitivity by reporting the effects obtained when varying control selection in 250-meter intervals, starting at 40 kilometers and up to 80 kilometers from the nearest POW camp.[27] Panel (a) presents the effects on output while Panel (b) investigates the sensitivity of the effects on productivity. In both cases, the sign and significance of the estimates remain unchanged across alternative control groups. If anything, the positive effects on output in the short run and on productivity in both the short and longer run become larger in magnitude when controls are drawn from distances greater than those used in our baseline analysis.

Limited Power to Detect Pre-Trends. Another potential concern, emphasized in recent developments in the DiD literature, is that pre-trends, which are central to our identification diagnostics, may go undetected because of limited power to test for pre-trends rather than the absence of actual trends. To investigate this possibility, we apply the approach of Roth (2022) and conduct power calculations for pre-trend tests in our setting. Specifically, we ask: how large would a violation of parallel trends need to be in order to be detected at least 80% of the time? Following Roth (2022), we measure the violation as the slope of a potential linear pre-trend. Panel (b) of Table 3 (last row) presents the results. Across all specifications, we estimate that the slope of the pre-trend would need to be about one-third of the 1944–45 effect to be detected 80% of the time. This relatively limited violation suggests that sizable pre-trends are unlikely to remain undetected in our setting.

Based on the results of the previous paragraph, one may worry that relatively small pre-trends could go undetected. In that case, one may question whether our main conclusions

[27] Beyond 80 kilometers, constructing a reliable control group becomes challenging as the number of parishes in the control group is smaller and less comparable to the treatment.

would remain valid under violations of the parallel-trends assumption. To investigate this possibility, we employ the methodology introduced by Roth et al. (2023), which estimates treatment effects and standard errors under varying degrees of deviation from parallel trends. The degree of violation is measured relative to the maximum pre-treatment deviation.

Appendix Figure A.9 presents the results of this analysis. We report 95% confidence intervals for the estimated effects under varying degrees of parallel trends violation, denoted as *Mbar* in the figure. Panel (a) refers to short-run output effects (1944–45), while Panel (b) refers to long-run productivity effects (1944–51). Reassuringly, our main findings are robust to relatively large violations of parallel trends: output effects remain significant for violations up to 4.5 times as large as the maximum pre-treatment deviation, and productivity effects up to 3 times as large. This suggests that our main conclusions are unlikely to change under plausible departures from the parallel-trends assumption.

Focus on Farmers. One implication of our proposed mechanism is that prisoners with prior experience working in agriculture are those whose knowledge should matter most for the observed productivity-enhancing changes in output composition and technology use. Appendix Table A.8 re-estimates our mechanism specifications using only prisoners whose pre-war occupation in Italy was in agriculture to distinguish between areas with above- and below-median expertise. The resulting estimates are very similar to our baseline results, consistent with workers with prior farming experience driving the observed mechanisms.

Robustness to Excluding Camps with Internees. Finally, we test the robustness of our findings to excluding camps in which internees were also detained. As mentioned in Section 2, internees were not allowed to work outside prisoner camps and therefore could not have contributed to the effects or mechanisms that we document. Consistent with this argument, we obtain effects that are in line with the baseline when we exclude the eight camps in Victoria in which internees were detained (see Appendix Tables A.9 and A.10).[28]

8 Conclusion

Can worker mobility generate productivity gains in destination economies even in the absence of wage and related labor market adjustments? What role does origin-specific knowledge carried by workers play in generating such gains? And can these productivity effects outlast the workers who generate them? This paper provides empirical answers to these questions.

[28] Australia detained a total of 5,152 Italian civilian internees (Moore and Fedorowich, 2002, p. 73). Only 315 of them (6%) were detained in Victoria and their distribution was highly concentrated: 97% were held in just three detention camps (see Appendix C.1 for more details).

Using newly collected data and the unique setting of the Australian prisoner employment program during WWII, we show that an inflow of labor not only increased agricultural output in the short run but also generated persistent productivity gains over the longer run. We provide evidence consistent with the transfer of origin-specific knowledge about relevant crops and technology as a key mechanism underlying these gains.

Overall, our findings underscore the importance of knowledge diffusion through worker mobility for productivity growth. Future research could extend our analysis by studying the effects of prisoner employment on prisoners' places of origin. Prisoners may have acquired skills and know-how while working abroad that enhanced productivity at home upon repatriation. Whether this was indeed the case remains an open question for future empirical investigation.

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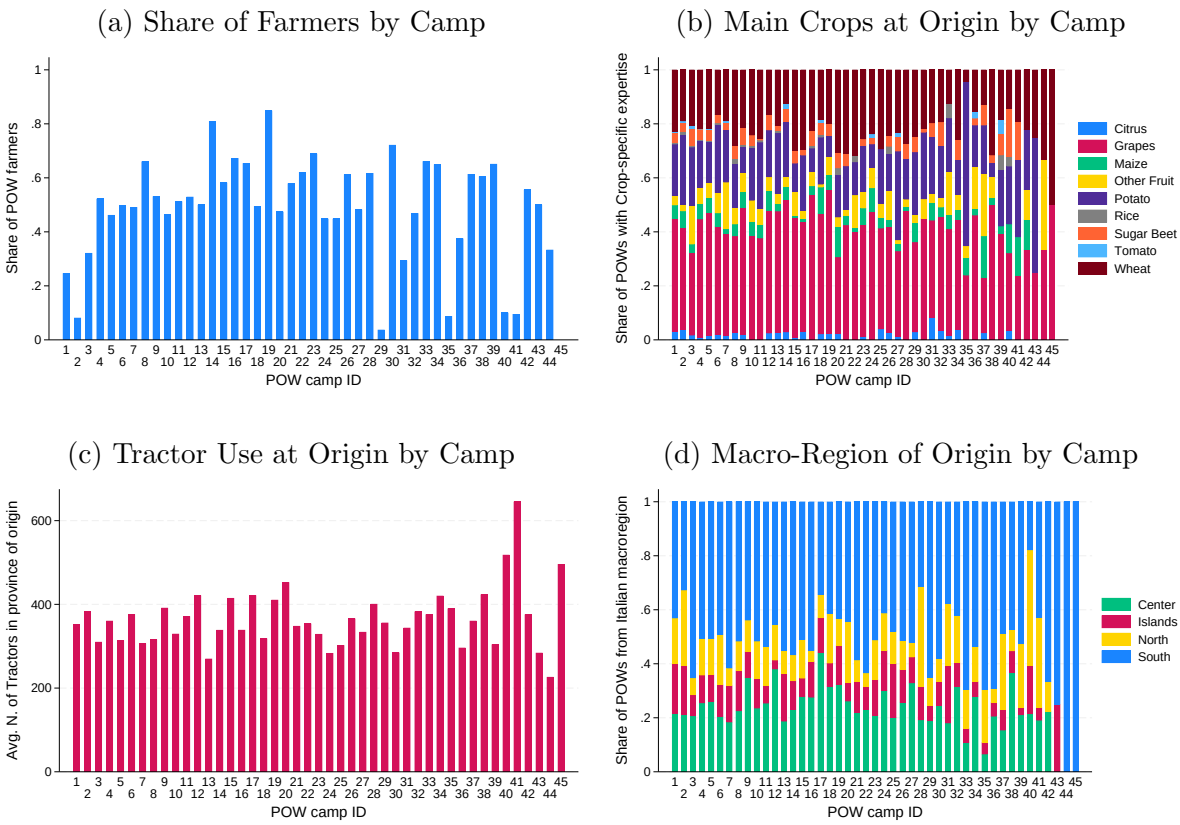
Figures

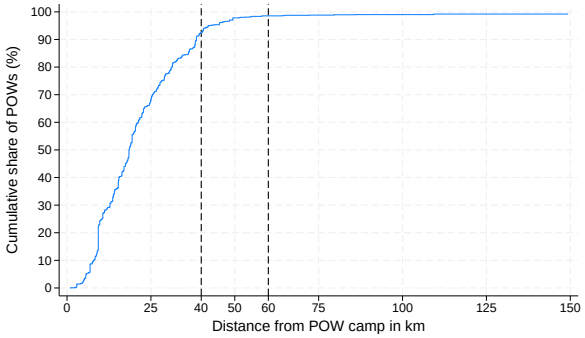
Figure 1: POW Origin-Specific Farming Exposure by Prisoner Camp



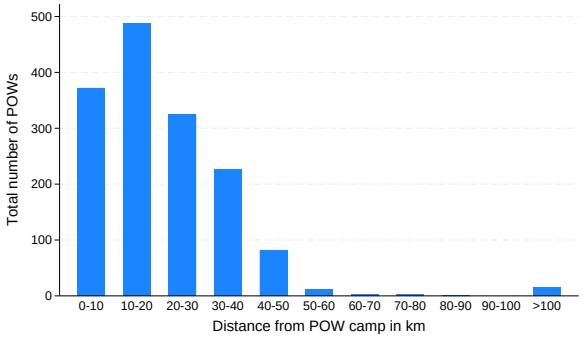
Notes: Panel (a) shows, for each camp, the share of prisoners who were employed in agriculture before the war. Panel (b) shows the distribution of prisoners within camps according to the main crop produced in their Italian province of residence before the war. Panel (c) shows tractor use in prisoners' provinces of residence before the war. Panel (d) shows the distribution of prisoners within each camp by their Italian macro-region of origin: Center, Islands, North, and South. Each number in the panels identifies a camp. The analysis is restricted to POW camps located in Victoria and to camps outside Victoria that were within 40 km of at least one Victorian parish.

Figure 2: POW Employment as a Function of Distance to the Nearest Camp

(a) Cumulative Distribution of POWs



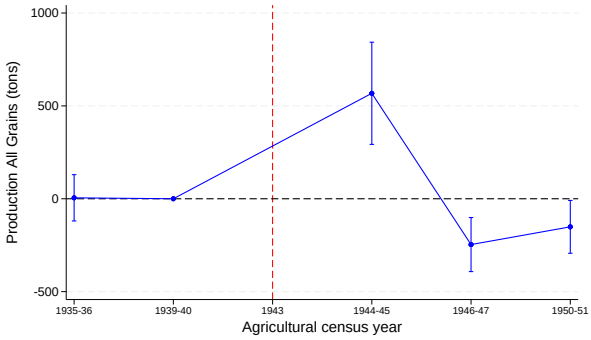
(b) Distribution of POWs in 10 km Bins



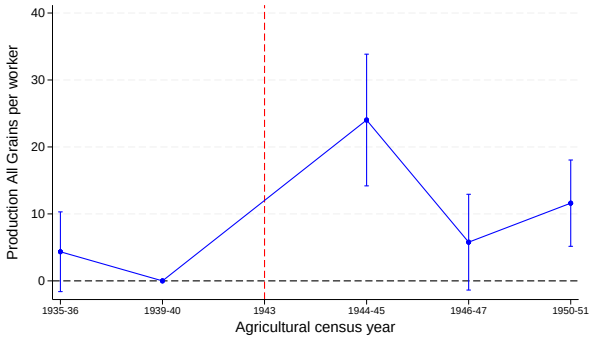
Notes: Panel (a) plots the cumulative distribution of prisoners of war employed across parishes in the 1944–45 Agricultural Census against each parish's distance from the nearest POW camp. Panel (b) plots the number of prisoners of war employed in parishes in 1944–45, grouped into 10-kilometer-wide intervals, against distance from the nearest POW camp.

Figure 3: Output and Productivity Effects of Prisoner Employment

(a) Output



(b) Output per worker

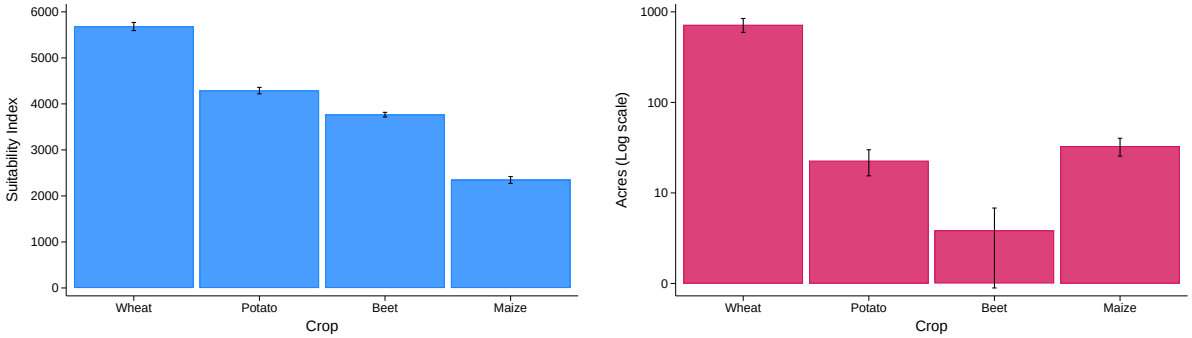


Notes: This figure reports point estimates of β_t obtained from equation (2), together with their 95% confidence intervals. Panel (a) plots estimates using production of all grains available in the Agricultural Census, measured in imperial tons, as the outcome variable. All grains include: wheat, oats, barley, and rye. Panel (b) plots estimates using production of all grains per worker as the outcome variable. Standard errors are clustered at the parish level.

