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ORIGINAL PAPER

Non-financial hurdles for human capital accumulation: landownership in Korea under Japanese rule

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Abstract This study examined the relationship between land inequality and human capital accumulation in the Korean colonial period by using a panel data set from 1934 to 1942. Evidence of the adverse relationship between land inequality and the accumulation of human capital has thus far only been presented by using data from Western countries and from countries that achieved industrialization not under colonial occupation but by their own economic interest. The presented findings thus contribute to the body of knowledge on this topic and confirm the generalizability of the Galor model by analyzing the unique Korean context under Japanese rule in the early twentieth century. It is the first study to present evidence that inequality in landownership had an adverse effect on the level of public education in the Korean colonial period (i.e., it is a non-financial hurdle for human capital accumulation). By using a fixed effects model and a fixed effects two-stage least squares model with an instrumental variable estimation, this study exploits variation in inequality in land concentration across regions in Korea, accounting for the unobserved heterogeneity across these regions. Overall, this analysis establishes a highly significant adverse effect of land inequality on education in the Korean colonial period.

Keywords Inequality · Education · Development · Korean economic history

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1 Introduction

Human capital accumulation plays a critical role in Unified Growth Theory, which explains the transition from Malthusian-trapped growth to modern growth by capturing the relationship between two historical events: the Industrial Revolution and the demographic transition (Galor and Weil 2000; Galor 2011a). The process of industrialization increases demand for human capital, which in turn incentivizes individuals to acquire more education. This accumulated human capital further accelerates economic growth. Therefore, circumstances that promote or limit the accumulation of human capital are crucial in explaining cross-country differences in the growth path and the timing of the transition to modern growth (Galor and Weil 2000; Galor 2011b; Dao 2015; Diebolt and Perrin 2013; Jun and Lee 2014).

The findings presented in this paper confirm that inequality in landownership has an adverse effect on the establishment of public primary education, which promotes human capital accumulation in the early stages of economic development, as hypothesized by Galor et al. (2009). By using evidence from the Korean colonial period (1934–1942), this study argues that in a society with greater inequality in landownership as an initial condition, institutions that promote human capital accumulation are established later, leading, on average, to less education.

Galor et al. (2009) investigated the economic interests of the established landed elite, the emerging industrial elite, and common workers during the industrialization process. Because of the complementarity between physical capital and technology, the accumulation of physical capital from industrialization results in increased demand for human capital (Lucas 1988; Uzawa 1965). The emerging industrial elite, therefore, exhibits a friendly attitude toward public education, which can boost human capital accumulation. The landed elite, on the other hand, initially manifests a negative attitude toward public education for two reasons. The first is the lack of complementarity between land and education, which means highly educated labor is not a requirement for agricultural production. Secondly, and even more importantly, education tends to separate labor from land, resulting in a lower return to land.

The accumulation of human capital requires individuals to invest in education by allocating their time to attend school or by trading off their other resources to learn a higher skill. Because of capital market imperfections, however, these investments are often suboptimal (Galor and Zeira 1993). Public investment in education, therefore, lessens the financial burden of accumulating human capital on individuals and reinforces economic growth. As described above, the landed elite initially impedes the implementation of public education. Nevertheless, as the economy gradually shifts from agriculture to industry, landowners accumulate more physical capital and thus change their positions on public education. A society with more equally distributed landownership or scarce land, therefore, can implement an optimal education policy earlier than a society with greater inequality in landownership. Moreover, this earlier implementation of public education promotes investment in human capital and thus accelerates economic growth.

The presented results are consistent with those of Galor et al. (2009) and Cinnirella and Hornung (2011), who used data from the USA and Prussia, respectively. So far, the adverse relationship between land inequality and human capital accumulation has only been tested by using data from Western countries and from countries that achieved industrialization not under colonial occupation but by their own economic interest. Early twentieth-century Korean industrial development, however, occurred in a different context. Because the country was occupied by Japan from 1910 to 1945, the Japanese government determined the economic policies to be implemented in Korea. The result of this research, which proves the significant effect of land inequality on education in Korea, shows that the adverse effect of non-financial hurdles such as land inequality on human capital accumulation can be applied more broadly to countries outside of the Western world.

The empirical analysis presented herein uses a panel data set from the Annual Statistical Report of the Government-General (i.e., the Japanese colonial government in Korea) to show the existence of an adverse effect of landownership on education. Because Japanese occupancy on the Korean Peninsula lasted from 1910 to 1945, the data set, which covers the period from 1934 to 1942, was gathered by the Japanese colonial government. This panel data set allows us to control for unobserved heterogeneity across regions at the province level. By using a fixed effects model, we find an effect of inequality in landownership on education without unobserved heterogeneity across regions, by controlling for regional differences in economic factors, demographic factors, the structure among ethnic groups, and colonial power. To enhance the credibility of our results, this study further tests this adverse effect by using two instrumental variables (IVs), namely rice productivity and the power of a colonial company, the Oriental Development Company, in each region. The findings demonstrate that the results remain robust in the IV specification.

The remainder of this paper proceeds as follows: In Sect. 2, we present the theoretical background and related literature. Section 3 provides a historical background of Korea, focusing on its distinctive colonial experience in terms of land inequality and education. Section 4 presents the empirical results, and, finally, Sect. 5 gives concluding remarks.

2 Related literature and theoretical background

Keynes (1920) and Kaldor (1957) established the classical approach by hypothesizing that inequality is beneficial for economic growth. They focused on the fact that wealthier people have a higher marginal propensity to save, which leads to a higher degree of saving, greater physical capital accumulation, and higher economic growth. After their classical approach, however, the representative agent model of the neoclassical approach hindered further research on the channel of inequality and the relationship between inequality and growth without considering the heterogeneity of income among economic agents (Galor 2009).

The modern perspective on inequality in terms of growth appeared when Galor and Zeira (1988, 1993) constructed a macroeconomic model by adding the heterogeneity of income. Galor and Zeira (1993) showed that inequality, in the presence of credit constraints and fixed costs in human capital acquisition, has an adverse effect on human capital formation and economic growth in an industrialized society in the long run. If there was no credit market imperfection and parents could easily access the capital market and borrow money for their children's education, all parents would invest in their children's education at the optimal level. Under credit market constraints, however, each household is unable to invest in their children's human capital optimally, resulting in low-income families increasing their human capital investment through extra income.

Banerjee and Newman (1993) also examined the relationship between inequality and economic development under credit market imperfection. They focused on the effects of wealth heterogeneity on the occupational decisions of agents. Poor agents choose to become laborers, whereas wealthy agents choose to become entrepreneurs by investing in their own education. Banerjee and Newman (1993) argued that if credit market imperfection holds, lower inequality may lead to underinvestment in entrepreneurial activities, which hampers economic development.

Fershtman et al. (1996), Owen and Weil (1998), Maoz and Moav (1999), Checchi et al. (1999) and Hassler et al. (2000) represent the stream of modern approaches that emphasize credit market imperfection and heterogeneity among individuals (Galor 2009). These authors examined the effects of inequality on intergenerational mobility by analyzing the efficient distribution of human capital among occupations.

The theory of credit market imperfection, however, is not the only viewpoint that argues that inequality harms economic development. The political economy perspective, for example, suggests that underinvestment can result in diminishing economic growth (Alesina and Rodrik 1994; Persson and Tabellini 1994; Perotti 1996). A society that has more equally distributed income tends to be less reliant on governmental fiscal policy, which is related to a redistribution policy through taxation, particularly in terms of physical capital (Alesina and Rodrik 1994) and on human capital (Persson and Tabellini 1994; Perotti 1996). Therefore, a more equal society has less economic distortion and thus more room for investment, which leads to economic growth.

The body of empirical research on the relationship between inequality/intergenerational mobility and growth, however, is inconclusive and somewhat controversial. In addition, modeling credit market imperfection is challenging because of the identification of credit constraints (Black and Devereux 2011). Barro (2000) and Forbes (2000) empirically showed that inequality has a neutral and a positive effect on growth, respectively. Galor (2009), however, mentioned that these results should be interpreted carefully because they test the effect of inequality after having controlled for education and fertility (i.e., by removing the education channels). In other words, this finding can be interpreted that inequality does not influence growth without the education channel.

Moreover, this finding was methodologically challenged by Banerjee and Newman (1993), who argued for the existence of a negative relationship between

lagged inequality and the rate of economic growth. In addition, Easterly (2007) empirically showed that inequality affects the formation of human capital and, in turn, economic growth. On the contrary, Panizza (2002) pointed out that the empirical inequality–growth relation is not robust and that small differences in the analysis can result in large divergences in the estimated relationship.

