Persistent Stigma in Space: 100 Years of *Japan's Invisible Race* and Their Neighborhoods *

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Abstract. We provide evidence of a large and persistent land price discount in neighborhoods historically inhabited by the outcaste group (*buraku*) in Japan. Our border design shows that this price discount declined from 53% in 1912 to 11% in 2006 but remained constant thereafter. Furthermore, we provide evidence that the vestiges of territorial stigma of buraku areas is the primary cause of these persistently lower land prices. Living in the stigmatized buraku area increases the risk of being identified as buraku and experiencing discrimination. Therefore, the lower land prices reflect the higher discrimination risk in the spatial equilibrium of our model.

Keywords: Discrimination, Land prices, Border design, Capitalization, Buraku.

JEL classification: J15, N95, R12, R21, R30.

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The buraku issue is an issue of discrimination stemming from the feudal caste system.... Neighborhoods that were inhabited by the buraku class are also discriminated against....

If you live in a buraku area, the chance that you are regarded as coming from the buraku class emerges. You want to avoid such "risk of being regarded as buraku."

Hitoshi Okuda [1]

1 Introduction

Historically, many societies maintained formal institutional rules that discriminated against minority groups. Although *de jure* discrimination against minority groups has been abolished in many contexts, *de facto* discrimination may persist long after these formal institutions have been reformed. Understanding the persistence of discrimination is thus essential for addressing the long shadow of discriminatory institutions over minority groups. However, empirically identifying the persistence of discrimination has been difficult for several reasons. First, scholars need data on important economic outcomes over long periods for members of the majority and minority groups, which is often hard to obtain in historical contexts (for example: Derenoncourt, Kim, Kuhn and Schularick forthcoming). Second, the elimination of discriminatory rules could be relatively recent so that the long-run persistence of discrimination is difficult to analyze. For example, since the Civil Rights Act in the U.S. was enacted in 1964, we cannot analyze the persistence of the *de facto* discrimination against African Americans over more than 60 years. Finally, it can be empirically challenging to separate the role of discrimination from other causes of economic gaps between groups because no exogenous variation in minority group affiliation is available (Sen and Wasow 2016).

To address these challenges, this study analyzes the distinctive case of *buraku* discrimination in Japan, whereby a person is at a disproportionately high risk of being identified as a minority group member if they live in historical neighborhoods of buraku people (*buraku areas*). Combining

[1] Quotes are taken from Okuda (2000, 2007). The original sources of the quotation are translated from Japanese by the authors.

100 years of granular land price data, a simple spatial economic model, and a border design, we exploit a quasi-experimental variation in minority group affiliation to provide novel revealed preference evidence on the strong persistence of discrimination, even 150 years after the emancipation that eliminated institutional discrimination against the buraku people, who are culturally and ethnically homogeneous with the majority people.

Buraku is the name of an outcaste group in pre-modern Japan. Until 1871, the buraku class faced formal discriminatory rules that limited their residence to small "ghettoized" neighborhoods and limited their work opportunities to a few distasteful occupations. In 1871, a liberation edict, which was a part of the Meiji restoration, eliminated all formal discrimination toward the buraku class, and permitted free occupational and residential choice. However, even 150 years after their emancipation, historical neighborhoods of the former buraku people still remain. Importantly, living in a buraku neighborhood can still put one at a risk of experiencing discrimination. This is because buraku people are visually indistinguishable from other Japanese, as best illustrated by the term *"Japan's Invisible Race"* coined by De Vos and Wagatsuma (1966). Under such invisibility, living in a buraku area may serve as an important signal of affiliation with the former buraku class (De Vos and Wagatsuma 1966; Okuda 2007). By incorporating such location-dependent discrimination in a spatial equilibrium model à la Rosen (1979), Roback (1982), and Glaeser (2008), we find that the higher risk of being identified as buraku and experiencing discrimination is capitalized into the lower buraku land prices. This potential capitalization of the discrimination risk motivates us to investigate the land price discount of buraku areas, which we empirically find to be substantial and persistent over the last 100 years, to learn about the severity and persistence of discrimination against buraku people.