Figure 4: Crop Suitability and Cultivated Area Rankings

(a) Suitability Index

(b) Cultivated Area (1939)



Notes: The figure shows averages and standard deviations of the suitability index in Panel (a) and cultivated area in Panel (b) for wheat, potatoes, beet, and maize. Suitability index measures are based on GAEZ pixel-level data, aggregated at the parish level by averaging crop suitability within a 15-kilometer radius around each parish centroid. Cultivated area is shown on a logarithmic scale to reduce differences in scale between wheat and the other crops and provide a clearer view of their relative ranking.

Tables

Table 1: Descriptive Statistics

Panel (a): Italian POWs Detained in Australia			
	Obs.	Mean	St. Dev.
Age	18,269	29.437	6.061
Unmarried	18,261	0.612	0.487
Captured by 1941	18,083	0.998	0.042
Employed in Agriculture	18,411	0.474	0.499
Weight (kg)	17,522	64.799	7.236
Height (cm)	17,697	167.386	7.497
Panel (b): Victorian Agricultural Census, 1935-1951			
	Obs.	Mean	St. Dev.
POWs relative to 1939 employment (parishes with $\geq$1 POW)	277	0.121	0.201
Total area occupied by holding (acres)	1,680	23517.430	21967.624
Total employment	1,680	55.838	82.638
Number of tractors	1,680	8.777	14.244
At least one tractor before the war (share)	1,680	0.720	0.391
Two or more tractors before the war (share)	1,680	0.555	0.442
Total production (tons)	1,680	1357.081	1734.449
Total production per worker	1,680	34.395	38.237
Production All Grains (tons)	1,680	1125.312	1694.324
Production All Grains per worker	1,680	30.889	39.334
Revenue Wheat, Oats, and Barley	1,680	8265.167	10916.934
Revenue Wheat, Oats, and Barley per worker	1,680	225.943	248.216
Area cultivated with wheat (acres)	1,680	1616.452	3129.216
Area cultivated with maize (acres)	1,680	16.742	68.178
Area cultivated with potato (acres)	1,680	30.128	161.989
Area cultivated with grapes (acres)	1,680	25.668	605.922
Area cultivated with beet (acres)	1,680	1.279	20.195
Wheat (% of total area)	1,680	5.825	9.555
Maize (% of total area)	1,680	0.092	0.323
Potato (% of total area)	1,680	0.214	0.995
Grapes (% of total area)	1,680	0.075	1.367
Beet (% of total area)	1,680	0.004	0.066
Tractors per 100 hectares (capital intensity)	1,680	0.113	0.515
Workers per 100 hectares (labor intensity)	1,680	0.907	3.717

Notes: Panel (a) shows summary statistics of Italian POWs detained in Australia during WWII. Panel (b) reports summary statistics for the agricultural census of Victoria variables used in our main analysis. Unless otherwise noted, averages are calculated over the entire sample period (1935–1951).

Table 2: Identification Tests: Pre-Trends and Wartime Enlistment

	Panel (a): Test for Parallel Pre-Trends			
	Production All Grains (1)	Prod. All Grains Per worker (2)	Total Production (3)	Total Prod. Per worker (4)
POW Eligible × 1935	1.349	4.128	-92.705	3.242
	(63.577)	(3.034)	(66.256)	(3.210)
Observations	2,720	2,720	2,720	2,720
R-squared	0.961	0.926	0.956	0.918
Mean D.V. control group	2491.199	86.325	2539.545	88.180
Mean D.V. in 1939	1626.271	54.729	1938.436	61.374
Pre-trend slope (Roth 2022)	178.115	8.501	185.621	8.992
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*

	Panel (b): Differences in Enlistment	
	Number of Enlisted	
	(1)	(2)
POW Eligible	-85.040	-64.239
	(96.935)	(101.231)
Latitude		96.628
		(99.246)
Longitude		16.713
		(32.619)
Distance from State Capital		0.137
		(0.485)
Observations	1,360	1,360
R-squared	0.036	0.061
Mean D.V.	396.779	396.779
Region FEs	*Yes*	*Yes*

Notes: Panel (a) presents estimates from equation (2), restricting the sample to 1935–36 and 1939–40 and using 1939–40 as the reference year. Columns 1 and 2 use production of all grains reported in the Agricultural Census, measured in imperial tons. These include wheat, oats, barley, and rye. Columns 3 and 4 consider a broader production measure that includes all crops for which output can be measured. Standard errors in Panel (a) are clustered at the parish level and reported in parentheses. Panel (b) presents the association between treatment status and World War II enlistment at the parish level. The dependent variable measures cumulative WWII enlistment based on residents' enlistment records. Standard errors in Panel (b) are clustered at the SA2 level and reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 3: The Effects of Prisoner Employment on Production and Productivity

	Production All Grains (1)	Prod. All Grains Per worker (2)	Total Production (3)	Total Prod. Per worker (4)
	Panel (a): Static DiD Estimates			
POW Eligible × Post	54.113	11.631***	98.167	11.047***
	(66.686)	(2.873)	(67.261)	(2.983)
Observations	6,800	6,800	6,800	6,800
R-squared	0.820	0.775	0.820	0.762
Mean D.V. control group	1947.631	57.069	2001.541	58.593
Mean D.V. in 1939	1626.271	54.729	1938.436	61.374
	Panel (b): Dynamic (event-study) DiD Estimates			
POW Eligible × 1935	5.122	4.349	-88.935	3.466
	(63.611)	(3.038)	(66.276)	(3.212)
POW Eligible × 1944	567.819***	24.021***	546.171***	23.125***
	(140.307)	(5.017)	(142.713)	(5.183)
POW Eligible × 1946	-246.635***	5.780	-240.097***	4.848
	(74.264)	(3.649)	(76.638)	(3.873)
POW Eligible × 1950	-151.175**	11.605***	-144.763*	10.357***
	(72.536)	(3.288)	(74.868)	(3.568)
Observations	6,800	6,800	6,800	6,800
R-squared	0.823	0.777	0.822	0.764
Mean D.V. control group	1947.631	57.069	2001.541	58.593
Mean D.V. in 1939	1626.271	54.729	1938.436	61.374
Pre-trend slope (Roth 2022)	178.211	8.510	185.678	9.000
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*

Notes: This table presents DiD estimates of the effects of the POW employment program on agricultural output and productivity. Panel (a) reports estimates of γ from equation (1). Panel (b) reports estimates of β_t from equation (2) for each year in our Victoria agricultural census sample. Columns 1 and 2 use production of all grains reported in the Agricultural Census, measured in imperial tons. These include wheat, oats, barley, and rye. Columns 3 and 4 consider a broader measure of production that includes all crops for which output can be measured: wheat, oats, barley, peas, rye, grass/clover and alfalfa. Output measures across crops are harmonized as described in Data Appendix C.2. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 4: Prisoner Employment, Crop Mix and Crop Knowledge

	Panel (a): Mix of Italian Crops				
	% of Total Area				
	Wheat	Maize	Potato	Grapes	Beet
	(1)	(2)	(3)	(4)	(5)
POW Eligible × Post	0.017	-0.059***	0.093***	-0.080	-0.010**
	(0.203)	(0.021)	(0.020)	(0.070)	(0.005)
Observations	6,798	6,798	6,798	6,798	5,438
R-squared	0.945	0.612	0.841	0.932	0.543
Mean D.V. control group	11.922	0.021	0.074	0.009	0.000
Mean D.V. in 1939	6.537	0.117	0.134	0.091	0.008
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

	Panel (b): Crop Shift and Crop Knowledge			
	% of Total Area			
	Potato		Maize	
	Above Median	Below Median	Above Median	Below Median
	(1)	(2)	(3)	(4)
POW Eligible × Post	0.196***	0.011	-0.179***	-0.010*
	(0.050)	(0.009)	(0.065)	(0.006)
Observations	3,248	3,550	2,758	4,040
R-squared	0.846	0.817	0.583	0.780
Mean D.V. control group	0.091	0.062	0.052	0.006
Mean D.V. in 1939	0.219	0.055	0.187	0.070
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*

Notes: Panel (a) of the table presents the estimated DiD effects from equation (1) on the percentage of area cultivated under wheat, maize, potatoes, grapes, and beet. Panel (b) reports separate DiD estimates for the share of area cultivated under potatoes (columns 1 and 2) and maize (columns 3 and 4), depending on whether the parish is located near a prisoner camp whose prisoners came from Italian provinces with above- versus below-median familiarity with the specific crop. For each prisoner camp, we calculate the number of prisoners from provinces where potatoes or maize was the main crop produced prior to the war. Using these measures, we classify camps as having above- or below-median levels of potato or maize knowledge and re-estimate the main effects, distinguishing between parishes whose nearest camp was above versus below the median in crop-specific knowledge. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 5: Prisoner Employment, Technology Use, and Know-How

		Number of Tractors	
	Number of tractors	Above Median POW expertise	Below Median POW expertise
	(1)	(2)	(3)
POW Eligible × Post	4.905**	9.591**	-0.233
	(2.100)	(3.933)	(0.586)
Observations	5,440	2,784	2,656
R-squared	0.717	0.693	0.809
Mean D.V. control group	9.805	9.456	10.144
Mean D.V. in 1939	5.954	6.043	5.861
Region by Year FEs	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*

Notes: This table presents the estimated DiD effects of prisoner employment on tractor use obtained from equation (1). Column 1 reports effects on the number of tractors used in production, while columns 2 and 3 report separate effects depending on whether the parish is located near a prisoner camp whose prisoners, on average, came from provinces with an above- versus below-median number of tractors. Tractor numbers in the provinces of origin are obtained from the 1938 Census of Agricultural Machinery. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 6: Heterogeneous Effects of POW Employment by Baseline Productivity, Labor and Capital Intensity

	Potato (% total area)		Maize (% total area)		N. of tractors	
	Above Median (1)	Below Median (2)	Above Median (3)	Below Median (4)	Above Median (5)	Below Median (6)
	Panel (a): By productivity (1939)					
POW Eligible × Post	-0.010	0.315***	-0.040*	-0.276**	0.678	13.907***
	(0.039)	(0.070)	(0.023)	(0.107)	(1.241)	(4.337)
Observations	1,124	2,124	1,024	1,734	1,252	1,532
R-squared	0.901	0.818	0.518	0.576	0.845	0.683
Mean D.V. control group	0.035	0.159	0.004	0.132	12.808	1.341
Mean D.V. in 1939	0.202	0.228	0.025	0.282	8.629	3.930
	Panel (b): By labor intensity (1939)					
POW Eligible × Post	0.259***	0.009	-0.158*	-0.030	13.752***	-0.392
	(0.077)	(0.006)	(0.089)	(0.030)	(5.270)	(0.787)
Observations	1,844	1,404	1,544	1,214	1,380	1,404
R-squared	0.844	0.350	0.595	0.588	0.69	0.893
Mean D.V. control group	0.263	0.006	0.070	0.046	6.852	10.138
Mean D.V. in 1939	0.383	0.003	0.294	0.050	5.814	6.268
	Panel (c): By capital intensity (1939)					
POW Eligible × Post	0.030	0.281***	-0.031	-0.185**	17.509*	2.381***
	(0.049)	(0.085)	(0.064)	(0.076)	(9.575)	(0.843)
Observations	1,473	1,775	1,378	1,380	1,356	1,428
R-squared	0.911	0.713	0.654	0.418	0.686	0.658
Mean D.V. control group	0.067	0.112	0.018	0.098	15.427	2.956
Mean D.V. in 1939	0.291	0.159	0.256	0.117	11.230	1.118
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Notes: DiD estimates from equation (1), using as outcome variables the share of area cultivated with potatoes (columns 1 and 2), the share cultivated with maize (columns 3 and 4), and the number of tractors in a parish (columns 5 and 6). We restrict the analysis to the sample of parishes with above-median POW expertise only. In Panel (a), parishes are split according to their labor productivity in 1939. Labor productivity is defined as production of main crops divided by total employment. In Panel (b), parishes are split by labor intensity in 1939, defined as total employment divided by total area. In Panel (c), parishes are split by capital intensity in 1939, defined as number of tractors divided by total area. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 7: DiD Effects by Degree of Suitability–Production Mismatch

	Potato (% total area)		Maize (% total area)	
	More Mismatched	Less Mismatched	More Mismatched	Less Mismatched
	(1)	(2)	(3)	(4)
	Panel (a): Absolute mismatch			
POW Eligible × Post	0.344***	0.090*	-0.245**	-0.089*
	(0.109)	(0.051)	(0.107)	(0.050)
Observations	1,553	1,695	1,490	1,268
R-squared	0.889	0.523	0.574	0.645
Mean D.V. control group	0.160	0.051	0.071	0.032
Mean D.V. in 1939	0.376	0.075	0.223	0.144
	Panel (b): Relative mismatch			
	Under-Cultivated	Not Under-Cultivated	Over-Cultivated	Not Over-Cultivated
POW Eligible × Post	0.102***	0.531***	-0.397**	-0.071
	(0.036)	(0.181)	(0.161)	(0.061)
Observations	2,183	1,065	1,040	1,718
R-squared	0.471	0.883	0.660	0.391
Mean D.V. control group	0.053	0.127	0.032	0.097
Mean D.V. in 1939	0.046	0.574	0.354	0.086
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*