Given the inconclusiveness of the research findings on this topic, Galor and Moav (2004) provided a theoretically unified framework that attempted to embrace the previously demonstrated positive and negative relationships between inequality and growth. They argued that in the early stage of the Industrial Revolution, when economic growth was driven by physical capital, inequality enhanced growth, whereas in the later stage of the Industrial Revolution, when economic growth was driven by human capital, inequality harmed growth. Thus, they showed that classical and modern approaches toward the inequality–growth linkage can be unified under one framework by considering the stage of economic development.

Although the industrialization process enhances the role of human capital owing to the increase in complementarity between physical capital and human capital, not all economic viewpoints welcome the accumulation of human capital at the dawn of industrialization. Because there is little complementarity between land and human capital, the established landed elite impedes the development of a public education system built on tax revenue, while the emerging elite, who owns physical capital rather than land, welcomes an education system that encourages human capital accumulation. In this sense, the strong power of the established landed elite, which leads to high inequality in landownership, can also impede the accumulation of human capital to the detriment of economic growth (Galor et al. 2009).

The theory developed by Galor et al. (2009) suggests that land inequality has an adverse effect on education, finding that the differences in expenditure for education across the US stem from the variation in the distribution of landownership. Similar to Galor and Zeira (1993), this theory explores the conditions favorable for human capital accumulation, but differs in that the hurdle for human capital accumulation is not a financial barrier but rather inequality in landownership is.

Likewise, Cinnirella and Hornung (2011) found supporting evidence for the adverse effect of inequality in landownership on the timing of human capital formation by using data from nineteenth-century Prussia. Becker and Woessmann (2009, 2010) and Becker et al. (2011) had already shown that Protestantism in Prussia promoted human capital accumulation because of its instruction in reading the Bible before Prussia's industrialization, which resulted in the country's relatively strong literacy rate compared with other European countries. Cinnirella and Hornung (2011), however, focused on variations in land inequality and the level of education across Prussia. They argued that landowners delayed the establishment of mass education by maintaining the institution of serfdom, which restricted the mobility of labor and therefore the benefit from human capital accumulation. Despite the presence of schools and teachers, regions with higher land concentration had lower education attainment. It was only after serfdom was abolished and the peasantry emancipated in Prussia that its level of education finally rose, which permitted its transition onto a higher growth path.

Nevertheless, the empirical evidence of the negative effect of land inequality on education level is scarce and it has only been tested by using data from Western countries that achieved industrialization not under colonial occupation but by their own economic interest. Hence, if by examining the early twentieth-century Korean case this study was able to show a negative relationship between land inequality and education, the argument would enjoy a more general setting.

3 Historical background

The period of Japanese rule in Korea from 1910 to 1945 can be divided into three eras: the reign of the military police era (1910–1919), the conciliatory policy era (1919–1931), and the prewar era (1931–1945; see Fig. 1). During the first era, the military police controlled Korea through violent and oppressive rule, building an institutional base for exploitation, for example, by introducing the Japanese Land Survey on Korean Land. After the March First Movement in 1919, a nationwide act of resistance against the Japanese occupation, the policy of the Japanese colonial government, although conciliatory, aimed at driving a wedge among Korean people. During this era, the colonial powers made the Korean economy somewhat peripheral, while profit-seeking behavior using tenancy agreements was typical in the agricultural sector. The third era was triggered by the Manchurian Incident in 1931, which was the first step of the Japanese invasion of China. Because of the agricultural crisis in early 1930s Japan, accompanied by the Great Depression, the control of the colonial government over the agricultural sector lessened in this era and the market system became dominant. At the same time, however, the Government-General built a comprehensive system to force both the Korean economy to work as a military base for Japan's continental invasion and the Korean people to be cooperative and unable to resist. This attempt to make Korea a supply base for the war lasted until the country's independence in 1945. This study uses data from the third era, focusing on the development of tenancy contracts and of the education system in Korea.

Under Japanese rule, land distribution became increasingly skewed, as evidenced by the rise in the proportion of tenants relative to all farming households, from 42 % in 1913 to 70 % in 1945. This change was propelled by the migration policy of Japan and the Government-General. From the beginning of its colonial rule, the Japanese government encouraged its people to migrate into Korea, with the intention to increase Japanese settlements in Korea to the extent that the Japanese

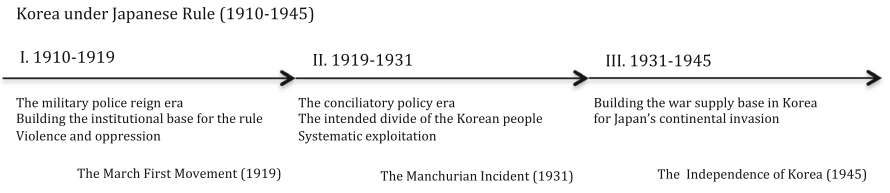

Fig. 1 Three eras of Japanese rule in Korea

would become landlords there (Kikkawa 1904). The Japanese experienced difficulties in migrating into the USA after the US government revamped its immigration policy in 1907. In its quest to tackle urban overpopulation, the Japanese government needed alternative countries to send people belonging to the lower rungs of its society to. Additionally, after the Japanese won in the Russo-Japanese War in 1905, the extent of territory under Japanese management expanded. Therefore, sending Japanese from the mainland to the Korean Peninsula and eventually having them become landlords there appeared to be a good solution that would satisfy Japan's military, political, and economic needs. To fulfill these needs efficiently, the Oriental Development Company was founded in 1908 by law (Kim 1986; Chung 1993). The company began to purchase large tracts of land in Korea to entice Japanese settlers and eventually became the largest landlord in Korea, owning 75,178 *jungbo* (1 *jungbo* ≈ 10,000 m^2) in 1917 and 200,722 *jungbo* in 1942 (Moskowitz 1974; Eckert et al. 1991). In 1912, the enforcement of the Japanese Land Survey on Korean Land further augmented the tenancy rate by strengthening the legal rights of landowners and encouraging Japanese investment in Korean land (Kim et al. 1989; Shin 1982; Eckert et al. 1991; Kim 2007).

Japan implemented its plan to improve rice yields, which also contributed to increasing the tenancy rate in the 1910s and enhanced the policy in the 1920s. At that time, Japan was experiencing soaring demand for cheaper rice as its rate of industrialization progressed. This increased demand from the Japan mainland was combined with the demand for Korean rice from Japanese military troops stationed in Manchuria after the Russo-Japanese War in 1904. To meet this greater demand for food, the colonial government was instructed to increase the production of rice at the expense of other crops. Because rice grew best in wet paddy land, it was necessary to construct a more extensive irrigation system, the cost of which was very high. Rather than providing governmental support, however, rice producers, namely tenants and farmers, were burdened by the expenses for the irrigation project. Because the policy inevitably connected Korean rice production with the Japanese and Chinese markets, price fluctuations also increased. Meanwhile, because Japanese landowners preferred detailed written contracts, poorer Korean tenants, who did not have experience of signing written agreements, were forced into increasingly unfair tenancy arrangements. As a result, the economic conditions of tenants continued to deteriorate, increasing the rate of tenancy further still. For example, while in 1914 41 Japanese landlords owned more than 100 *jungbo*, by 1919 there were 88 such landlords. In the same vein, large-scale Korean landowners also enlarged their estates during the 1910s (Chung 1988). The plan lasted until 1934, when the disastrous effects of the 1929 Great Depression culminated in a widespread agricultural panic and a severe crisis for the Korean rural economy. Throughout the duration of this plan, the tenancy rate continued to increase (Park 1971; Kazuo 1976; Chang 1994; Park 2001; Lee 2003b)

The colonial government had the power to reorganize Korean society in accordance with the wishes of the metropolis and without the interference of sociopolitical interest groups (Woo 1991). If Japan needed an agricultural colony, then the colonial government would focus all its energy on developing the agricultural sector. If it needed an industrialized colony instead, then the

Government-General would force Korea toward industrialization (Ju 2003). During the 1910s and 1920s, for instance, the Government-General sought to promote an agricultural economy in Korea by encouraging the development of Korean agricultural sector and selling Japanese goods in the Korean market. Indeed, it aimed to avoid causing any economic conflicts between its industrial policies and the interests of Japanese industry, especially during the enforcement of its plan to increase rice yields from 1926 to 1934 (Ju 2003; Seo 2007).

Japanese control over the colonial government relaxed during the 1930s, but it still dictated economic conditions to the extent of facilitating the entrance of Japanese industry into the Korean market (Ju 2003). Japan had become substantially industrialized by the end of the First World War, and its industrial sector had matured by the 1930s. Like the free trade imperialism of Great Britain in the mid-nineteenth century, it was now ready to expand its power under a more liberalistic policy (Eckert et al. 1991; Seo 2007; Howe 1998; Darwin 2009; Gallagher and Robinson 1953). Although Cumings (1984) and Woo (1991) argued that the colonial government active promoted industrialization during the 1930s, the Japanese nevertheless maintained the basic colonial agenda that promoted the specialization of an industrialized Japan and an agricultural Korea until the second Sino-Japanese War in 1937, albeit under a more liberalistic government (Ju 2003; Heo 1983).