We begin by quantifying the land price discount of buraku areas by using the newly constructed comprehensive land price data of Kyoto city spanning from 1912 to 2018. Here, we focus on quantifying the land price discount while remaining agnostic about whether it results from the capitalization of the higher discrimination risk or some other mechanisms. For identification, we use a border design that compares land plots only in a neighborhood of the border of buraku areas, allowing us to control for any spatially continuous unobserved heterogeneity. We estimate that land prices in buraku areas were 53% lower in 1912 and 14% lower in 2018 than those in nearby non-buraku areas. By newly digitizing land price data in intermediate years, we also find that while the land price discount declined particularly fast during the period of extensive policies and efforts to mitigate buraku discrimination, the decline stopped in the 21st century. Overall, we have two key results. First, buraku areas have a large land price discount, despite the disappearance of the caste system that discriminated against the buraku class. Second, the land price discount has substantially diminished over time, but it persists even 150 years after the repeal of the caste system and after various efforts to de-stigmatize buraku areas.

Having quantified the land price penalty of buraku areas, we next investigate why buraku areas have lower land prices. After investigating various possible mechanisms, we find that the most important mechanism is the persistence of the territorial stigma and associated risk of experiencing discrimination by being identified as buraku people. Buraku people have few differences from the majority Japanese because buraku discrimination occurs among the same race due to the pre-modern history.[2] Consequently, living in a buraku area serves as arguably the most important signal of being affiliated with this discriminated class (Okuda 2007). Meanwhile, those who were born in these areas may attempt to reduce the discrimination risk by leaving these areas and passing themselves as non-discriminated Japanese (De Vos and Wagatsuma 1966; Dahis, Nix and Qian 2019). This distinctive role of residence implies that the discrimination risk is indirectly "traded" in the land market, and hence, capitalizes into land prices. Importantly, the discontinuous change in the discrimination risk at the border of buraku areas provides a quasi-experimental variation in minority group affiliation, which we exploit by the border design. Note that the cost of facing a higher discrimination risk reflected in land prices comprehensively captures the overall cost of being identified as the minority group, including forms of discrimination that are hard to observe in data. Together, the large and per-

[2]Other examples of discrimination among the same race due to pre-modern history include caste discrimination in India, *cagots* in western France and northern Spain, and *baekjeong* in Korea.

sistent land price discount serves as the novel revealed preference evidence of severe and persistent discrimination against the buraku people, who are culturally and ethnically homogeneous with the majority.

We also investigate other mechanisms that may cause the land price discount, even if buraku areas no longer have the territorial stigma and associated discrimination risk. Evidence suggests that these mechanisms play a relatively limited role in our context. The first is the adverse neighborhood quality due to poverty. However, recent buraku land price penalties are unlikely to be explained by the neighborhood quality, as we find that buraku areas today are no longer poorer than nearby non-buraku areas. Even in 1912, when buraku areas were poorer than nearby non-buraku areas, explicitly controlling for proxies of neighborhood income and a placebo analysis of poor non-buraku areas suggest the limited role of neighborhood quality. The second is the school quality, but Japanese schools are highly standardized and controlling for school districts does not alter the results. The third is the durable local capital, notably residential housing and public goods (e.g., roads, parks, and community centers). On residential housing, the fast depreciation of Japanese housing and place-based policies that have improved housing conditions imply that the century-long persistence can hardly be explained by housing durability. Further, we find little evidence that buraku areas have substantially worse public goods than nearby non-buraku areas. The fourth is locational characteristics, such as natural conditions and transportation access. However, our border design, which controls for locational characteristics that are spatially continuous, and checking if locational characteristics jump at the border all suggest that they play a limited role in inducing the buraku land price discount. The fifth is the aversion for interacting with people with outcaste ancestors. However, controlling for proxies of social networks does not affect our land price discounts. Moreover, even if our land price discount includes such aversion, it still serves as evidence of persistent buraku discrimination because this is simply another form of buraku discrimination. The last is the policy discontinuity at the buraku borders of buraku areas, especially the land-use regulation, but explicitly controlling for it does not change our results. Overall, our analysis suggests that the persistent territorial stigma and associated discrimination risk is likely the primary driver of the buraku land price discount.