Notes: DiD estimates from equation (1), using the share of area cultivated with potatoes (columns 1 and 2) and maize (columns 3 and 4) as outcome variables, and distinguishing between parishes based on the degree of mismatch between production and suitability. The sample is restricted to parishes with above-median POW expertise in the relevant crops. Mismatch is measured as the difference between the standardized suitability index for potatoes or maize in a given parish and the standardized share of parish area cultivated with the same crop in 1939. Each measure is standardized by subtracting its mean across parishes and dividing by its standard deviation. In Panel (a), mismatch is measured in absolute terms as the absolute difference between standardized suitability and standardized cultivated area. Odd-numbered columns report estimates for parishes with above-median absolute mismatch, while even-numbered columns report estimates for parishes with below-median absolute mismatch. In Panel (b), parishes are classified according to the sign of the mismatch. For potatoes, column 1 reports estimates for parishes in which standardized suitability exceeds the standardized share of cultivated area—that is, where potato cultivation is low relative to suitability. Column 2 reports estimates for the opposite case. For maize, column 3 reports estimates for parishes in which the standardized share of cultivated area exceeds standardized suitability—that is, where maize cultivation is high relative to suitability. Column 4 reports estimates for the opposite case. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 8: Literacy as a Pathway for Knowledge Transfer

	% of Total Area					
	Potato		Maize		N. of Tractors	
Literacy rate:	Above Median	Below Median	Above Median	Below Median	Above Median	Below Median
	(1)	(2)	(3)	(4)	(5)	(6)
POW Eligible × Post	0.398***	0.097**	-0.596***	-0.007	15.889*	4.564**
	(0.122)	(0.042)	(0.222)	(0.037)	(8.832)	(1.825)
Observations	1,668	1,580	1,308	1,450	1,372	1,412
R-squared	0.844	0.871	0.584	0.652	0.672	0.794
Mean D.V. control group	0.096	0.089	0.082	0.035	4.196	13.459
Mean D.V. in 1939	0.269	0.166	0.277	0.105	3.685	8.334
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

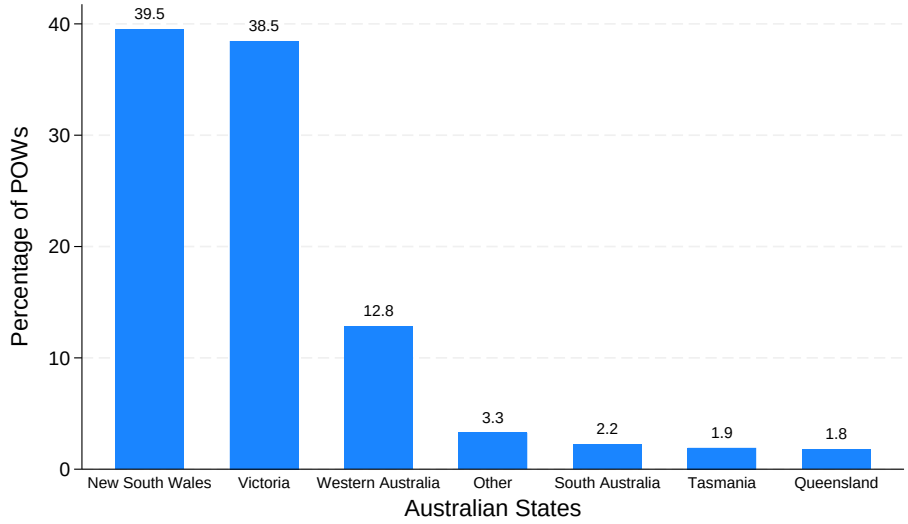
Notes: DiD estimates from equation (1) using the share of area cultivated under potatoes (columns 1 and 2) and maize (columns 3 and 4), and the number of tractors present in a parish (columns 5 and 6) as outcome variables. We distinguish between parishes based on whether they are located near prisoner camps housing prisoners from Italian provinces with above- or below-median literacy rates. For each prisoner camp, we assign to each prisoner the literacy rate of their province of origin in Italy, and compute a camp-level average literacy rate across all prisoners in the camp. Using these measures, we classify camps as having above- or below-median literacy rates and estimate the effects on the sample of above-median POW expertise splitting the sample accordingly. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

SUPPLEMENTAL APPENDIX
"Productivity and Knowledge Transfer: Evidence from Prisoner Employment"

A Results Appendix

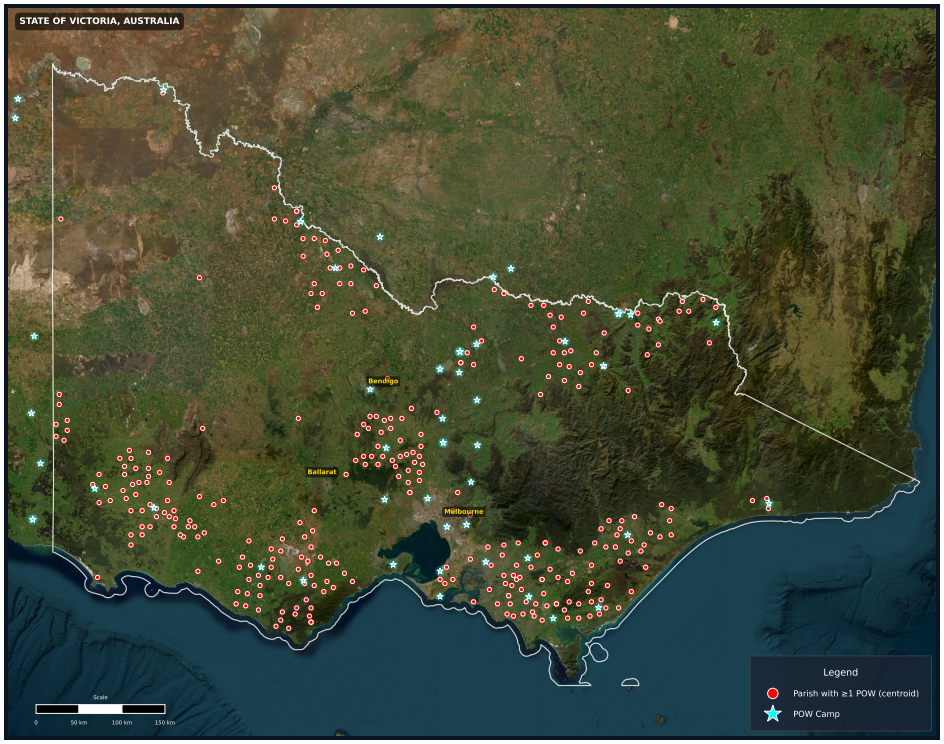
A.1 Appendix Figures

Figure A.1: Distribution of Italian Prisoners of War Across Australian States



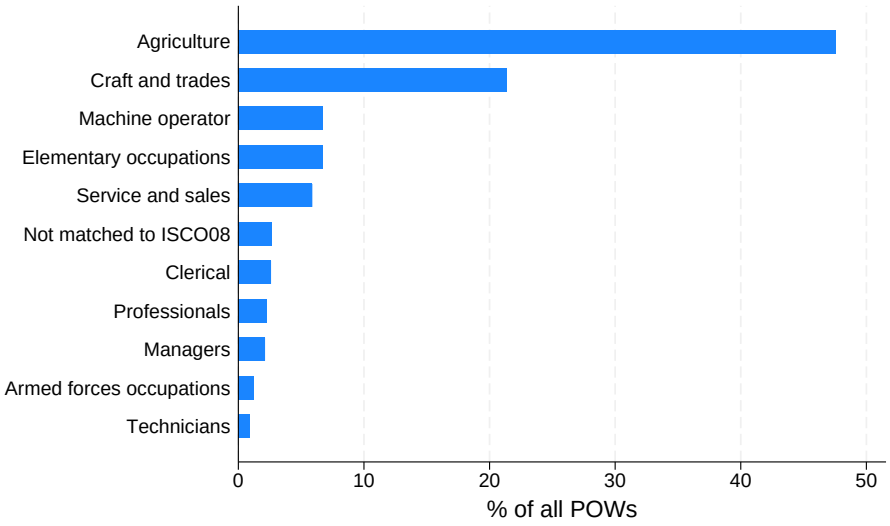
Notes: This figure shows the distribution of Italian prisoners of war across Australian states of detention. The state of detention is determined based on the district of assignment upon arrival available from record series MP1103/1. When this information is not available, we complement it with information on state of internment available in report series MP1103/2. Prisoners who were detained outside Australia, including in New Guinea and New Caledonia, or in territories such as the Straits Settlements, which were not formally part of Australia during WWII are counted in the category "Other".

Figure A.2: POW Camp Locations and Parishes Employing POWs (1944-45)



Notes: This figure shows the geographical location of POW camps (blue stars) and parishes that report employing at least one prisoner in 1944–45 (red dots). The locations of both POW camps and parishes are based on centroids.

Figure A.3: Distribution of Pre-war Occupations among Prisoners of War

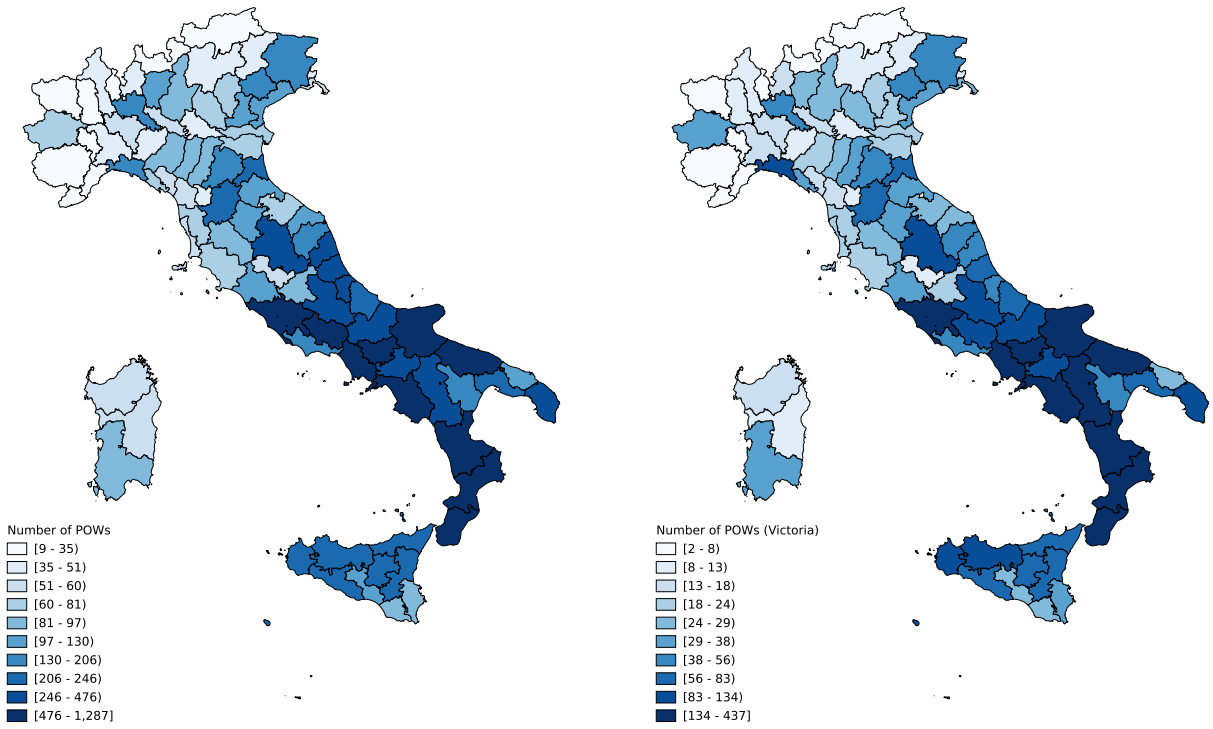


Notes: This figure shows the distribution of Italian prisoners of war occupations prior to the war. We first digitized, then cleaned and aggregated occupations following the ISCO08 classification.

Figure A.4: Province of Origin of Italian Prisoners of War

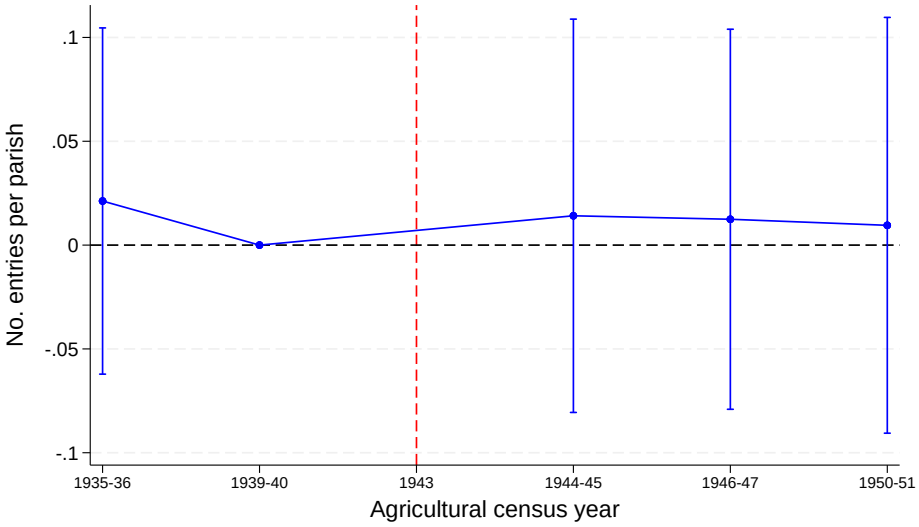
(a) All Italian POWs in Australia

(b) POWs Held in Victoria



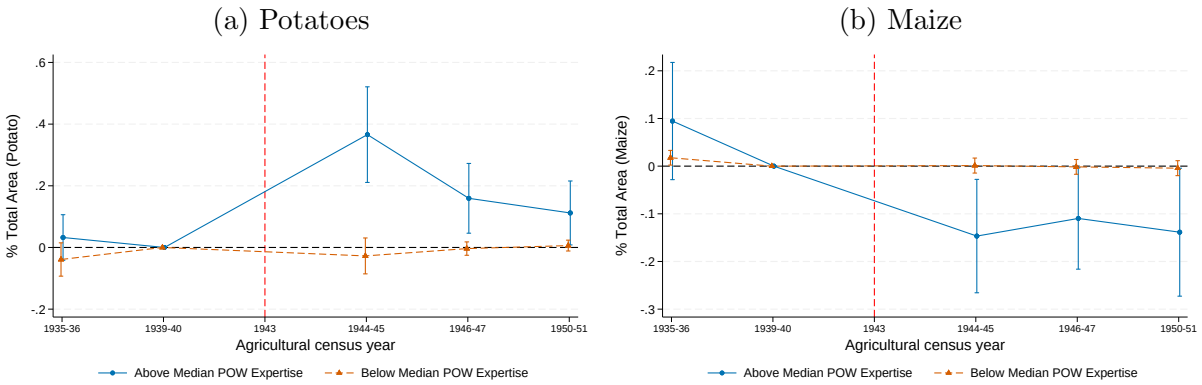
Notes: Panel (a) shows the distribution of all Italian POWs by their province of residence in Italy before the war. Panel (b) shows the corresponding distribution for POWs held in Victoria. In each panel, provinces are grouped into deciles based on the number of POWs residing in each province. The maps use Italy's national and provincial boundaries as reconstructed by the Italian National Institute of Statistics (ISTAT) for 1936. The version of the ISTAT boundaries provided for 1936 does not include the former provinces of Pola, Fiume (Carnaro), and Zara, which were part of Italy in 1936 but were ceded after the war under the 1947 Paris Peace Treaty. This omission does not affect the figures because our sample contains no prisoners who resided in these provinces before the war. See Appendix C.6 for further details.