It was only after the outbreak of the second Sino-Japanese War that Japan initiated serious industrialization in Korea. In particular, Japan sought to industrialize the northern regions of the Korean Peninsula, which is geographically located between Japan and China, to create a supply base for its invasion of China. For example, in the 5-year development plan submitted in May 1937, just before the outbreak of war, the colonial government proposed boosting the production of coal liquefaction, iron, coal, light metals such as aluminum, and cotton, all industries that would form the foundation of the support to the Japanese military power (Ju 2003). Similarly, the Japanese government aimed to smooth the flow of military supplies between Japan, Korea, and China (Seo 2007). In summary, although Korean industrialists well versed in the language and skills of entrepreneurship did begin to appear by 1919, it was nevertheless Japanese colonial policy that played the most important role in Korean industrialization during the study period (Eckert et al. 1991; Seo 2007).

The implementation of a public education system in colonial Korea also differed from that of the nineteenth-century USA or Prussia. Japan wished to instill Japanese culture and language in young Koreans, with the goal of creating loyal imperial subjects who were easy to control. To achieve this, Japan created a public education system that kept Korean youths in ignorance while forcing them to assimilate into Japanese culture. The schooling provided by the Japanese government was in fact so basic that students could only become unskilled or semiskilled labor upon graduation (Kang 2007; Song 2001). Education Ordinance of 1911 specifically dictated that the education system for Korean subjects was "to give the younger generations of Koreans such moral character and general knowledge as will make them loyal subject of Japan, at the same time enabling them to cope with the present

condition existing in the Peninsula." (Seth 2010; Choi 2010; Oh 2000; Kang 2007; Cho 1989).

Under colonial rule, the public education system in Korea remained fundamentally unequal. While Japanese students had easy access to higher education, the majority of Korean students were only given a minimal amount of schooling. The official curriculum dictated 14 years of school for Japanese residents in Korea, as opposed to just 4 years of "common school (*botong haggyo*)" for most Koreans. Even the titles for primary schools were different. The primary school designated for Koreans was called the "common school (*botong haggyo*)," which implied that students did not need to seek a higher education upon graduation. For Japanese students, by contrast, the primary school was called the "elementary school (*soh haggyo*)," a name that promised higher level institutions—middle school and high school—afterward (Cho 1989, 2014; Choi 2010; Oh 2000).

There is, however, a great irony that played out under the Japanese colonial public education system in Korea. While Japan sought to keep Koreans ignorant and subject to their rule, it actually expanded the opportunity for Koreans to access primary level education. This was because Japan implemented the "one school in three *myeon* [administrative district] policy" during the 1920s, followed by "one school per *myeon* policy" in the 1930s. Most historians who study Korean history, however, do not credit Japan as a benefactor in the development of Korean education, instead of focusing on the official wording of Japanese policies. Korean historians point out that the real focus should be on how colonial education actually impacted Korean lives, and how Koreans reacted to it. The important questions, they argue, are what colonial education meant for young Koreans, what Koreans expected to get out of modernized schooling, and how Koreans demanded an easier access to education. Of importance in studying these questions, then, is what conditions were necessary for Koreans to obtain education, and how these conditions varied over time and region (Oh 2000).

For most of the 1910s, Koreans were hesitant to accept modern education provided by the colonial government. This was because resistance to Japanese colonial rule was blended together with resistance against modern education. The new educational system that Japan implemented in Korea was considerably different from the traditional Korean school system. Although the Korean government had started installing modernized elementary schools in 1894 before Japanese occupation, many Koreans remained unacquainted with both the new system and the modern content being taught. As a result, schools based on Confucianism were still widespread and popular. The modern school system became firmly established in Korea only after Japanese occupation began in 1910. Nevertheless, because the imposed education system was specifically tailored to suit Japanese colonial interests, resistance against modern education quickly blended into resistance against Japanese colonial rule. Private modern Korean schools, which had opened before Japanese occupation, were oppressed by the Japanese government because they did not conform to the goals of the colonial government. As a result, hundreds of private modern Korean schools were forced to close doors. For those who wished to obtain modern education, the easiest way was to attend a colonial school offered by the Japanese government. In the eyes of patriotic

nationalist Koreans, however, such an action was often construed as national betrayal (Choi 2010; Oh 2000).

Despite patriotic resistance against the Japanese system, several socioeconomic factors contributed to the expansion of the Japanese modern education system in Korea over the 35 years of Japanese occupation. In 1910, when the Government-General of Japan first introduced the new education system in Korea, Koreans refused to attend the new schools because they saw the common schools (*botong haggyo*) as a tool of Japanese oppression. They preferred the traditional Korean school (*seodang*) over the common school. In 1911, 61.2 % of all Korean students were attending the traditional Korean school (*seodang)*, while only 14 % went to common schools and 24.8 % attended a private school. In 1919, however, after the March First Movement, colonial common schools started multiplying rapidly, actually exceeding the enrollment rate of the traditional Korean schools by 1923. Oh (2000) pointed to the year 1919 as a watershed moment when the preference of Koreans for education changed from the traditional Korean school to the modernized common school. By 1933, to borrow from Trow (1977)'s terminology, the common school had reached the stage of "mass education." In 1942, 1,780,000 students, or 84.1 % of all Korean students, were attending common schools.

The two perpendicular guide lines represent the division of eras; the reign of the military police era (1910–1919), the conciliatory policy era (1919–1931), and the prewar era (1931–1945).

Of special note in this expansion of common schools is the fact that Koreans themselves chose to accept the opportunity offered by the Japanese colonial government, especially upon the 1920s. Not only that, Koreans actively demanded greater access to education from the colonial government. Did this mean that Koreans wanted to make their children "loyal servants" of the Japanese empire? Were they conforming to the wishes of the colonial government? According to Oh (2000) and Han (1991), Korean acceptance of the opportunity for modern education cannot be equated with an acceptance of Japanese colonial policy and intent. Han (1991) argues that the surge in Korean demand for a modern education was not about acceptance of Japanese rule, but about becoming empowered as a political actor. In the March First Movement of 1919, most of the prominent activists who led the movement were those who had received modern education. By this time, Korean nationalists were seeing the value of modern education in promoting political thought and action. The March First Movement also provided an opportunity for the Korean public to abandon the prejudice that people who received modern education were traitors to their nation. Furthermore, when Korean nationalists tried to argue for Korean independence at the Washington Conference of 1921, their efforts were frustrated. This made the nationalists change strategies, lending preference to building national competency through modern education and industrialization rather than relying solely on diplomatic efforts.

There were, of course, other factors that contributed to the expansion of modern education in Korea. Oh (2000) points out that although the nationalist discourse promoted the expansion of modern education, its actual impact was nevertheless limited. Oh (2000) argues that while it might have awakened the Korean public to the value of modern education and negated the previous stereotype of equating

modern education with national betrayal, the real decision to obtain modern education depended on the conditions of each individual. Moreover, Han (1991) highlights an important socioeconomic motivation that drove Korean desire to obtain education. A higher education was often linked to higher social status, which usually spelled greater economic wealth. Even before Japanese occupation, obtaining Confucian education in Korea had been linked to mobility in social hierarchy. This education–social mobility link, however, had been severed in 1894 by the Gabo Reform, when the Korean royal government cut off access to higher society through the traditional education system (Son 2008; Han 1991). In the 1910s when Japanese occupation began, then, Koreans had been as yet hesitant to use education for upward mobility, especially since obtaining modern education was seen as an act of betrayal. When the criticism of betrayal finally lifted after the March First Movement, however, Koreans began actively demanding wider access to education during the 1920s as they had done before the Gabo Reform (Oh 2000).

Another factor behind the drive for modern education was cultural. Koreans had held the belief that only educated people knew how to behave properly, and had a tradition of discriminating against uneducated people. As a necessary condition for proper social life, then, Koreans believed education was crucial (Han 1991).