We believe that our results are insightful for other contexts. First, geographical concentration or segregation of minority people is a common phenomenon worldwide (e.g., African American communities in the U.S., outcaste communities in the Indian caste system, and Ghettoes and Roma communities in Europe). As shown by existing studies including Wacquant (2007), Besbris, Faber, Rich and Sharkey (2015), and Kirkness and Tijé-Dra (2019), such concentrated areas often get stigmatized due to discrimination against a minority group. Our result suggests that such areas and their residents may suffer for a long time because the territorial stigma does not easily disappear. Second, the strongly persistent buraku land price penalty provides the novel revealed preference evidence that discrimination against the buraku people exhibits strong persistence even 150 years after their emancipation. Our border design allows us to use an exogenous variation in minority group affiliation to analyze the overall severity of discrimination over 100 years, which is not attained by an experimental approach to discrimination because we cannot go back in time to measure discrimination in the past. Moreover, discrimination persists despite various efforts to eliminate it and absence of ethnic or cultural differences from the majority. Such strong persistence of discrimination even among the same race suggests that discrimination may not easily disappear in other contexts, such as racial discrimination in the U.S. (Boustan 2016; Derenoncourt and Montialoux 2021).

Related literature. This study is related to many strands of literature. First, our study relates to the research on discrimination in the spatial economy. The interplay between discrimination and space has been extensively investigated, especially in the context of racial discrimination in the U.S. (e.g., Schelling 1971; Yinger 1986; Fujita 1989; Cutler, Glaeser and Vigdor 1999; Bayer, Ferreira and McMillan 2007; Card, Mas and Rothstein 2008; Boustan 2016; Christensen and Timmins 2023). Our study is particularly distinctive in two ways. First, we employ 100 years of comprehensive land price data, documenting the persistent land price discount of the outcaste neighborhoods. Second, building on a spatial equilibrium model showing that the disamenities of buraku areas capitalize into their land prices, we document that the cost of facing an elevated risk of experiencing discrimination would be the main disamenity of living in buraku areas (Okuda 2007).[3] Therefore, we can use the land prices as quantitative revealed preference evidence on the overall severity of discrimination. This novel approach suggests strong persistence in buraku discrimination, even 150 years after their emancipation. Notably, buraku discrimination remains persistent without ethnic and cultural differences from the majority (De Vos and Wagatsuma 1966), and despite various efforts and policies to eliminate it (Teraki and Kurokawa 2016), highlighting the general difficulty of fully eliminating discrimination in many other contexts even after the discriminatory institutional rules disappeared.

Second, we contribute to the literature on the persistent impact of history (see Cantoni and Yuchtman 2021, Glaeser 2022, and Lin and Rauch 2022 for recent reviews). In particular, our study suggests the persistent impact of history on the spatial distribution of economic activities by showing that the historical stigma associated with certain neighborhoods has a persistent negative impact. Empirical studies on history dependence in the spatial economy are mixed: some studies find evidence of history independence in some contexts (e.g., Davis and Weinstein 2002, 2008; Miguel and Roland 2011; Takeda and Yamagishi 2023), whereas others find history dependence in other contexts (e.g., Dell 2010; Bleakley and Lin 2012; Sequeira, Nunn and Qian 2020; Ambrus, Field and Gonzalez 2020; Heblich, Trew and Zylberberg 2021; Allen and Donaldson 2022; Yamasaki, Nakajima and Teshima 2022). Therefore, an important open question entails understanding the conditions under which a historical event has a persistent impact (Lin and Rauch 2022). We contribute to this by highlighting the role of territorial stigma, which can persist even after the initial cause of the stigma disappears. Beyond the spatial context, our result suggests that a historical event, a former caste system in our context, can shape persistent discriminatory preferences against certain groups of people. The persistence of discriminatory preferences has been documented by Voigtländer and Voth (2012), who show the centuries-long persistence of anti-semitism in Germany, and Schindler and Westcott (2021), who show that an exposure to African American soldiers in the United Kingdom mitigated discriminatory preferences over generations. Our result also suggests that discriminatory preferences

[3]This is in line with the traditional Becker (1971)'s view that market prices reflect preferences about discrimination.

against the buraku are strongly persistent.