Figure A.5: Number of Census Entries per Parish



Notes: This figure reports point estimates of β_t obtained from equation (2), together with their 95% confidence intervals, using the number of entries recorded for each parish in the Victorian Agricultural Census as the outcome variable. Each entry likely corresponds to a farm or group of farms. Standard errors are clustered at the parish level.

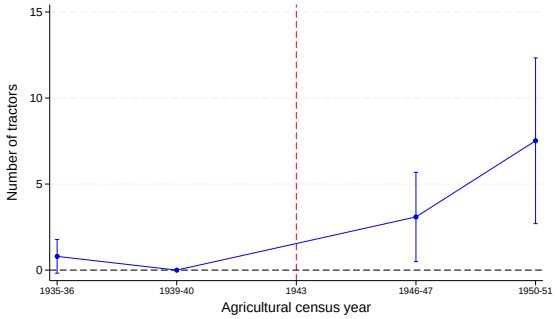
Figure A.6: Crop Shift Effects of Prisoner Employment



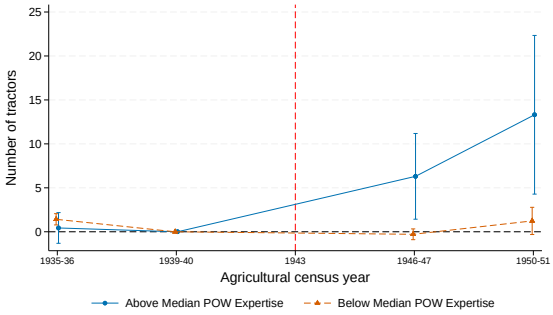
Notes: This figure reports point estimates of β_t obtained from equation (2), together with their 95% confidence intervals. Panel (a) uses the percentage of area cultivated with potatoes as the outcome variable, while Panel (b) uses the percentage cultivated with maize. Both panels distinguish between parishes exposed to above- and below-median POW expertise. POW expertise is measured as described in the notes to Table 4. Standard errors are clustered at the parish level.

Figure A.7: The Effects of Prisoner Employment on Tractor Use

(a) Number of Tractors

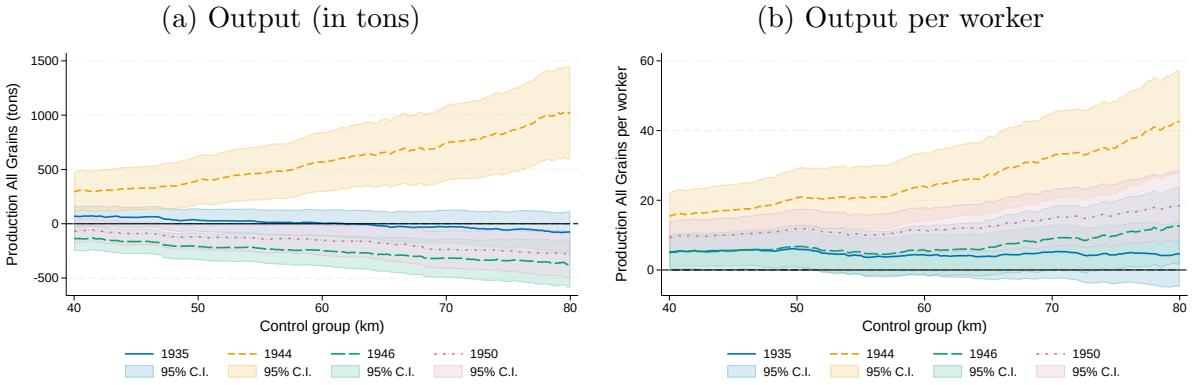


(b) Number of Tractors by POW Expertise



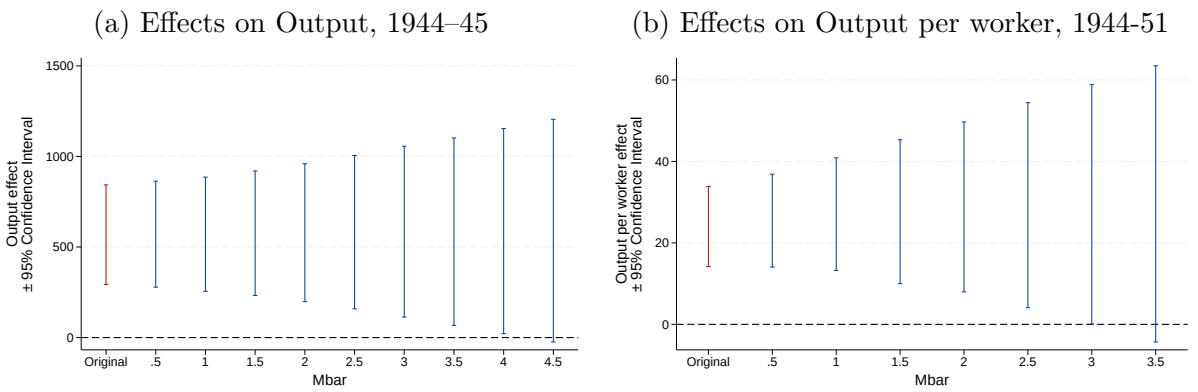
Notes: This figure reports point estimates of β_t obtained from equation (2), together with their 95% confidence intervals. Panel (a) uses the number of tractors as the outcome variable. Panel (b) reports separate estimates for parishes exposed to above- and below-median POW expertise in tractor use. Expertise in tractor use is measured as described in the notes to Table 5. Standard errors are clustered at the parish level.

Figure A.8: Effects of POW Employment with Alternative Control Groups by Distance



Notes: This figure reports point estimates of β_t obtained from equation (2), together with their 95% confidence intervals. Panel (a) uses production of all grains as the outcome variable, while Panel (b) uses production of all grains per worker. For each year in the sample, both panels report estimates based on alternative control groups defined using distance thresholds ranging from 40 to 80 kilometers from the nearest POW camp, in 250-meter increments. Standard errors are clustered at the parish level.

Figure A.9: Effects of POW Employment under Varying Violations of Parallel Trends



Notes: This figure shows 95% confidence intervals from the sensitivity analysis obtained following Roth et al. (2023), under varying degrees of violation relative to the maximum pre-treatment violation observed in the data. The degree of violation of parallel trends is reported on the x-axis. Panel (a) plots confidence intervals on 1944–45 production of all grains. Panel (b) plots the confidence intervals on 1944–51 production of all grains per worker. Standard errors are clustered at the parish level.

A.2 Appendix Tables

Table A.1: Descriptive Statistics: Italian Prisoners of War – Victoria vs Other States

Panel (a): Distribution by state

	Frequency	%	Cum.
New South Wales	7,262	39.504	39.504
Victoria	7,071	38.465	77.969
Western Australia	2,354	12.805	90.774
Other	602	3.275	94.049
South Australia	412	2.241	96.290
Tasmania	353	1.920	98.210
Queensland	329	1.790	100.000
Total	18,383	100.000	

Panel (b): Demographic characteristics

	Victoria			Other States		
	Obs.	Mean	St. Dev.	Obs.	Mean	St. Dev.
Age	7,031	29.918	5.579	11,238	29.136	6.325
Unmarried	6,957	0.602	0.490	11,278	0.618	0.486
Captured by 1941	7,000	0.998	0.040	11,057	0.998	0.044
Employed in Agriculture	7,071	0.514	0.500	11,313	0.449	0.497
Weight (kg)	6,821	65.298	7.083	10,676	64.474	7.306
Height (cm)	6,957	166.120	6.549	10,714	168.213	7.944

Notes: This table presents descriptive statistics on Italian prisoners of war detained in Australia. Panel (a) reports the distribution of POWs by state in Australia. In panel (b), summary statistics are reported separately for POWs held in Victoria and those who were detained in other Australian states.

Table A.2: The Effects of Prisoner Employment on Revenue-based Measures of Production and Productivity

	Production Wheat, Oats, and Barley (1)	Prod. per worker Wheat, Oats, and Barley (2)	Revenue Wheat, Oats, and Barley (3)	Rev. per worker Wheat, Oats, and Barley (4)
	Panel (a): Static DiD Estimates			
POW Eligible × Post	53.777	11.643***	423.867	86.203***
	(66.693)	(2.872)	(597.620)	(22.704)
Observations	6,800	6,800	6,800	6,800
R-squared	0.820	0.775	0.803	0.736
Mean D.V. control group	1946.804	57.041	12396.208	377.182
Mean D.V. in 1939	1626.097	54.725	12595.306	416.740
	Panel (b): Dynamic (event-study) DiD Estimates			
POW Eligible × 1935	5.089	4.347	77.039	36.719
	(63.609)	(3.038)	(442.904)	(22.541)
POW Eligible × 1944	566.740***	24.004***	3278.013***	161.426***
	(140.283)	(5.017)	(984.680)	(35.353)
POW Eligible × 1946	-247.534***	5.782	-1360.434**	55.208*
	(74.264)	(3.649)	(625.741)	(29.069)
POW Eligible × 1950	-150.253**	11.654***	-530.606	96.966***
	(72.510)	(3.287)	(636.859)	(26.982)
Observations	6,800	6,800	6,800	6,800
R-squared	0.823	0.777	0.805	0.737
Mean D.V. control group	1946.804	57.041	12396.208	377.182
Mean D.V. in 1939	1626.097	54.725	12595.306	416.740
Pre-trend slope (Roth 2022)	178.206	8.510	1240.832	63.150
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*

Notes: This table re-estimates Table 3 using wheat, oats, and barley, the crops for which price information is available, and compares quantity-based and revenue-based outcome measures. Columns 1 and 2 use total production and production per worker, while columns 3 and 4 use total revenue and revenue per worker. Revenue is calculated by multiplying each crop's production in imperial tons by its 1939 price per ton and then summing the resulting revenues across crops. The specifications are otherwise identical to those in Table 3. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.3: POW Labor Supply and Parish Productivity

	Number of POWs		Share of POWs	
	Total	Farmers	Farmers	Central and Southern Italy
	(1)	(2)	(3)	(4)
Output per worker, 1935–39	-0.222	-0.053	0.0002	0.0002
	(0.179)	(0.060)	(0.0003)	(0.0003)
Latitude	-16.457	-8.241	-0.102*	-0.038
	(33.274)	(13.423)	(0.055)	(0.044)
Longitude	15.547	-3.375	-0.030	0.006
	(25.936)	(6.485)	(0.028)	(0.016)
Distance from State Capital	-0.027	-0.064	0.0005	-0.0004
	(0.322)	(0.099)	(0.0003)	(0.0002)
Observations	1,762	1,762	1,762	1,762
R-squared	0.078	0.054	0.340	0.230
Mean D.V.	137.387	56.682	0.463	0.659
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*

Notes: This table reports regressions of the number of POWs (column 1), the number of POWs previously employed in agriculture (column 2), the share of POWs previously employed in agriculture (column 3), and the share of POWs from central and southern Italy (column 4) on 1935–39 productivity in POW-eligible parishes located within 40 km of a camp. Productivity is measured as production of all grains per worker. We classify Italian provinces into macro-regions following ISTAT's official classification. Standard errors, in parentheses, are clustered at the SA2 zone level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.4: POW Labor Supply and Census Entry Productivity