The steep increase in attendance at common schools during the 1930s needs further attention. In Fig. 2, the number of students attending a modernized colonial school increased rapidly during the 1930s. To explain this phenomenon, Lee (1988) and Ahn (1989) have pointed to industrialization, using a similar framework as Bowles and Gintis (1977). Nevertheless, as Kim (1965), Choi (1988), and Lee (1994) argue, colonial industrialization was limited because it did not create a large

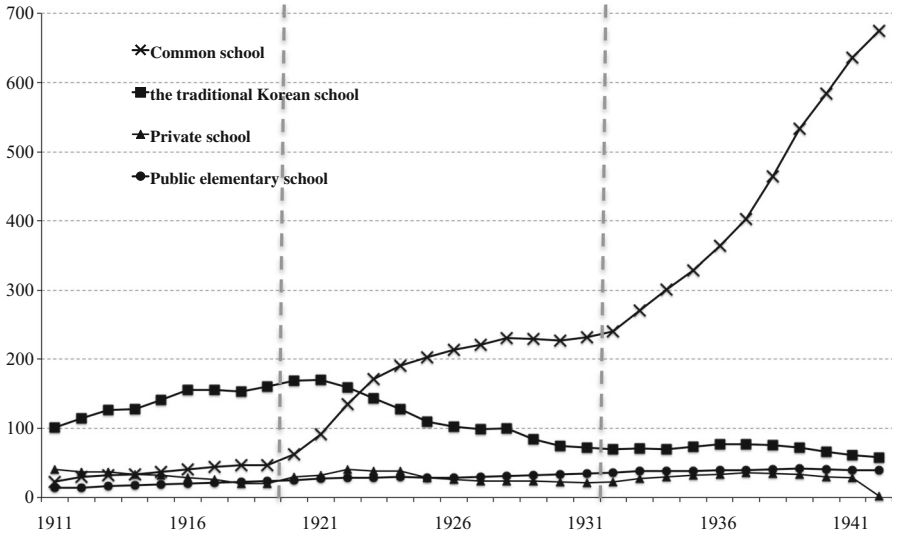

Fig. 2 The number of students per 10,000 population of common school, public elementary school, traditional Korean school and private school. *Source*: the Annual Statistical Report of the Government-General

number of jobs in Korea. According to Kajimura (1985), colonial industrialization created hardly any jobs at all for Koreans. Oh (2000) has likewise pointed out that Korean society under Japanese rule had been a typical agricultural society, where the majority of people worked in the agricultural sector.

To truly understand the expansion of education in the 1930s, a study of the agricultural context is therefore crucial. Oh (2000) tries to explain the expansion of education in the 1930s by focusing on the agricultural aspect of colonial Korean society. Koreans, Oh argues, sought to escape the severe poverty caused by the Government-General's plan to increase rice yields, a plan launched in 1926, by seeking education as a channel to higher social status. Unable to access any other means of escaping poverty, many poor Korean farmers saw modern education as the last and only resort.

The expansion of primary education in the 1920s and the 1930s was primarily a result of the motivations of Koreans themselves to better their social conditions. Nevertheless, even with the expansion of colonial education, many Koreans continued to face difficulties in obtaining education because, regarding Korea was an agricultural society, other factors, such as land inequality, also played a role in attaining education.

Indeed, despite the central education policy set forth by the colonial government, different localities reacted differently due to varying regional characteristics such as the degree of industrialization and urbanization, inequality in landownership, and differences in regional culture and geography. Further, landowners in Korea exercised great influence over the lives of their tenants, to a degree comparable to that of serfdom in early nineteenth-century Prussia (Soh 2005). This influence also stretched to wielding power over tenants' access to education. The level of elementary education, therefore, was also affected by the degree of inequality in land distribution. Accordingly, this study focuses on the regional variations in the responses to the central educational policy.

An examination of Korea in the early twentieth century is meaningful in the sense that we can test the proposed model to show whether there exists an adverse relation between land inequality and the level of education in such a unique historical context, i.e., the colonial experience. If the relation holds, as the results of previous studies with Prussian and American cases suggest, the adverse relationship between land inequality and human capital accumulation can be generalized.

4 Empirical analysis

4.1 Data description

The data in this study are sourced from the Annual Statistical Report of the Government-General, and the unit of analysis is the Korean province. The Government-General, which as noted earlier instituted the Japanese colonial government in Korea from 1910 to 1945, published annual reports comprising a compilation of major statistical information. These data were first collected in 1907 by the Residency-General. The investigated items changed over the Japanese ruling

period, but they remained consistent for the time period we consider in this study (i.e., 1934–1942, during the third era of Japanese rule as depicted in Fig. 1). Our data are taken from the period when the market system was dominant in the agricultural sector (i.e., after the completion of the Government-General's plan to increase rice yields) and when tenancy was well stabilized. They include items such

Table 1 Variables of the estimates of the effect of land inequality on education—summary of previous findings

Variables	Galor et al. (2009)	Cinnirella and Hornung (2011)	This study
Main variables			
Dependent variable	Educational expenditure	School enrollment rate	School enrollment rate
Explanatory variable	Land concentration	Land concentration	Land concentration
Data type	Panel data with 4 periods of observation	5 Different cross-sectional data	Panel data with 9 periods of observation
Empirical model	Panel analysis with IV	Cross-sectional analysis with IV	Panel analysis with IV
Economic control			
Income per capita	✔		
Urban (share)	✔		✔
Industrial (share)		✔	✔
Agricultural (share)		✔	✔
Demographic control			
Population growth rate			✔
Population density		✔	
Education			
School density		✔	✔
Historical context			
Ethnicity/ language (share)	✔	✔	✔
Religion (share)		✔	
Law		✔	
Ethnic structure of industry			✔
Colonial power			✔
Instrument variables	Climate conditions	Soil texture	Rice productivity
	Change in the relative price of cotton		Power of colonial company

as land and weather, population and households, agriculture, manufacturing, fishery, forestry, money and banking, education, religion, and finance (Park and Seo 2003).

4.2 Empirical specification: fixed effects model

The empirical analysis in this study examines the effect of inequality in landownership distribution on the level of education through comparisons of the variations across provinces. Inequality in the distribution of landownership, $\text{LandInequality}_{i,t-1}$, is measured as the proportion of tenant households in province i in period $t-1$. This variable does not capture the ethnic differences between landowners because the Annual Statistical Report does not provide land inequality on the ethnicity of landowners at the regional level. However, Kim (2000) argues that while most landowners were Korean because most of the landed elite inherited land before the Japanese occupation, the tenancy system was actually expanded by Japanese landowners. In that sense, we can use the variable without loss of generality. As given in Table 1, Cinnirella and Hornung (2011) and Galor et al. (2009) also measured inequality in landownership as land concentration to reflect the power of landowners. Although this variable does not capture variation among tenants, this shortcoming does not affect the results because the critical factor is whether a person is under the influence of the landowner.

The level of education, $\text{Education}_{i,t}$, is measured in two ways: (i) as the number of all students in all types of schools, including common schools, public elementary schools, governmental schools, Korean traditional schools, and private school (Education 1), and (ii) as the number of public elementary school students per person in province i in period t (Education 2), as in Cinnirella and Hornung (2011). While the variable Education 1 comprises all students including Korean and Japanese students, the variable Education 2 includes mostly Japanese students. Although the Annual Statistical Report of the Government-General does not classify students by ethnic group within each type of school, we can distinguish students' ethnicity by separating elementary schools, which were for mostly Japanese students. The data cover eight periods of observation from 1934 to 1942 and thirteen provinces. A single period of observation is 1 year, so that when t is 1935, $t-1$ is 1934, and so on through to 1942.

We use the following empirical specification:

$$\text{Education}_{i,t} = \beta_0 + \beta_1 \text{LandInequality}_{i,t-1} + BX_{i,t-1} + v_{i,t} \quad (1)$$

where X is the vector of control variables including the share of agriculture, which is the number of farmers relative to the total population of province i in period $t-1$; the share of manufacture, which is the number of workers in the manufacturing sector relative to the total population of province i in period $t-1$; the share of Japanese manufacture, measuring the number of Japanese workers in the manufacturing sector relative to all manufacturing workers and that relative to the population of province i in period $t-1$; the share of Korean manufacture, which is the number of Korean workers in the manufacturing sector relative to the all

manufacturing workers; the share of urbanization,[1] which is the number of workers in commerce/transportation relative to the total population in province i in period $t-1$; the rate of population growth in province i in period $t-1$; the share of Japanese, which is the number of Japanese people relative to the total population of province i in period $t-1$; and the number of public elementary schools per 1000 people in province i in period $t-1$. This formulation captures the lag in making changes to education with respect to current economic and political conditions.

Table 1 shows the control variables used in this research as well as those applied in Cinnirella and Hornung (2011) and Galor et al. (2009). Compared with these two studies, the variables used herein consider the ethnic structure in the industrial and agricultural sectors to control for the historical context. This study also considers the share of Japanese in the industrial sector in each region, while Galor et al. (2009) controlled for the share of black people and Cinnirella and Hornung (2011) for the share of people not using German, the share of the Protestant population, and differences in inheritance law. Table 2 provides the summary statistics for these variables.