	Number of POWs		Share of POWs	
	Total	Farmers	Farmers	Central and Southern Italy
	(1)	(2)	(3)	(4)
Output per worker, 1935–39	-0.314*	-0.071	0.0004	0.0005
	(0.179)	(0.061)	(0.0003)	(0.0003)
Latitude	-6.967	-6.448	-0.122**	-0.046
	(39.956)	(18.433)	(0.048)	(0.044)
Longitude	28.155	1.410	-0.018	0.009
	(26.829)	(6.464)	(0.031)	(0.018)
Distance from State Capital	-0.019	-0.064	0.0004	-0.0005*
	(0.326)	(0.127)	(0.0003)	(0.0003)
Observations	5,283	5,283	5,283	5,283
R-squared	0.084	0.087	0.371	0.262
Mean D.V.	135.490	57.699	0.452	0.656
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*

Notes: This table reports regressions of the number of POWs (column 1), the number of POWs previously employed in agriculture (column 2), the share of POWs previously employed in agriculture (column 3), and the share of POWs from Central and Southern Italy (column 4) on average 1935–39 productivity in POW-eligible parishes located within 40 km of a camp. Productivity is measured as production of all grains per worker. We classify Italian provinces into macro-regions following ISTAT's official classification. The unit of observation is an entry in the Agricultural Census of Victoria, likely corresponding to a farm or group of farms. Standard errors, in parentheses, are clustered at the POW camp level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.5: Pre-war Parish Characteristics and POW Expertise

	N. of POWs experts in:				Tractors in POW	
	Potato		Maize		Province of origin	
	(1)	(2)	(3)	(4)	(5)	(6)
Potato (% of total area), 1935-39	1.167	1.883				
	(0.929)	(1.128)				
Maize (% of total area), 1935-39			0.598	0.900		
			(0.559)	(0.566)		
N. Tractors, 1935-39					-0.964	-1.621
					(1.193)	(0.997)
Observations	1,762	1,762	1,762	1,762	1,762	1,762
R-squared	0.001	0.112	0.002	0.123	0.006	0.084
Mean D.V.	24.041	24.041	6.259	6.259	350.787	350.787
Region by Year FEs	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*
Geo controls	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*

Notes: This table shows the association between pre-treatment (1939) share of area cultivated under potato or maize (columns 1 to 4) or number of tractors (columns 5 and 6) and the number of prisoners in the closest camp originating from provinces where potatoes or maize were the main crops cultivated before the war (columns 1 to 4) or the average number of tractors in prisoners' provinces of origin (columns 5 and 6). Geographic controls include: latitude, longitude, distance from Melbourne. Standard errors, in parentheses, are clustered at the POW camp level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.6: Mechanisms: Controlling for Differences across Italian Areas

	% of Total Area					
	Potato		Maize		Number of Tractors	
	Above Median	Below Median	Above Median	Below Median	Above Median	Below Median
	(1)	(2)	(3)	(4)	(5)	(6)
POW Eligible × Post	0.133***	0.045***	-0.123**	-0.024**	7.617**	1.390**
	(0.035)	(0.015)	(0.054)	(0.011)	(3.577)	(0.638)
Observations	3,443	3,355	3,180	3,618	2,700	2,740
R-squared	0.861	0.709	0.556	0.755	0.687	0.802
Mean D.V. control group	0.162	0.009	0.029	0.011	9.876	9.713
Mean D.V. in 1939	0.224	0.041	0.103	0.130	6.471	5.445
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Notes: In this table, we re-estimate the specifications reported in Panel (b) of Table 4 and columns 2 and 3 of Table 5, using measures of crop- and tractor-related expertise that account for differences across Italian provinces and macro-areas. We construct these measures by separately regressing potato production, maize production, and tractor use across Italian provinces in 1930 (1938 for tractors) on literacy rates, population over 5 years of age, and macro-area fixed effects (north, center, south, and islands). We then use the residuals from these regressions to classify each POW camp as having above- or below-median expertise in potato and maize cultivation, or tractor use, following the procedures used in Tables 4 and 5. The specifications otherwise are the same as those reported in Panel (b) of Table 4 and columns 2 and 3 of Table 5. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.7: Mechanisms Controlling for Prisoner Labor Availability

	% of Total Area			
	Potato		Maize	
	Above Median	Below Median	Above Median	Below Median
	(1)	(2)	(3)	(4)
POW Eligible × Post	0.197***	0.009	-0.178***	-0.015**
	(0.050)	(0.009)	(0.064)	(0.006)
N. POWs × Post	0.00027***	-0.00019	0.00002	-0.00024**
	(0.00009)	(0.00024)	(0.00003)	(0.00010)
Observations	3,248	3,550	2,758	4,040
R-squared	0.847	0.817	0.583	0.780
Mean D.V. control group	0.091	0.062	0.052	0.006
Mean D.V. in 1939	0.219	0.055	0.187	0.070
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*

Notes: In this table, we re-estimate the specifications reported in Panel (b) of Table 4 adding, as control, the interaction between the number of POWs held at the nearest camp and a post-1943 indicator. The specifications are otherwise identical to the corresponding baseline specifications. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.8: Mechanisms based on Farmers Only

	% of Total Area					
	Potato		Maize		Number of Tractors	
	Above Median	Below Median	Above Median	Below Median	Above Median	Below Median
	(1)	(2)	(3)	(4)	(5)	(6)
POW Eligible × Post	0.212***	0.032***	-0.161**	-0.020***	8.627**	1.194
	(0.052)	(0.010)	(0.066)	(0.007)	(4.033)	(0.920)
Observations	3,054	3,744	2,418	4,380	2,644	2,796
R-squared	0.825	0.904	0.576	0.772	0.675	0.822
Mean D.V. control group	0.106	0.055	0.057	0.006	7.477	11.270
Mean D.V. in 1939	0.239	0.048	0.199	0.072	4.546	7.286
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Notes: In this table, we re-estimate the specifications reported in Panel (b) of Table 4 and columns 2 and 3 of Table 5. To construct indicators for above- versus below-median expertise in potato cultivation, maize cultivation, and tractor use, we consider only POWs whose reported pre-war occupation in Italy was in agriculture. The specifications are otherwise identical to the corresponding baseline specifications. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.9: Excluding All Camps that Hosted Internees

	Production All Grains (1)	Prod. All Grains Per worker (2)	Total Production (3)	Total Prod. Per worker (4)
	Panel (a): Static DiD Estimates			
POW Eligible × Post	79.865	13.237***	106.993	12.608***
	(73.519)	(3.166)	(74.123)	(3.287)
Observations	6,110	6,110	6,110	6,110
R-squared	0.821	0.774	0.819	0.760
Mean D.V. control group	2067.136	60.424	2122.007	61.921
Mean D.V. in 1939	1716.321	58.384	2020.528	64.941
	Panel (b): Dynamic (event-study) DiD Estimates			
POW Eligible × 1935	-1.945	4.481	-76.770	3.776
	(69.745)	(3.356)	(72.515)	(3.548)
POW Eligible × 1944	657.484***	27.143***	641.811***	26.386***
	(154.663)	(5.528)	(157.081)	(5.711)
POW Eligible × 1946	-267.135***	6.389	-272.985***	5.508
	(81.555)	(4.033)	(84.021)	(4.276)
POW Eligible × 1950	-153.667*	12.891***	-162.801**	11.585***
	(79.692)	(3.630)	(81.955)	(3.940)
Observations	6,110	6,110	6,110	6,110
R-squared	0.824	0.777	0.822	0.763
Mean D.V. control group	2067.136	60.424	2122.007	61.921
Mean D.V. in 1939	1716.321	58.384	2020.528	64.941
Pre-trend slope (Roth 2022)	195.397	9.401	203.156	9.940
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*

Notes: In this table, we re-estimate the specifications reported in Table 3, excluding camps that hosted at least one internee in Victoria. The specifications are otherwise identical to the corresponding baseline specifications. The total-production measure in columns 3 and 4 consider includes all crops for which output can be measured: wheat, oats, barley, peas, rye, grass/clover and alfalfa. Output measures across crops are harmonized as described in Data Appendix C.2. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.10: Mechanisms Excluding All Camps that Hosted Internees

	% of Total Area					
	Potato		Maize		N. of Tractors	
POW expertise:	Above Median	Below Median	Above Median	Below Median	Above Median	Below Median
	(1)	(2)	(3)	(4)	(5)	(6)
POW Eligible × Post	0.151***	0.011	-0.044	-0.010*	9.410**	-0.253
	(0.045)	(0.009)	(0.033)	(0.006)	(4.646)	(0.620)
Observations	2,678	3,430	2,138	3,970	2,504	2,384
R-squared	0.850	0.817	0.699	0.780	0.691	0.814
Mean D.V. control group	0.098	0.062	0.032	0.006	10.270	10.448
Mean D.V. in 1939	0.261	0.057	0.163	0.071	6.147	6.097
Region by Year FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Parish FEs	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Notes: In this table, we re-estimate the specifications reported in Panel (b) of Table 4 and columns 2 and 3 of Table 5, excluding camps that hosted at least one internee in Victoria. The specifications are otherwise identical to the corresponding baseline specifications. Standard errors, in parentheses, are clustered at the parish level. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

B Additional Historical Background on Italian POWs in Australia

This appendix complements the historical background in Section 2. It describes how Italian soldiers were captured in large numbers early in WWII, the conditions of their detention in Australia, and the relationships they formed with Australian farmers during and after the employment program.

B.1 WWII and the Problem of POWs

While prisoners of war have existed throughout the history of warfare, the scale of captivity reached unprecedented levels during WWII, with at least 12 million soldiers taken prisoner by all belligerent countries (Davis, 1977, p. 624).[29] Great Britain alone took more than 3 million prisoners over the course of the war (Davis, 1977, p. 624).

For most of the conflict, Italians constituted the majority of prisoners of war held by the British. This predominance reflected the scale of Italy's early military defeats. When Mussolini brought Italy into World War II on 10 June 1940, siding with the Axis powers despite opposition from his foreign minister and senior military leaders (Knox, 1982), the Italian army was largely unprepared for war and soon suffered major defeats in North and East Africa, where large numbers of its troops were captured. Between December 1940 and February 1941, the British offensive in Egypt and Libya (Operation Compass) alone took about 130,000 Italian prisoners, and tens of thousands more were captured in East Africa in the spring of 1941.[30] By September 1943, when Italy signed the Armistice of Cassibile, the British Empire held 315,966 Italian prisoners (Moore and Fedorowich, 2002, Table 1), out of 591,000 held by the Allies (Ministero della Guerra, 1947). Even in early 1945, after the Allied landings in France had brought in large numbers of German prisoners, Italians still accounted for about 60 percent of the prisoners captured and held by Britain (376,600 out of 617,100, Moore and Fedorowich, 2002, Table 3).

Holding this large number of prisoners was costly and organizationally challenging: they had to be guarded, fed, and housed when food and manpower were scarce resources. For this reason, starting in 1941, Italian prisoners were reallocated across the Empire, including

[29] According to Davis (1977), p. 624, the total number of prisoners ranges between 12 and 35 million, with the upper bound being inflated by the mass surrenders of German and Japanese forces at the end of the war.

[30] These included about 38,300 prisoners taken at Sidi Barrani in December 1940, between 36,000 and 40,000 at Bardia and about 25,000 at Tobruk in January 1941, and about 25,000 at Beda Fomm in February 1941. In East Africa, the surrender of the Duke of Aosta at Amba Alagi in May 1941 brought the number of prisoners taken in that area to 18,000–19,000 (Long, 1952; Playfair et al., 1954).

to Australia, as described in Section 2.

B.2 The Experience of Italian POWs in Australia

The experience of Italian POWs in Australia has been described as "neither eventful nor horrific" (Saunders, 2009, p. 28). Australian authorities largely adhered to the provisions of the Geneva Convention, and Italian prisoners were overall "well treated and respected by the local populace" (Moore and Fedorowich, 2002, p. 72). The mortality rate was remarkably low: only 101 of the 18,432 Italian POWs (0.5%) died while in Australia, 85 of them of natural causes (Fitzgerald, 1981, p. 116).

In this respect, detention in Australia differed markedly from detention in Allied camps in Europe and Asia, where living conditions were considerably harsher, food shortages frequent, and diseases widespread (Fitzgerald, 1981; Tonizzi, 2013). Conditions were similarly harsh for the Italian soldiers held by Germany after September 1943, who were officially classified as "internees," a designation adopted to circumvent the provisions of the Geneva Convention (Hammermann, 2004).

Historical accounts point to generally positive relationships between Italian POWs and the Australian farmers who employed them (Section 2). While language was a major barrier to communication, Australian families helped prisoners learn English, often providing them with dictionaries, and occasionally tried to learn some Italian themselves (Fitzgerald, 1981). It was not uncommon for farmers and prisoners to share meals and daily routines, and in some cases prisoners lived in their employers' homes. Of course, not all experiences were positive, and some prisoners who refused to work were disciplined. However, in letters to their families in Italy, most prisoners described farm life in positive terms, particularly when they were treated "as a member of the family" rather than as prisoners (Fitzgerald, 1981, p. 117 and Ch. 9).

Historical accounts also contain examples of prisoners' agricultural knowledge changing local farming practices. Two cousins from Arezzo, in Tuscany, Bruno Duranti and Remo Salvini, were employed by the Littlely family in South Australia (Fitzgerald, 1981, p. 94). Bruno was struck by the waste of animal manure and dairy washings, which in Italy were commonly reused as fertilizers. According to Fitzgerald, as a result of POW employment this practice became "in force in most Australian dairies" (Fitzgerald, 1981, p. 95).

In several cases, farmers and former prisoners stayed in touch after the war, mostly by letter (Fitzgerald, 1981, p. 103). Some employers even visited their former workers in Italy years later. In 1961, while visiting Rome, the Cribb family from Queensland took the train to Grosseto to see their former employee Severino Donato and "spent some hours with him"

(Fitzgerald, 1981, p. 100). Similarly, when the Plueckhan family, who had employed Vincenzo Di Mais from Naples on their farm in South Australia, travelled to Europe in 1969, they made a considerable effort to find his address and visit him. Di Mais reportedly "welcomed them with open arms," showed them his home and workplace, and still kept photographs of the family in his bedroom (Fitzgerald, 1981, p. 101).

C Data Appendix

This Data Appendix describes the data collection procedures behind our paper in greater detail. It describes the primary sources, their coverage, and provides additional details about the resulting dataset.

C.1 Prisoners of war records

The first step in data collection involved compiling a comprehensive list of Italian prisoners of war (POWs) detained in Australia during World War II. The relevant individual-level, military records are held by the Australian National Archives (NAA). These files have been digitized and we accessed them through the NAA's online archival portal, RecordSearch (https://recordsearch.naa.gov.au/), in July 2020.

More specifically, we queried series number MP1103/1, which contains the *Service and Casualty* Forms (Form A112) "for internees, and prisoners of war captured (dead or alive) by the Australian Military Forces or an Allied force, and held in camps in Australia" between January 1, 1939, and December 31, 1947. These forms record rich individual-level information, including an identification number; full name; date and place of capture; date and place of birth; occupation in Italy before WWII; religion; nationality; marital status; name and address of next of kin; some physical characteristics such as hair and eye color; and any distinctive marks. They also document the individual's period of detention: importantly for our analysis, the camps in which POWs were detained and the transfers across camps – information that allows us to know which POWs were in any given camp in a given year (see Appendix C.5 for details on how prisoners were linked to camps) – as well as hospitalizations and disciplinary proceedings if any, and release and repatriation dates to Italy. Figure C.1 provides an example of one such record.

To download all the files referring to Italian POWs or internees, we proceeded in two steps. First, we downloaded all files with identifier *PWI*, which—according to official NAA documentation—refer to Italian prisoners of war.[1] These files were a total of 18,502. Sec-

[1]The following file-level identifiers, called control symbols by NAA, refer to Italian prisoners of war: (i) PWI:

ond, we collected all remaining records for individuals of Italian nationality, totaling 5,422 records. Most of them correspond to internees, which we identified following the NAA's official description.[2] A small number of these records (180), however, refer to POWs for whom the identifier *PWI* was not properly recorded, either in the original military form or in the NAA digitization. We identified and corrected these cases by manually verifying the original archival documents.

We digitized a total of 23,924 records of POWs and internees, with the assistance of a data entry company. Some records were duplicates of the same individuals;[3] after their removal, the final dataset comprises 18,411 unique POWs. This figure covers nearly the entire universe of 18,432 Italian POWs held in Australia during WWII, according to official government statistics (NAA Series A7711/1, p. 106), a number also reported in secondary sources (Fitzgerald, 1981, p. 172; Moore and Fedorowich, 2002, p. 72).[4] We also identify 4,960 unique Italian internees arrested either in Australia or in Allied countries and detained in Australia, roughly 96% of the 5,179 Italian internees recorded by official statistics (4,754 interned locally and 425 received from overseas; NAA Series A7711/1, pp. 91 and 19) and of the 5,152 reported by Moore and Fedorowich (2002) (p. 73).

For "each prisoner of war or internee captured by the Australian Military Forces and/or held in camps in Australia," the Prisoners of War Information Bureau maintained an additional set of "basic documents," that we downloaded for Italian individuals from the NAA series number 1103/2. These documents contain three forms: the *Report on Prisoner of War/Internee* (Form A111), the *Property Statement – Prisoner of War/Internee* (Form A114), and the *Report on Prisoners of War for Information of International Bureaux of Relief and Information* (Form A111A). The *Report on Prisoner of War/Internee* includes, in addition to the identification number and name, additional individual demographic information such as height, weight, and complexion, each POW's address in Italy, which allows us to identify the POW's province of residence before the war, the place and date of capture, the date and port of embarkation and disembarkation in Australia, and the first internment camp and date (Figure C.2). The *Property Statement* records personal items of value and

Italian POWs held on behalf of the United Kingdom; (ii) PWI USA: Italian POWs held on behalf of the United States; (iii) PWIM Italian: Italian POW merchant seamen held on behalf of the United States; (iv) PWIA Italian: Italian POWs held by the Commonwealth; and (v) PWIX Italian: Italian POWs captured in various locations and transported to Australia via India.

[2]According to NAA, internees' file-level identifiers contain the label *PW* followed by a letter indicating the state or the country of capture. For Australia: i) Q - Queensland; ii) N - New South Wales; iii) V - Victoria; iv) S - South Australia; v) W - Western Australia; vi) T - Tasmania; vii) D - Darwin. For other Allied countries: viii) E – England; ix) P – Palestine; x) Z – Singapore; xi) CI – New Caledonia.

[3]These records were digitized twice by NAA, so they have different file-identifier numbers, but the same official individual identifier, as well as the same personal information.

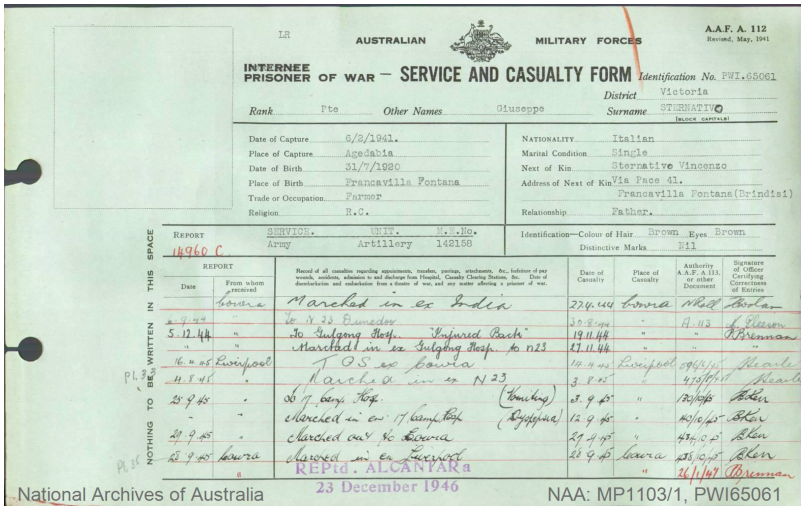
[4]Extensive discussions with NAA staff did not lead to identifying the existence of the missing 21 records.

money owned by the POW or internee; in most cases, this consists of small amounts of cash and a few belongings, such as blankets and pillows (Figure C.3). The *Report on Prisoners of War for Information of International Bureaux of Relief and Information*, compiled by the Prisoners of War Information Bureau upon receiving Forms A111 and A114 in observance of the Geneva Convention, includes information on next of kin, date and place of capture, first place of internment, and the Australian and Middle East POWs identification numbers (Figure C.4).

While the *Report on Prisoner of War/Internee* is available for most POWs (97%) and internees (90%), the other two forms are not systematically available. As they do not contain additional information relevant to our analysis, we do not rely on them.

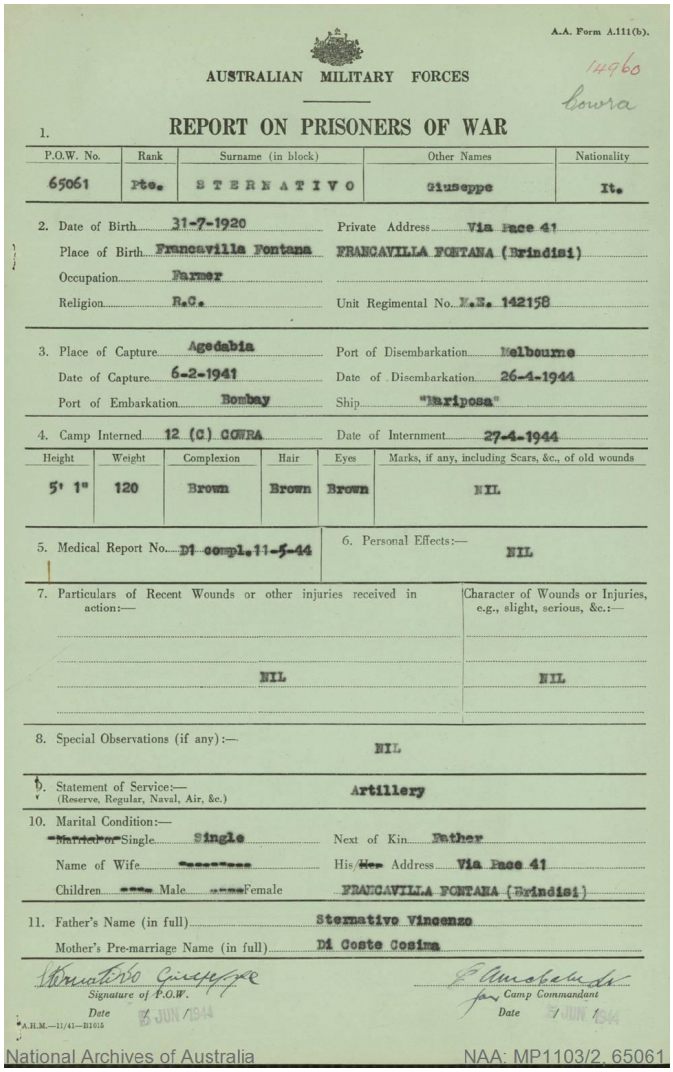
Our analysis focuses on POWs and not internees who were not permitted to work outside the detention camps. Unlike POWs, internees were predominantly detained in Queensland (43%), followed by Western Australia and New South Wales (24.5% and 16.4%, respectively). Victoria—the state at the core of our analysis—hosted only 315 Italian internees (6% of the total). Internees in Victoria were highly concentrated: 97% were held in just three camps. Possibly reflecting concerns that internees were more politically aligned than POWs, these camps housed a disproportionately large share of internees, between 70 and 90% of the occupants. The remaining five camps hosted between one and six internees each, representing less than 3% of the total occupants of these camps.

Figure C.1: Example of *Service and Casualty Form*



Notes: This figure shows an example of the *Service and Casualty Form* (Form A112) for an Italian POW. The form reports, among other information, the POW's first and last names, identification number, date and place of capture, date and place of birth, occupation, religion, nationality, marital status, name and address of next of kin, hair and eye color, and any distinctive marks, movements across camps while in Australia, and repatriation date.

Figure C.2: Example of *Report on Prisoner of War*



A.A. Form A.111(b).

AUSTRALIAN MILITARY FORCES

1496
Cowra

1. REPORT ON PRISONERS OF WAR

P.O.W. No.	Rank	Surname (in block)	Other Names	Nationality
65061	Pte.	S T E R N A T I V O	Giuseppe	It.

2. Date of Birth 31-7-1920 — Private Address Via Pace 41
Place of Birth Francavilla Fontana — FRANCAVILLA FONTANA (Brindisi)
Occupation Farmer
Religion R.C. — Unit Regimental No. M.E. 142158

3. Place of Capture Agedabia — Port of Disembarkation Melbourne
Date of Capture 6-2-1941 — Date of Disembarkation 26-4-1944
Port of Embarkation Bombay — Ship "Mariposa"

4. Camp Interned 12 (C) COWRA — Date of Internment 27-4-1944

Height	Weight	Complexion	Hair	Eyes	Marks, if any, including Scars, &c., of old wounds
5' 1"	120	Brown	Brown	Brown	NIL

5. Medical Report No. D1 compl. 11-5-44
6. Personal Effects:— NIL

7. Particulars of Recent Wounds or other injuries received in action:— NIL
Character of Wounds or Injuries, e.g., slight, serious, &c.:— NIL

8. Special Observations (if any):— NIL

9. Statement of Service:— (Reserve, Regular, Naval, Air, &c.) Artillery

10. Marital Condition:— ~~Married or~~ Single
Name of Wife ~~xxxxxxxx~~
Children ~~xxxx~~ Male ~~xxxx~~ Female
Next of Kin Father
His/~~Her~~ Address Via Pace 41
FRANCAVILLA FONTANA (Brindisi)

11. Father's Name (in full) Sternativo Vincenzo
Mother's Pre-marriage Name (in full) Di Coste Cosima

Signature of P.O.W.
Date 13 JUN 1944

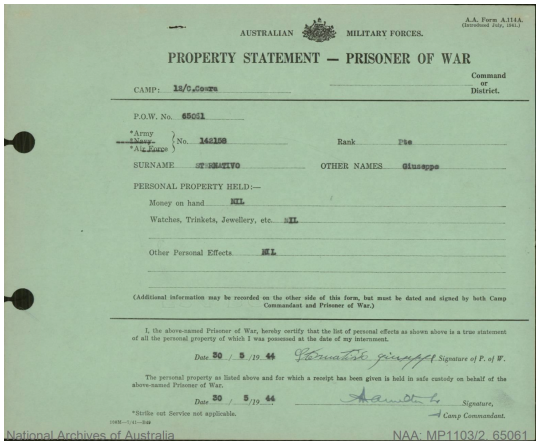
for Camp Commandant
Date 7 JUN 1944

A.H.M.—11/41—B1015

National Archives of Australia NAA: MP1103/2, 65061

Notes: This figure shows an example of the *Report on Prisoner of War* (Form A111) for the Italian POW Giuseppe Sternativo. The form reports, among other information, POW first and last name, identification number, date and place of capture, date and place of birth, occupation, religion, date and port of embarkation and disembarkation, internment camp and date, height, weight, complexion, hair and eye color and marks.