This study uses panel data. A primary benefit of panel data is that they can solve the problem of unobserved heterogeneity by controlling for regional fixed effects, whereas this is difficult to control for when using cross-sectional or time series data. The error term $\upsilon_{i,t}$ can be divided into time-invariant unobserved heterogeneity across provinces in the level of education, η_i and an error term $\varepsilon_{i,t}$:

$$\upsilon_{i,t} = \eta_i + e_{i,t} \tag{2}$$

Because the data used in this study are not a sample of the population but rather reflect the entire population, it is reasonable to think of $\upsilon_{i,t}$ as a parameter to be estimated instead of a random variable. Moreover, by using the Hausman test to verify the existence of η_i, we evaluate the p value of the Wu–Hausman statistic for the hypothesis $H_0 = \eta_1 = \eta_2 = \cdots = \eta_i$, which is less than 0.01; thus, we reject the null hypothesis. Therefore, we confirm that a fixed effects model is preferable for the current analysis rather than a random effects one.

Table 3 shows the correlation between the variables. Because of the high correlation between the economic co-variables (urbanization, agriculture,

[1] This study measures the level of urbanization using the number of workers in commerce and transportation relative to the total population, while Cinnirella and Hornung (2011) used the proxy of the share of the population living in urban centers. This distinction occurs because the process of urbanization in Korea differs from those in Western countries. According to Horvath (1969), "the colonial city model" has distinctive features compared to his other two city models, "the industrial city model" and "the pre-industrial model." After the opening of the ports in 1876 and the Japanese occupation, the Japanese colonial government reorganized Korean cities to make them the bases of colonial exploitation. In this situation, commercial activity, especially in relation to rice, was main activity that helped the cities grow. For example, the city of *Koonsan* underwent planned development under Japanese colonial rule. *Koonsan* is located close to the plains, and thus, it was easy to collect rice for export to Japan, and it also served as the perfect commercial base for selling goods manufactured in Japan to *Jeollanam-do* and *Chungcheongnam-do*. The construction of railway connections to the colonial cities further boosted their development (Cho 2000). For these reasons, it is more relevant to capture the level of urbanization of each region using the share of workers in commerce and transportation.

Table 2 Descriptive statistics of the Annual Statistical Report of the Government-General

Variable	Definition	Number of observations	Mean	SD	Min	Max
Education 1	The number of primary school students of all types of schools per 10,000 people	117	6.3194	1.6450	3.1465	9.7231
Education 2	The number of public elementary school students per 10,000 people	117	0.3811	0.2278	0.1110	0.9384
Land inequality	The number of households of tenants over the number of households of all farmers	117	0.8011	0.1248	0.4545	0.9550
Agriculture	The number of farmers over population	117	0.7283	0.1160	0.3612	0.875
Urbanization	The number of workers in commerce and transportation over population	117	0.0898	0.0403	0.0440	0.2040
Manufacture	The number of workers in manufacturing sectors over population	117	0.0344	0.0240	0.0096	0.1165
Japanese manufacture 1	The number of Japanese workers in manufacturing sectors over the number of all workers in manufacturing sectors	117	0.1141	0.0585	0.0340	0.2897
Japanese manufacture 2	The percentage of Japanese workers in manufacturing sectors of all population	117	0.4552	0.4681	0.0437	1.7897
Korean manufacture	The number of Korean workers in manufacturing sectors over the number of all workers in manufacturing sectors	117	0.0294	0.0199	0.0091	0.0978
Japanese	The number of Japanese people over population	117	0.0271	0.0174	0.0087	0.0666
Population growth	The ratio of increase in province's population from year $t-1$ to t	117	0.0276	0.0273	-0.0194	0.1389
School density	The number of public elementary schools per 1000 people.	116	0.0117	0.0056	0.0033	0.0262
Rice productivity	The productivity of rice measuring the number of *seok* ($\approx$144 kg) per *danbo* ($\approx$991.74 m^2)	91	1.2545	0.2824	0.6080	1.8640
Company immigrants	The average land area of Japanese immigrants households given by the Oriental Development Company	99	3.0746	1.2784	2.1000	12.3300

Table 3 Correlation between variables

Variable	Education 1	Education 2	Land inequality	Agriculture	Urbanization	Manufacture	Japanese manufacture 1
Education 1	1						
Education 2	0.1917	1					
Land inequality	−0.1010	0.2727	1				
Agriculture	−0.4893	−0.8322	0.1000	1			
Urbanization	0.5391	0.8154	−0.0821	−0.9458	1		
Manufacture	0.4018	0.7463	−0.1798	−0.9261	−.8624	1	
Japanese manufacture 1	0.1096	0.6353	−0.3039	0.6172	0.6323	0.5846	1
Japanese manufacture 2	0.3242	0.7023	−0.3288	−0.8367	0.8233	0.8927	0.8537
Korean manufacture	0.3875	0.7410	−0.1118	−0.9097	0.8400	0.9918	0.4955
Japanese	0.2191	0.9910	−0.1898	−0.8824	0.8536	0.8067	0.6640
Population growth	0.1007	0.2328	−0.0531	−0.4104	0.3590	0.4259	0.1512
School density	−0.0860	0.5464	−0.0336	−0.0862	0.3408	0.2685	0.6038
Rice productivity	0.3387	−0.0825	−0.2012	−0.1116	0.0894	0.0412	0.0238
Colonial company	0.0724	−0.1100	−0.4182	−0.1048	0.1085	0.2204	0.1987

Variable	Japanese manufacture 2	Korean manufacture	Japanese	Population growth	School density	Rice productivity	Colonial company
Education 1							
Education 2							
Land inequality							
Agriculture							
Urbanization							
Manufacture							
Japanese manufacture 1							
Japanese manufacture 2	1						

Table 3 continued

Variable	Japanese manufacture 2	Korean manufacture	Japanese	Population growth	School density	Rice productivity	Colonial company
Korean manufacture	0.8331	1					
Japanese	0.7624	0.7970	1				
Population growth	0.3424	0.4341	0.2777	1			
School density	0.3866	0.2214	0.5431	−0.0917	1		
Rice productivity	0.0419	0.0269	−0.0587	−0.1868	0.0321	1	
Colonial company	0.3280	0.1823	−0.0499	0.0721	−0.1048	0.0722	1

Table 4 Relationship between Education 2 (the share of Korean students in public, private, and traditional schools) and land inequality (fixed effects model with 1-year lag) (1934–1942)

Explanatory variables	Dependent variable: Education 1								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Land inequality	**−53.5877***	**−63.4821****	**−59.0717*****	**−83.7766*****	**−53.3206***	**−81.7683*****	**−80.5845*****	**−66.2494****	**−83.9662*****
	29.8580	24.5341	22.1816	29.0025	29.9617	28.9294	29.1591	28.8220	25.5895
Agriculture		**−18.7531*****							
		2.8023							
Urbanization			**40.7243*****						
			4.7275						
Manufacture				**52.6824*****					
				13.9596					
Japanese manufacture 1					**−3.6403**				
					5.7840				
Japanese manufacture 2						**2.7804*****			
						0.7458			
Korean manufacture							**56.9911*****		
							16.1949		
Japanese								**177.1616*****	**169.2105*****
								57.1787	55.6193
Population growth									**−5.6447**
									5.6348
School density									**−658.6745*****
									125.8391
R^2 (within)	0.0346	0.3577	0.4735	0.1677	0.0388	0.1648	0.1525	0.1286	0.3415
Pro > F	0.0000	0.0000	0.0000	0.0003	0.1716	0.0003	0.0006	0.0022	0.0000
Number of observations	104	104	104	104	104	104	104	104	104

*, **, *** Significance at a 10, 5, and 1 % level, respectively

Table 5 Relationship between Education 1 (the share of the public elementary school students) and land inequality (fixed effects model with 1-year lag) (1934–1942)

Explanatory variables	Dependent variable: Education 2								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Land inequality	**−2.0210*****	**−2.0924*****	**−2.0545*****	**−2.0072*****	**−2.0533*****	**−2.4849*****	**−1.8987*****	**−2.3625*****	**−2.3715*****
	0.5429	0.5323	0.5320	0.5680	0.4897	0.5569	0.5637	0.4900	−0.4476
Agriculture		**−0.1353****							
		0.0608							
Urbanization			**0.2484****						
			0.1134						
Manufacture				**−0.0241**					
				0.2734					
Japanese manufacture 1					**0.4400*****				
					0.0945				
Japanese manufacture 2						**0.0458*****			
						0.0138			
Korean manufacture							**−0.2581**		
							0.3131		
Japanese								**4.7406*****	**6.6195*****
								0.9721	0.9723
Population growth									**−0.2990*****
									0.0986
School density									**0.1750**
									0.2208
R^2 (within)	0.1334	0.1791	0.1778	0.1355	0.3031	0.2293	0.1400	0.3161	0.4877
Pro > F	0.0000	0.0000	0.0002	0.0017	0.0000	0.0000	0.0012	0.0000	0.0000
Number of observations	104	104	104	104	104	104	104	104	104

*, **, *** Significance at a 10, 5, and 1 % level, respectively

manufacture, Japanese manufacture, and Korean manufacture, Japanese), they are used separately.