Figure C.3: Example of *Property Statement*



AUSTRALIAN MILITARY FORCES. A.A. Form A.114A. (Introduced July, 1941.)

PROPERTY STATEMENT — PRISONER OF WAR

CAMP: 12/C.Cowra — Command or District.

P.O.W. No. 65061

*Army / *Air Force — No. 142158 — Rank Pte

SURNAME STERNATIVO — OTHER NAMES Giuseppe

PERSONAL PROPERTY HELD:—

Money on hand NIL

Watches, Trinkets, Jewellery, etc. NIL

Other Personal Effects NIL

(Additional information may be recorded on the other side of this form, but must be dated and signed by both Camp Commandant and Prisoner of War.)

I, the above-named Prisoner of War, hereby certify that the list of personal effects as shown above is a true statement of all the personal property of which I was possessed at the date of my internment.

Date 30 / 5 /19 44 — Signature of P. of W.

The personal property as listed above and for which a receipt has been given is held in safe custody on behalf of the above-named Prisoner of War.

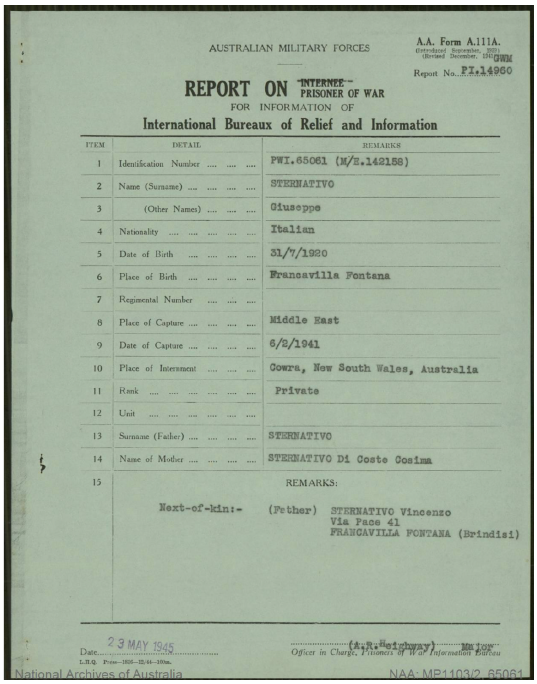
Date 30 / 5 /19 44 — Signature, Camp Commandant.

*Strike out Service not applicable.

National Archives of Australia NAA: MP1103/2, 65061

Notes: This figure shows an example of the *Property Statement* (Form A114) for the Italian POW Giuseppe Sternativo. The form reports POW first and last name, identification number and personal property held.

Figure C.4: Example of *Report on Prisoners of War for Information of International Bureaux of Relief and Information*



AUSTRALIAN MILITARY FORCES

A.A. Form A.111A. (Introduced September, 1939) (Revised December, 1941)

Report No. P.I.14960

REPORT ON ~~INTERNEE~~ PRISONER OF WAR FOR INFORMATION OF

International Bureaux of Relief and Information

ITEM	DETAIL	REMARKS
1	Identification Number	PWI.65061 (M/E.142158)
2	Name (Surname)	STERNATIVO
3	(Other Names)	Giuseppe
4	Nationality	Italian
5	Date of Birth	31/7/1920
6	Place of Birth	Francavilla Fontana
7	Regimental Number	
8	Place of Capture	Middle East
9	Date of Capture	6/2/1941
10	Place of Internment	Cowra, New South Wales, Australia
11	Rank	Private
12	Unit	
13	Surname (Father)	STERNATIVO
14	Name of Mother	STERNATIVO Di Coste Cosima
15	REMARKS: Next-of-kin:- (Father)	STERNATIVO Vincenzo, Via Pace 41, FRANCAVILLA FONTANA (Brindisi)

Date 23 MAY 1945 — (A.R. Hathaway) Major — Officer in Charge, Prisoners of War Information Bureau

National Archives of Australia NAA: MP1103/2, 65061

Notes: This figure shows an example of the *Report on Prisoners of War for Information of International Bureaux of Relief and Information* (Form A111A) for the Italian POW Giuseppe Sternativo. The form reports POW first and last name, identification number, date and place of birth, place of internment, parents' names and address of the next of kin.

C.2 Agricultural Census Data in Victoria

We collected information on agricultural inputs and outputs from the *Australian Agricultural Census* for the state of Victoria. We focus on Victoria because, to the best of our knowledge, it is the only state that systematically collected these data both before and after World War II. Although the Agricultural Censuses were compiled by the Commonwealth Bureau of Census and Statistics separately for each Australian state, repeated attempts to locate comparable data for other states were unsuccessful.

The Victorian Agricultural Censuses belong to series MP570/1, "Summaries of agricultural, dairying and pastoral statistics obtained from police collectors' books in Victoria" which we physically collected from the National Archives of Australia (NAA) in Melbourne in October 2020. We focus on the years 1935–36, 1939–40, 1944–45, 1946–47, and 1950–51, as these are the only years for which complete volumes exist for all counties. In other years, data for some counties are missing from the NAA and could not be located despite extensive correspondence with NAA staff. These five years nonetheless provide strong coverage for our analysis: two years before POW arrivals, one year during POW employment, and two years after their departure.

The Victorian Agricultural Censuses consist of county-level summaries of agricultural, dairying, and pastoral statistics. Each of the 37 counties is assigned a unique registration number (e.g., Bourke is county number 1, see Figure C.5), and agricultural data are recorded in separate booklets for each county. For any given census year, the structure of these booklets is uniform across counties. Although the same entry identifiers are used across years, the set of agricultural variables changes between the 1939–40 and 1944–45 censuses, while remaining consistent in the years before and after this break.

For the 1935–36 and 1939–40 seasons, the censuses report statistics on the following categories: Tenure of Land; Hands Employed—by Use; Cereal, Hay, and Fodder Crops—Acreage; Cereal, Hay, and Fodder Crops—Production; Root Crops, Orchards, and Vineyards—Acreage; Land in Fallow, Pastures, Ensilage, etc.; Horses; Farm Machinery; and Wheat and Oat Growers.[5] For the 1944–45, 1946–47, and 1950–51 seasons, the categories collected are: Number of Persons Working on Holdings; Cereal, Hay, and Fodder Crops—Acreage; Root Crops, etc. and Orchards—Acreage; Vineyards and Other Crops; Land in Fallow—Acreage; Cereal, Hay, and Fodder Crops—Production; All Other Crops—Production; Horses; Artificial Fertilizers;

[5]The Victorian Agricultural Censuses also include extensive information on husbandry. For example, in 1935–36 these sections cover Dairy Cattle; Pigs; Sheep; Shearing and Wool Production; Lambing; Slaughtering and Mortality of Stock; Butter and Cheese; Bees; Ensilage; Chaff; Straw; Fodder Consumed; Manure Used; and Cowkeepers and Pigkeepers. Husbandry statistics are reported less consistently across seasons. Because our analysis focuses on agriculture, we describe in detail only the agriculture-related components of the data.

and Machinery. The "Machinery" section is not available for the 1944–45 census.

Each census entry corresponds to either a single holding or a group of holdings. Because consistent identifiers for holdings over time are unavailable—and because it is not possible to determine whether an entry refers to one or multiple holdings—we aggregate the raw data to the parish level to obtain a consistent unit of observation across years. The parish is the most disaggregated unit that remains time-consistent. To match observations across census years, we use the following variables: county identifier, county name, book letter, line number, shire/municipality name, and parish name. This procedure allows us to consistently match 97.7% of parishes across the five census waves. The final sample comprises 1,680 parishes, yielding 8,400 parish-year observations.

The crops reported are alfalfa, barley, chicory, citrus, flax, fodders, grapes, grass/clover, hops, maize, millet, nurseries, oats, onions, other fruits, peas, potatoes, pumpkins, rye, sugar beet, tobacco, and wheat. For each crop, the data report the area cultivated in acres. For a subset of crops, the censuses also record production quantities: alfalfa, barley, grass/clover, oats, peas, rye, and wheat. These quantities are recorded either in imperial tons or in bags. When production is reported in bags, we first convert quantities into metric tonnes using the crop-specific conversion rates reported in Panel (a) of Table C.1 (Office of the Government Statist, Victoria, 1912). We then convert the resulting quantities from metric tonnes to imperial tons using a conversion rate of 0.984207 imperial tons per metric tonne.

Aggregate yield data. Data on yields of main Italian crops in Australia prior to POW employment come from "Commonwealth Bureau of Census and Statistics, Official Year Book No. 25 (1932), Chapter XX, p.627"[6]. The crops used to compute average yields are wheat, maize, potatoes, sugar beet, and grapes. The aggregate measure is a weighted average of crop-level yields, with weights based on total Australian production of each crop. The Australian crop-level yields are reported in Panel (b) of Table C.1. The corresponding Italian yields come from the 1930 *Agricultural Census* and are reported in the same panel (see Section C.6).

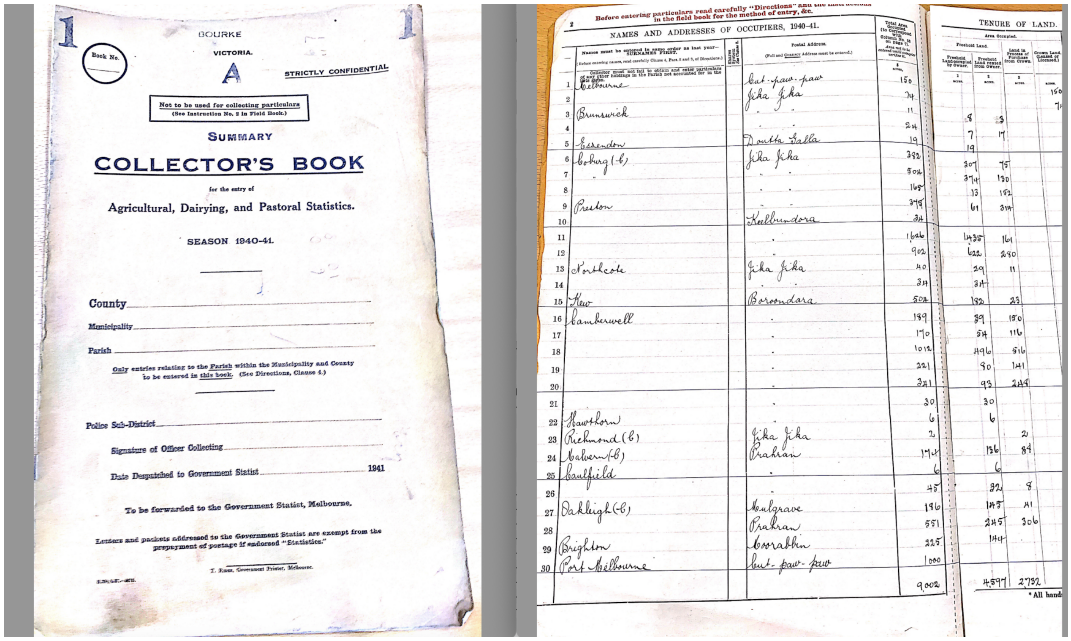
Yields in Italy around 1930 were generally similar or higher than the corresponding yields in Australia. The main exception is represented by grapes and is due to the differential diffusion of this crop in the two countries. In Italy grapes represent one of the most widely produced crops nationwide, with a sizable portion of this production occurring on mixed fields, i.e. fields where grapes were grown on the same land with other crops. By construction, using this cultivation method depressed measured yield, as production is divided by a larger area that is used for multiple uses. On the other hand, in Australia grapes represented a

[6] https://openresearch-repository.anu.edu.au/entities/publication/7aa59ae9-7b6c-428b-9919-b3d981467b81

minor crop, concentrated in a few highly specialized farms, where only grapes were grown. Hence, the stark difference in yields reflects the different patterns of grape production of the two countries at the time.

Data on crop prices. Information on crop prices in 1939 is available from the "Australia Yearbook, 1944 – Chapter 20, Agricultural Production"[7] (wheat: p. 793, oats: p. 804, malting barley: p. 810) only for wheat, barley and oats among the main crops. Raw prices per bushel are converted to prices per ton[8] and then multiplied by production of each crop respectively to obtain revenues. Revenue from the main crops are therefore the sum of revenues for wheat, barley, and oats.

Figure C.5: Example of Victorian *Agricultural Census* Records



Notes: This figure shows an example of the Victorian *Agricultural Census* for Bourke (county number 1).

[7] https://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/1301.01944-45?OpenDocument

[8] Conversion rate for wheat is obtained from USDA ERS data (https://www.ers.usda.gov/data-products/wheat-data/documentation), while for oats and barley we use conversion rate from Rayglen (https://www.rayglen.com/crop-bushel-weights/). Conversion rates from bushels to tons: wheat 36.7437, oats 64.842, barley 45.9296.

Table C.1: Conversion Rates and Crop Yields

Panel (a): Conversion rates	
Crop	Bags per metric tonne
Wheat	12.3555
Barley	14.8266
Oats	17.2977
Peas	12.3555
Rye	13.1200

Panel (b): Crop yields		
	Yield (tonnes per hectare)	
Crop	Australia	Italy
Wheat	0.571	1.414
Maize	1.658	1.618
Potatoes	5.172	6.620
Sugar beet	26.639	26.709
Grapes	9.064	1.911

Notes: Panel (a) reports the crop-specific conversion rates used to convert production reported in bags into metric tonnes. The rates are from Office of the Government Statist, Victoria, 1912. Panel (b) reports average crop yields in Australia and Italy around 1930. Australian yields are from the *Official Year Book of the Commonwealth of Australia No. 25* (1932), Chapter XX, p. 627. Italian yields are from the 1930 Italian *Agricultural Census*; see Section C.6.