4.3 Results

4.3.1 Fixed effects model

Tables 4 and 5 depict the results of this estimation in columns (1)–(9), by using the variables Education 1 and Education 2, respectively. In each column of these two tables, the adverse effect of land inequality on education is apparent. Lagged land inequality has an adverse and highly significant effect on education with no controls [column (1)] as well as when controlling for the share of agriculture, that of manufacture, that of urbanization, that of Japanese manufacture, that of Korean manufacture, the rate of population growth, the share of the Japanese population, and the number of public elementary schools per 1000 people. The differences in the order of magnitude between the coefficient of land inequality in Tables 4 and 5 stem from the difference in the order of magnitude of the number of students in Education 1 and Education 2.

As one would expect, column (2) and column (4) of Table 4 show that the share of agriculture and the share of manufacture have a negative and positive highly significant effect on education, respectively, and we continue to observe a positive and significant effect of land inequality on education. Moreover, the share of urbanization shows a highly significant relationship with the level of education [column (3)].

Because of the collinearity between the share of agriculture, share of manufacture, level of urbanization, and share of Japanese, we include only one of these variables in the regressions [results presented in columns (4)–(9)]. The share of Japanese has a positive and highly significant effect in both Tables 4 and 5, reflecting the fact that the Japanese population in Korea tended to receive more education. In Table 4, the positive and highly significant effect of the share of Japanese on the number of Japanese students is trivial. Even controlling for the share of Japanese, the negative and strong effect of land inequality on education holds. The significant relationship between land inequality and education may not have held when colonial factors were controlled for if the colonial government had made a decision on land inequality and on education simultaneously. However, the levels of land inequality and education were not highly correlated and not decided upon by the colonial government at the same time. It is true that tenancy did increase with the colonial government's encouragement toward land inequality during the colonial era. However, according to Soh (2005), before the 1930s, the tenancy rate had stabilized and land inequality during the period considered in this study was affected by the level of agricultural output each year. In addition, because landowners were superior to tenants and controlled tenants' production processes and economic conditions, the decisions of tenant households pertaining to their children's education could not result only from the education policy of the central government.

Table 6 Robustness check: the relationship between education and land inequality (1934–1942)

Explanatory variables	Dependent variable: Education					
	1-year lag		2-year lag		No lag	
	Education 1	Education 2	Education 1	Education 2	Education 1	Education 2
Land inequality	**−87.445*****	**−2.0807*****	**−92.5833*****	**−1.1058***	**−50.9672****	**−0.8685**
	26.9754	0.5652	29.1313	0.6603	24.1251	0.5486
Manufacture	**30.7611****	**0.3245**	**48.0988*****	**−0.4336**	**12.9572**	**0.5495***
	15.3234	0.3211	18.0554	0.4092	13.7056	0.3117
Population growth	**−2.9431**	**−0.1666**	**−11.7410****	**0.0469**	**10.7937****	**−0.1244**
	5.6797	0.1190	5.5839	0.1266	5.0398	0.1146
School density	**−56.3553*****	**0.3200**	**−53.6775*****	**0.3129**	**−45.1730*****	**0.4165**
	13.6253	0.2855	14.2154	0.3222	11.3860	0.2589
R^2 (within)	0.3053	0.1720	0.2728	0.0918	0.3569	0.0799
Pro > F	0.0000	0.0023	0.0001	0.1249	0.0000	0.0000
Number of observations	104	104	91	91	116	116

*, **, *** Significance at a 10, 5, and 1 % level, respectively

In column (9) of both Tables 4 and 5, the effect of the population growth rate on education is negative (but it is highly significant only in Table 5), reflecting the quantity–quality trade-off in education in this period. In column (9), we control for the number of schools per 1000 people to isolate the effect of the supply of schools on education, especially in the case of Table 5. When considering only Japanese students, the coefficient of the number of schools per 1000 people is not significant, while the coefficient is negative and highly significant when considering all students. Given that the education cost per Japanese student was 82.1 won and the asset of a school per Japanese student was 240.8 won, compared with 30.8 won and 69.3 won for Korean students, respectively, this result implies that competitive relations existed between the schools for Korean and Japanese students subject to the budget constraints of the colonial government (Oh 2000).

4.3.2 Robustness check

As shown by the robustness checks in Table 6, the effect of land inequality on education is negative and highly significant in both cases with different measure of education except the case with no lag considering only Japanese student. The main findings in Tables 4 and 5 are consistent with those in Table 6 (lagging land inequality by 2 years and no lag at all), especially the case with the variable Education 1, and are thus robust.

4.3.3 IV estimation

To enhance our results on the negative effect of land inequality on education, we analyze this relationship by using an IV estimation. When using panel data, the instruments should reflect province-specific as well as time-variant differences. Galor et al. (2009), for example, used two IVs, namely the climatic conditions of all provinces, which are province-specific but time-invariant, and the relative price of agricultural goods, which reflects the differential effect of agricultural prices over time on the concentration of landownership across provinces. Cinnirella and Hornung (2011) used one IV, the difference in the geographical composition of the soil.

In light of the historical evidence provided by Engerman and Sokoloff (2000) regarding the positive effects of agricultural crops associated with economies of scale (e.g., cotton and sugar cane) on land inequality across the Western world, one should expect regional differences in climatic characteristics and thus in the suitability for such crops to generate variation in the regional concentration in landownership.

The two IVs in this study for land inequality are the nationwide change in rice productivity, which is time-variant, and variation in the power of the Oriental Development Company, which is province-specific but time-invariant. First, rice productivity, measured as the number of *seok* ($\approx$144 kg) per *danbo* ($\approx$1000 m^2), reflects the national change in agricultural crops. Although small regional variations exist, this productivity index tends to follow the national trend closely because rice productivity follows the change in annual weather fluctuation in a national level. For example, in 1934, the productivity of rice in the North Chuncheong province is 0.93,

while it is 0.94 in the North Jeolla province. On the contrary, every province has the highest level of productivity in 1937 and the lowest in 1939, which means that the level of rice productivity of all provinces follows the national trend. As pointed out by Engerman and Sokoloff (2000), change in agricultural crops is associated with economies of scale, which affect land inequality. Galor et al. (2009) adopted nationwide changes in the relative prices of agricultural crops to reflect economies of scale that alter the concentration of landownership over time. Our first IV is thus an exogenous variable that does not influence the level of public education directly.

Our second IV reflects the power of the Oriental Development Company, a national enterprise built to further Japan's colonial exploitation policies in Korea. This IV reflects province-specific but time-invariant variation. Even though the data were collected every year in each province, they show nearly time-invariant characteristics, since the period of this research coincides with the last era of Japanese rule that began 21 years after from 1910. Indeed, the agenda of the company had also changed over time, accompanying the changes in Japanese rule. In terms of the changes in the company's agenda, 1908–1916 marked the first period of the company's operation; 1917–1930, the second period; and the period after 1931 marked the last period. During the first and second periods of its operation, the company focused on boosting Japanese migration into Korea, specifically, to highly fertile lands that were already well settled by the Koreans. However, faced with stubborn opposition from Korean farmers and tenants, the Oriental Development Company changed their method of operation from 1927 onwards and thereafter promoted the use of uncultivated land after reclaiming it. Additionally, because land that was to be redistributed among the immigrants became scarce and the profitability of immigration decreased over time, the number of immigrants from Japan also decreased and eventually leveled off. Therefore, the rapid changes in the number of immigrants and the proportion of land owned by the company took place before the 1930s, and the company's power over that land stabilized after this period (Kim 1986).

The power of the company, measured as the average land area offered by the Oriental Development Company to Japanese immigrant households, is directly related to land inequality. First, as described in Sect. 3, the major focus of the company was Japanese agricultural migration and purchasing land to redistribute it to Japanese immigrants, making the company the biggest landlord in the Korean Peninsula. Second, although the company stopped importing Japanese farmers into Korea and granting them already cultivated land, they continued importing them to tend to uncultivated land after its reclamation, which entailed huge labor requirements and considerable cost. The Korean tenants and small landowners were mostly burdened these requirements, thus deepening Japan's tenancy (Kim 1986; Lee 2003a, b). Thus, these actions of the company promoted the tenancy in Korea.