C.3 Australian Enlistment Data

We collected data on Australian enlistment from the Australian Government Department of Veterans' Affairs, which has published nominal rolls listing members of Australia's defense forces who served during WWII, Korean War, Vietnam War and First Gulf War.[9] We downloaded data on the 63,288 soldiers resident in Victoria who served during WWII and for whom enlistment location was available. We used enlisted individuals' place of residence to construct a measure at the Statistical Area Level 2 (SA2) zone level on WWII enlistment, the most disaggregated geographical level available. SA2 zone-level enlistment data are then matched to the agricultural parish-level data using the shire to which each parish belongs reported in the agricultural censuses. Shires are matched to SA2 zones based on names and on overlapping polygons when names don't match.

The mean enlistment count across SA2 regions in Victoria is 518.91. Enlistment varies substantially, ranging from 0 to 3,647 soldiers enlisted per SA2 (see Appendix Table C.2).

[9]https://nominal-rolls.dva.gov.au/ww2 accessed in January 2022.

Table C.2: Enlistment: summary statistics

	Obs.	Mean	St. Dev.	Min	Max
Enlistment	129	518.907	732.477	0	3,647

Notes: This table reports descriptive statistics on WWII enlistment across Statistical Area Level 2 (SA2) regions in Victoria. We use each individual's place of residence at the time of enlistment to construct SA2-level enlistment counts. SA2 is the most disaggregated geographic level at which enlistment is recorded.

C.4 Crop Suitability: GAEZ Data

To measure crop suitability to the Australian soil, we used the Global Agro-Ecological Zones (GAEZ) database, developed jointly by the Food and Agriculture Organization (FAO) and the International Institute for Applied Systems Analysis (IIASA).[10] These data provide spatially detailed information on the agro-ecological suitability and potential productivity of land for a wide range of crops under varying input and climate scenarios. They also include biophysical characteristics such as climate, soil, topography, and land cover, as well as crop-specific agronomic requirements.

For all available crops in the FAO-GAEZ data, we downloaded the corresponding suitability index raster data for Australia. To compute a measure of crop suitability that does not capture any human intervention, we select the variable "Suitability index range (0 – 10000); all land in grid cell", computed based on climatic data for the period 1961-1990 – the earliest available, water supply is set to "rainfed", input level to "low", and fertilization to "without CO2 fertilization". Using this specification of the suitability index, we compute the average suitability index in a radius of 5, 10, 15 km of the parish centroids and use the resulting value as a measure of crop suitability at the parish level.

The dataset is only available for the period 1961–1990, which we therefore use in our analysis. Although this period postdates POW employment, we do not view this as a major concern, since crop suitability is unlikely to have changed substantially over time.

C.5 POW Camps

We retrieved the full list of military POW camps in Australia from Fitzgerald (1981). These data were, in turn, collected and digitized from the NAA series A7711 "Report on the Directorate of Prisoners of War and Internees of Army Headquarters," located in Melbourne.

Overall, Australia had 187 POW camps. We geolocated the centroids of these camps using historical camp maps and Google Maps. Of these, 41 were located in Victoria. An

[10] We downloaded the latest released version (GAEZ v4) in Fall 2021 from "Suitability and Attainable Yield" section available at https://gaez.fao.org/pages/data-viewer-theme-4

additional two camps in New South Wales and two in South Australia were sufficiently close to the Victorian border to fall within 40 kilometers of at least one Victorian parish, bringing the total number of camps used in our analysis to 45. Figure A.2 shows the distribution of these camps across Victoria.

The first camp that hosted Italian POWs was Murchison in June 1941. The last ones to close in January 1947 were Seymour, Puckapunyal, Attwoods-Broadmeadows, and the two Tatura camps. On average, camps could host almost 400 individuals but were fairly heterogeneous in size. The largest one, Murchison, could host up to 4,000 people, while the smallest one, Corryong, only 25.

For the analysis of mechanisms presented in Section 6, we use fuzzy string matching (Raffo, 2015) to link the camp named in each prisoner's MP1103/1 *Service and Casualty Form* to the list of 45 relevant camps described above. We do so by constructing a panel containing one observation per POW-year. For POWs detained in multiple camps during a given year, we retain the camp in which the prisoner spent the most time, as this is likely to best capture their principal place of employment. To construct the camp-level measures of exposure to relevant crops and technologies used in Section 6, we consider all POWs for whom a given camp was the primary camp for at least one year.[11]

C.6 Italian Census Data

We collected and digitized data on Italian agricultural outcomes from the 1930 *Agricultural Census*, the last available year before the war, compiled by the Italian Statistical Office (ISTAT). More specifically, we retrieved information on the top three crops cultivated in each province. We then matched this information with POWs' province of origin, information available for around 87% of POWs in our sample. Provinces are relatively small in size in Italy, and agricultural conditions and expertise tend to be similar across municipalities within a province.

We complement these data with the province-level information on the number of tractors, retrieved from Bianchi and Giorcelli (2023), which were in turn collected from the *Annuario di Statistica Agraria* (Annals of Agricultural Statistics) in 1938, the last available year before WWII. We also use data on province-level literacy rates from the 1931 Italian Population Census, previously collected and digitized by Bianchi and Giorcelli (2023). Because POWs reported their province of residence when they were captured between 1940 and 1943, we

[11] We do not simply use the first camp of detention because, upon arrival, POWs were generally taken to a major reception camp, such as Murchison in Victoria, before being relocated. The initial camp therefore provides an incomplete picture of their geographic distribution and likely places of employment during the war.

harmonize the data using the 1936 provincial boundaries, the last pre-war boundaries provided by the Italian National Institute of Statistics (ISTAT). Two provinces included in the 1936 boundaries did not yet exist when the agricultural production and literacy data were collected in 1930 and 1931: Littoria (now Latina), created in 1934 from the province of Rome, and Asti, created in 1935 from the province of Alessandria. For agricultural production, we use the 1930 values subsequently reconstructed by ISTAT for Littoria and Asti. Because literacy rates are available only under the 1931 boundaries, we assign Littoria and Asti the rates of their respective parent provinces, Rome and Alessandria.

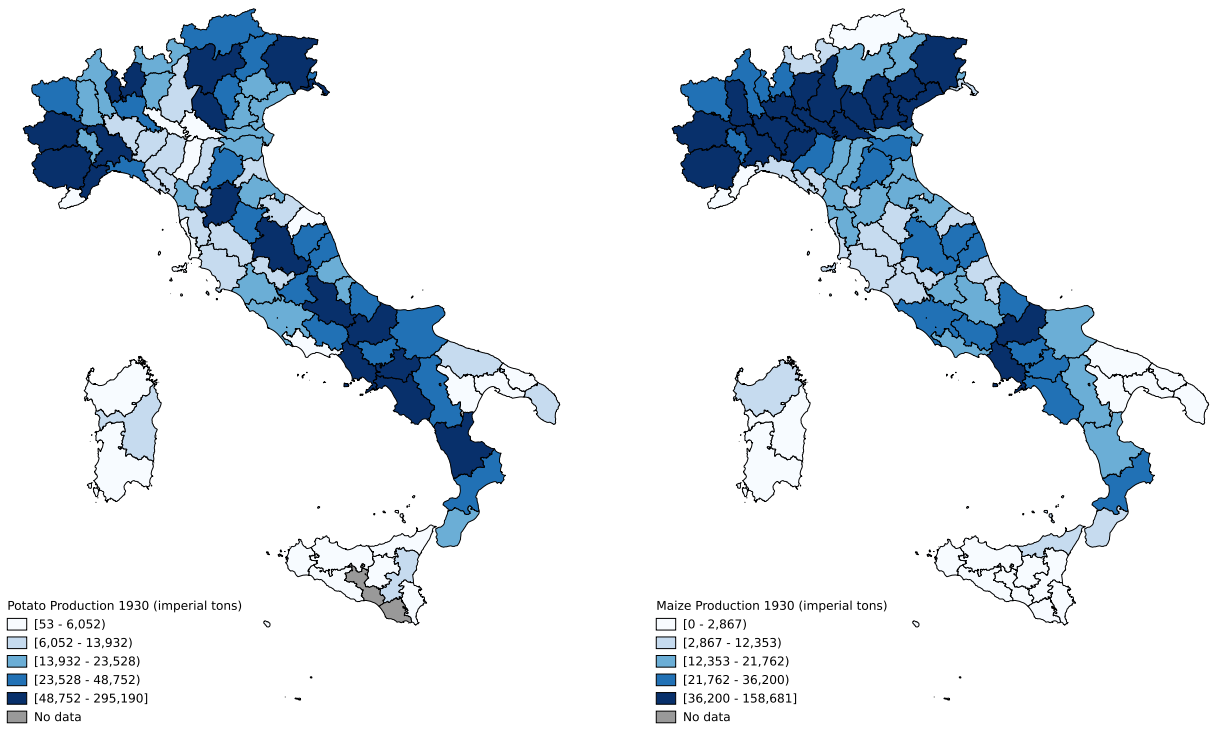
Figures C.6 and C.7 below show the distributions of potato and maize production, tractor numbers, and literacy rates across Italian provinces. The maps use Italy's national and provincial boundaries as reconstructed by the Italian National Institute of Statistics (ISTAT) for 1936.[12] The version of the ISTAT boundaries provided for 1936 does not include the former provinces of Pola, Fiume (Carnaro), and Zara, which were part of Italy in 1936 but were ceded after the war under the 1947 Paris Peace Treaty. This does not affect the figure because our sample contains no prisoners residing in these provinces before the war.

[12]These boundaries are available at: https://www.istat.it/notizia/confini-statistico-amministrativi-analisi-storica/

Figure C.6: Italian Potato and Maize Production in 1930

(a) Potato production

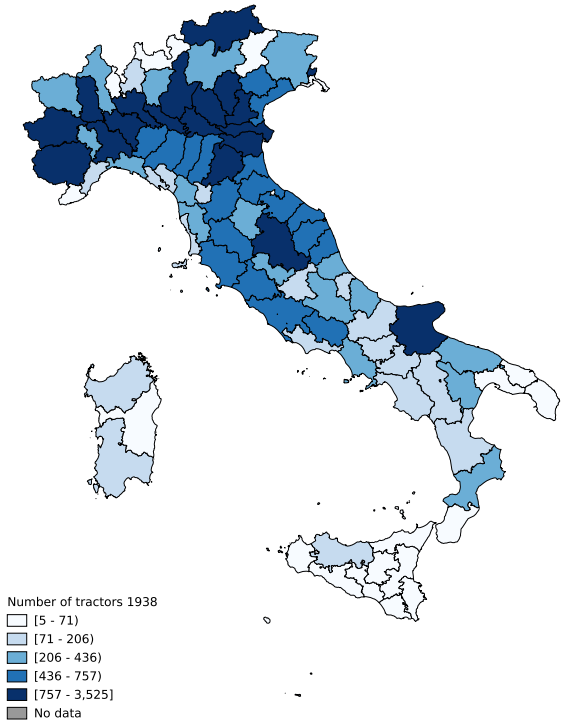
(b) Maize production



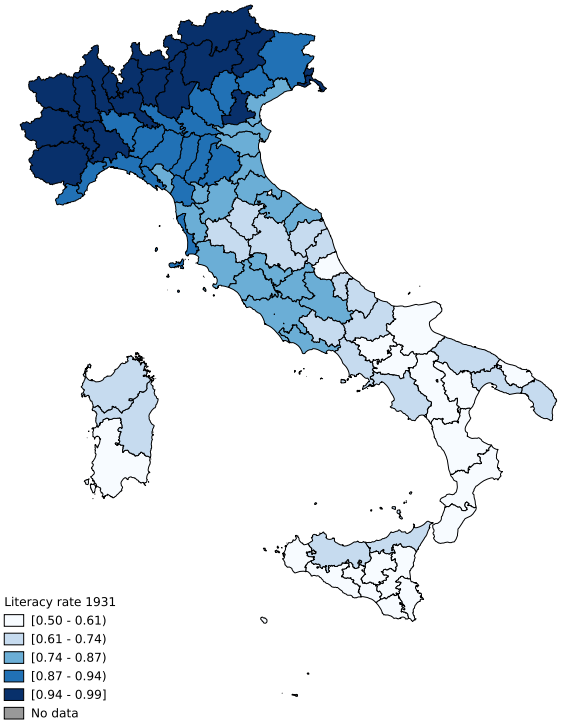
Notes: Panel (a) shows the distribution of potato production across Italian provinces in 1930, while Panel (b) shows the corresponding distribution of maize production. In both panels, production is measured in imperial tons and provinces are grouped into quintiles based on the distribution of production of the respective crop across Italian provinces. Raw production data are reported in quintals and converted to imperial tons using the following conversion rate: 1 quintal = 0.0984207 imperial tons.

Figure C.7: Italian Tractor Use and Literacy

(a) Number of tractors, 1938



(b) Literacy rate, 1931



Notes: Panel (a) shows the distribution of tractors across Italian provinces in 1938, while Panel (b) shows the distribution of literacy rates across Italian provinces in 1931. In each panel, provinces are grouped into quintiles based on the distribution of the respective variable across Italian provinces.