Additionally, this second IV can be regarded as an exogenous variable that is time-invariant but regionally variant, in the sense that the company primarily purchased productive and fertile land in locations having a high proportion of paddy fields compared to dry fields. The proportion between paddy fields and dry fields was determined using the regional characteristics of soil, altitude, and climate, which are exogenous (Cho 1999). Moreover, the regional variation in the power of the company depended on regional resistance (i.e., the revolts of the Korean

Table 7 IV specifications for the relationship between landownership and education (1934–1940)

Dependent variable	Education 1	Education 2	Education 1		Education 2	
Instrumental variables			Rice productivity		Rice productivity	
			Colonial company		Colonial company	
Explanatory variables	FE		FE2SLS		FE2SLS	
Land inequality	**−84.0503*****	**−1.7378*****	**−282.016****	**−289.3057****	**−7.7124*****	**−7.9708*****
	31.5018	0.6219	131.7002	113.1997	2.7748	2.8449
Manufacture	**18.5231**	**0.1500**		**21.7044**		**0.2466**
	22.0945	0.4362		29.9528		0.7528
Population growth	**−34.5909*****	**−0.2314**		**−37.3426*****		**−0.3150**
	8.0237	0.1584		10.9521		0.2752
School density	**−322.5593****	**1.6638**		**−427.5281****		**−1.5238**
	154.9736	3.0595		216.5295		5.4418
R^2 (within)	0.4041	0.1627	0.1357	0.1577	0.1357	0.1577
First-stage F statistics			3176.68	2966.25	3176.68	2966.25
First-stage p value			0.0000	0.0000	0.0000	0.0000
Number of observations	66	66	66	66	66	66

*, **, *** Significance at a 10, 5, and 1 % level, respectively

peasants) (Wen 2006), and the level of the resistance often reflected the cultural context of each region. For example, the Koreans of *Hwanghea-do* offered some of the most severe resistance against the company's migration business; they were culturally aware of their rights to own their land because their ancestors had reclaimed the waste land in the region around the seventeenth century (Choi 2000). Therefore, considering that the second IV is mainly influenced by geographical and cultural factors, it is sufficiently exogenous. In addition, this IV influences education indirectly in the sense that, as given in Table 3, the correlation between the power of the colonial company and education level is low.

The number of observations shrinks from 104 to 66 when using these two IVs with a 1-year lag, because the data on rice productivity end in 1940 and the data on the power of the colonial company do not exist for two provinces, which are *Pyeongannam-do* and *Hamkyungbuk-do*. As shown in the first and second column of Table 7, we apply our empirical specification, Eq. (1), which does not use IV, using the shrunken dataset to contrast the fixed effects estimation and fixed effects two-stage least squares estimation to check and avoid possible selection bias. Nevertheless, as given in Table 7, the adverse effect of land inequality on education still holds in the IV estimation.

Columns (1) and (2) in Table 7 show the results of the fixed effects model with the reduced number of observations ($n = 66$), using Education 1 and Education 2, respectively. Columns (3) and (4) present the results of the IV estimation in which Education 1 is used within a two-stage least squares estimation to supply exogenous variation in land inequality, $\text{LandInequality}_{i,t-1}$, while columns (5) and (6) present the results of the two-stage least squares estimation in which Education 2 is used. Columns (2) and (4) include the control variables as given in Table 6 (i.e., the share of manufacture, the rate of population growth, and the density of public elementary schools). As can be seen, the value of the coefficient representing land inequality is larger than that in the fixed effects model in both Education 1 and Education 2, without IVs, and remains significant at the 5 % level and the 1 % level, respectively.

The first-stage results show that our instruments are strong enough to explain variation in land inequality. As shown in columns (4) and (6), the F statistics of the joint significance of the instruments have the same value of 2966.25, which is much larger than 10 and highly significant at less than 1 %. Since we have two instruments, there exists the possibility of overidentification. As given in Table 7, the Sargan–Hansen statistics of overidentification, however, cannot reject the null hypothesis that both instruments are uncorrelated with the error term $\varepsilon_{i,t}$.

In conclusion, the two-stage least squares estimation with IVs supports our argument that inequality in landownership had an adverse effect on the level of public education in the Korean colonial period.

5 Conclusion

Human capital accumulation plays a critical role in both the transition from Malthusian stagnation to modern growth and the timing of the implementation of modern growth. Institutions promoting human capital accumulation have

contributed to the great divergence in per capita income across countries. Credit market imperfections provide one well-studied hurdle for the accumulation of human capital, but non-financial hurdles are also important impediments, too.

Historical and empirical evidence of the effects of non-financial hurdles in the current economic literature, however, has been largely limited to nineteenth-century century Prussia and the early twentieth-century USA, both of which are Western countries. By contrast, Korea under Japanese occupancy developed in a historical context different from these two countries because of its unique geographical location and colonial experience. Nevertheless, our study showed that the adverse effect of inequality in landownership on the accumulation of human capital is still valid in this case, which signifies that the model formalized by Galor et al. (2009) can be applied more broadly to countries outside of the Western world.

We used a panel data set with observations from 13 provinces in each year from 1934 to 1942. With these panel data, we controlled for the unobserved variables by using a fixed effects model. Although land distribution and the public education system in Korea were driven in part by the colonial powers, responses to the central education policy varied by province because of the differences in the level of inequality in landownership. Our results showed that landownership inequality, a non-financial hurdle, has a strongly significant effect on human capital accumulation. This finding was strengthened by the results of the IV analysis. The index of rice productivity and colonial power of each region were used as instruments, and the results again support the existence of an adverse effect of land inequality on the level of education.

No single theory fully explains the most critical factor that caused the Great Divergence. Every scholar agrees, nevertheless, that one crucial factor behind the differentiation in the level of income between nations is the timing of industrialization. According to our research, land inequality was one of the factors that acted as an obstacle to industrialization. Higher land inequality impedes the accumulation of human capital, which in turn delays the timing of industrialization. If two countries were identical except for the level of land inequality, the country that has the lower level of inequality would industrialize first. In this regard, our study provides empirical evidence for this model. For underdeveloped countries that remain in the vicious cycle of the agricultural Malthusian trap, our research may provide valuable policy implications that could contribute to eliminating the hurdles that hinder their industrialization.

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References

Ahn B (1989) The Research on the Structure of Labor Market: Focusing on the Industrialization in the 1930s. In: Ahn B (ed) The Economic Structure of Modern Korea (Geundea Choseoneui Kyungjea Gucho). Seoul, Bibong

Alesina A, Rodrik D (1994) Distributive politics and economic growth. Quart J Econ 109(2):65–90

Banerjee AV, Newman AF (1993) Occupational choice and the process of development. J Polit Econ 101(2):274–298

Barro R (2000) Inequality and growth in a panel of countries. J Econ Growth 5(1):5–32

Becker SO, Woessmann L (2009) Was Weber wrong? A human capital theory of protestant economic history. Q J Econ 124(2):531–596

Becker SO, Woessmann L (2010) The effect of protestantism on education before the industrialization: evidence from 1816 Prussia. Econ Lett 107(2):224–228

Becker SO, Cinnirella F, Woessmann L (2011) The effect of investment in children's education on fertility in 1816 Prussia. Cliometrica 6(1):29–44

Bernargee AV, Duflo E (2003) Inequality and growth: What can the data say? J Econ Growth 8(3):267–299

Black SE, Deverux PJ (2011) Recent developments in intergenerational mobility. In: Ashenfelter O, Card D (Eds) Handbook of Labor Economics, vol. 4B. Elsevier, Amsterdam, pp 1487–1541

Bowles S, Gintis H (1977) Schooling in capitalist America: educational reform and the contradictions of economic life. Basic Books, New York

Chang SW (1994) The plan for the increased yield of rice and the change of rural area. Hankoosa 13 (the Korean History 13), Hangilsa

Checchi D, Ichino A, Rustichini A (1999) Most equal but less mobile? Education financing and intergenerational mobility in Italy and in the US. J Pub Econ 74(3):351–393

Cho Y (1989) Contents and methods of elementary education from Chosun dynasty through Japanese occupation. Chodeunkyoyookyeonku (The Research on the Elementary Education) 3:34–65

Cho SY (1999) The Construction of Agricultural Productive Basis and Management of a Large Scale Farm under Japanese Colonial Rule. Studies on folklore (Minsokhak yeongu) 6:383–408

Cho SY (2000) The formation of colonial small town and the change of urban space under the Japanese rule. Studies on folklore (Minsokhak yeongu) 7:7-31

Cho SW (2014) Expansion of General Education in the 1920s and Korea Modern History Depiction Narration of National History in General School. Ilbonhak (The Study on Japan) 39:117–154

Choi WK (1988) Fascism and Korean Society in the late period of Japanese Rule (Iljeashidea fascismgua hankooksahoe), Cheong-A

Choi WK (2000) The Oriental Development Company's Emigration Project and the Korean Movement against Emigration. Korean Culture (HankookMinjokMoonhwa) 16:69–118

Choi HK (2010) Founding and Education Activity of Elementary School in Japanese Imperialism Period—Gun-po City in Center Research. Kyungjusahak (The Kyungju Study on History) 31:151–183

Chung YT (1988) The agricultural policy of Japanese colonial government and the colonial landowner-tenant system. Hankooksaron (Discourse of Korean History) 20:413–502

Chung YT (1993) The discourse on Japanese immigration and the colonial immigration system. Korean Cult (HankookMoonhwa) 14

Cinnirella F, Hornung E (2011) Landownership concentration and the expansion of education. CESifo working paper series, no. 3603. CESifo Group Munich

Dao NT (2015) From Agriculture to Manufacturing: How Does Geography Matter?. Cliometrica, pp 1–33. doi:10.1007/s11698-015-0132-3

Diebolt C, Perrin F (2013) From stagnation to sustained growth: the role of female empowerment. Am Econ Rev 103(3):545–549

Easterly W (2007) Inequality does cause underdevelopment: insights from a new instrument. J Dev Econ 84(2):755–776

Eckert CJ, Lee KB, Lew YI, Robinson M, Wagner EW (1991) Korea old and new: a history. Ilchokak Publishers, Seoul

Engerman S, Sokoloff KL (2000) Institutions, factor endowments, and paths of development in the new world. J Econ Perspect 14:217–232

Fershtman C, Murphy K, Weiss MY (1996) Social status, education, and growth. J Polit Econ 104(1):108–132
Forbes JK (2000) A reassessment of the relationship between inequality and growth. Am Econ Rev 90(4):869–887
Gallagher J, Robinson R (1953) The imperialism of free trade. Econ History Rev, second series 6, no. 1, pp 1–15
Galor O (2009) Inequality and economic development: an overview. Working papers 2009-3, Brown University, Department of Economics
Galor O (2011a) Unified growth theory. Princeton University Press, Princeton
Galor O (2011b) The demographic transition: causes and consequences. Cliometrica 6(1):1–28
Galor O, Moav O (2004) From physical to human capital accumulation: inequality and the process of development. Rev Econ Stud 71(4):1001–1026
Galor O, Weil DN (2000) Population, technology, and growth: from Malthusian stagnation to the demographic transition and beyond. Am Econ Rev 90:806–828
Galor O, Zeira J (1988) Income distribution and investment in human capital: macroeconomics implication. Working paper no. 197, Department of Economics, Hebrew University
Galor O, Zeira J (1993) Income distribution and macroeconomics. Rev Econ Stud 60:35–52
Galor O, Moav O, Vollrath D (2009) Inequality in landownership, the emergence of human-capital promoting institutions, and the great divergence. Rev Econ Stud 76:143–179
Han WH (1991) The resistance and the education fever on common school. Kyoyookeeron (Theory on Education) 6
Hassler J, Mora JR, Zeira J (2000) Intelligence, social mobility, and growth. Am Econ Rev 90(4):888–908
Heo SY (1983) Studies on characteristics of Korean colonial manufacturing sector under Japanese rule. Ph.D. Dissertation, Seoul National University
Horvath RV (1969) In Search of a Theory of Urbanization: Notes on the Colonial City. East Lakes Geographer 5:69–82
Howe A (1998) Free trade and liberal England 1846–1946. Oxford University Press, Oxford
Ju IJ (2003) Colonial government, private companies and industrialization in colonial Korea. Rev Econ History 35:63–87
Jun B, Lee J (2014) The tradeoff between fertility and education: evidence from the Korean development path. FZID discussion paper 92-2014. University of Hohenheim, Center for Research on Innovation and Services (FZID)
Kajimura H (1985) kyushokuminnchishakaikouseitairon (The Discourse on the Structure of Previous Colonial Society). kankokukinndaikeizaigennkyu (The Research on Modern Korean Economy), Sageyjeol
Kaldor N (1957) Alternative theories of distribution. Rev Econ Stud 23(2):83–100
Kang MS (2007) A historical study on the enactment of the first chosen educational ordinance in the Japanese colonial period. HankookKoyooksahak (The Study on Korean Educational History) 29:1–24
Kazuo H (1976) Nihon Teikoku Shugi No Chousen Ni Okeru Nougyou Seisaku -1920-neudai Shokuminchi Jinushi-sei No Keisei (An Agricultural Policy of ImperialJapan for Cononial Choseon -the Formation of Cononial Landownership). Nipponshi Kenkyuu 171 (The Studies on Japanese History 171)
Keynes JM (1920) The economic consequences of the peace. Macmillan and Co. Limited, London
Kikkawa S (1904) Kankoku Nogyokeieiron (Discourse of Management of Korean Agriculture). DiaNihon nokai, Tokyo
Kim C (1965) Population and Economy in the Colonial Period. In: Choi WK (ed) Fascism and Korean Society in the late period of Japanese Rule (Iljeashidea fascismguahankooksahoe), Cheong-A
Kim S (1986) The development of business of the oriental development company. In: The Korean Social History Studies Institute (Hankook sahoesa yeongoohoe) The Korean modern society in Rural under the Japanese Imperialism (Hankook nongchonwa ilbon jeakkok jooui). Literature and Intellect (MoonhakguaJisungSa)
Kim YS (2000) The research on the modern history of agriculture of Korea. Jisiksaneopsa
Kim Y (2007) The Korean peasants movement and agriculture policies of the Japanese government. Orient Stud, Dong Yang Kak 41:269–282
Kim S, Jeon K, Jang S, Park Y (1989) A study on the history of land reform. Korea Rural Economic Institute, Seoul

Lee MK (1988) The history of Choseon's education. Gureum
Lee HR (1994) The social structure of Korea in the colonial period. Hankoosa 14 (the Korean History 14), Hangilsa
Lee KS (2003a) The development of Japanese agricultural immigration. Seoul Rep Korea Rural Econ Inst 7:51–78
Lee SS (2003b) The Enforcement and Characteristics of an Increased Yield of Rice Policy in Chosun during the War time (1937–1945). SaChong (the Collection of History)
Lucas RJ (1988) On the mechanics of economic development. Journal of Monetary Economics 22:3–42
Maoz YD, Moav O (1999) Intergenerational mobility and the process of development. Economic Journal 109(458):677–697
Moskowitz K (1974) The creation of the Oriental Development Company: Japanese illusions meet Korean reality. Occasional papers on Korea 2–3
Oh SC (2000) The formation of Korean Primary School in the Colonial period. Kyoyookkwahaksa
Owen AL, Weil DN (1998) Intergenerational earnings mobility, inequality and growth. Journal of Monetary Economics 41(1):71–104
Panizza U (2002) Income inequality and economic growth: evidence from American Data. J Econ Growth 7:25–41
Park BY (1971) Shokuminchi Ni Okeru Shougyou-teki Nougyou No Tenkai (the development of commercialized agriculture of colony). Tokyo University Press, Tokyo
Park SH (2001) Association Enterprise And Transformations Of Rural Society Under Rule of Japanese imperialism. Chung-Ang Sa Ron 15 (Discourse of History at Chung-Ang University), 81–106
Park M, Seo H (2003) Colonial authority and statistics; statistical system of the Choson government-general and census. Seoul National University Press, Seoul
Perotti R (1996) Growth, income distribution, and democracy: what the data say. J Econ Growth 1(2):149–187
Persson T, Tabellini G (1994) Is inequality harmful for growth? Am Econ Rev 84(3):600–621
Seo MS (2007) Industrial policies of Japanese imperialism and formation of native capital in Korea. Orient Stud, Dong Yang Kak 41:251–267
Seth MJ (2010) A history of Korea: from antiquity to the present. Rowman & Littlefield Publishers, Lanham
Shin Y (1982) A survey on the land survey program of Korea under Japanese colonial rule. Jisik Sanup Publication Company, Seoul
Soh SY (2005) Structure and evolution of landowner–tenant relationship in the colonial "Chosun.". Korean J Agric History 4(2):65–88
Son JH (2008) The tracks going to ruling class in the Japanese imperialism. Kyoyookchulhak (Philosophy of Education) 35:341–343
Song HY (2001) The Comparative Study on the Japanese Policy of University Education. J Chinese Historical Researches (Joogkuksayeonku) 16:253–286
The Education Ordinance (1911) In: Academy of Korean Studies (ed) Encyclopedia of Korean Culture. http://encykorea.aks.ac.kr/
Uzawa H (1965) Optimum technical change in an aggregative model of economic growth. Int Econ Rev 6:18
Wen CM (2006) The study on Japanese agricultural migration to Korea in the early 20th century: focusing on "Japanese Oriental Development Company". Hallym J Jpn Stud 23:99–137
Woo J (1991) Race to the swift. Columbia University Press, New York