Third, we complement the experimental literature identifying racial discrimination, represented by the audit and correspondence studies in labor and housing markets (e.g., Yinger 1986; Bertrand and Mullainathan 2004; Kline and Walters 2021; Christensen and Timmins 2023). While these provide strong evidence of discrimination, the usage of the audit and correspondence study is limited to a blind setting in which the experimental manipulation of the race is possible. Moreover, the experimental approach is infeasible for analyzing discrimination in historical times. Our key departure from these studies is to introduce a quasi-experimental variation in the discrimination risk, which jumps discontinuously around the border of buraku areas, and identify the overall cost of facing a higher risk of being identified as a minority and experiencing discrimination using land prices. This allows us to quantitatively analyze the persistence of discrimination over the last 100 years.

Fourth, this study contributes to the research on stigmatized neighborhoods. In his influential book, Wacquant (2007, p169) states that "[a]ny comparative sociology of the novel forms of urban poverty...must begin with *the powerful stigma attached to residence in the bounded and segregated spaces.*" Indeed, his works have evoked a volume of subsequent studies on neighborhood stigmatization in various social science fields. Stigmatized neighborhoods due to discrimination against a minority group are common globally, such as African American communities in the U.S., outcaste communities in India, and Ghettoes and Roma communities in Europe.[4] We show that such territorial stigma may have a quite persistent adverse impact on the neighborhoods because the territorial stigma itself is quite persistent even 150 years after the removal of the initial cause of the stigma. Moreover, as we argue in Section 7.1, living in such a stigmatized neighborhood may reduce utility by increasing the risk of experiencing discrimination. While this is a distinctive feature of buraku discrimination, where the minority is visually indistinguishable from the majority and the residence serves as a signal of the affiliation with the discriminated group, this can also happen in other contexts such as online markets (Besbris et al. 2015).

[4]Specific examples include Harlem in New York, Clichy-sous-Bois in France, and Marxloh in Germany.

Finally, our study contributes to the research on buraku discrimination in Japan. Few studies have investigated the buraku issue using a formal economic model and an econometric framework. In contrast to the omission in economics, sociological and historical studies on buraku have been prolific (e.g., De Vos and Wagatsuma 1966; Teraki and Kurokawa 2016). Okuda (2000, 2006, 2007) is the only study that focuses on the land price data of buraku areas. Based on several case studies in late-20th and early-21st century Osaka, Okuda demonstrates that land prices in buraku areas are lower than nearby non-buraku areas and argues that aversion toward living in buraku areas may induce the lower price. While this is an important insight, the result remains suggestive because the lack of econometric modeling and identification strategy may limit the statistical significance and internal validity of the results. Our study makes at least four significant advancements beyond this suggestive evidence. First, we adopt modern econometric techniques and empirical strategies using comprehensive land price data of Kyoto. Second, our focus on Kyoto allows us to investigate the long-run evolution of the land price discount from 1912 to 2018. Third, we clarify the implications of the buraku land price discount by developing a spatial economic model. Finally, we scrutinize the mechanisms behind the lower land price of buraku areas using quantitative evidence, finding that the persistence of the territorial stigma itself and associated discrimination risk are crucial.

The rest of the study is organized as follows. Section 2 provides the institutional background about buraku relevant for our analysis. In Section 3, we introduce a within-city spatial model that guides our empirical analysis. We describe our data in Section 4 and our empirical strategies in Section 5. We present our empirical results on the land price discount in Section 6. Section 7 analyzes mechanisms behind the land price discount of buraku areas. Section 8 concludes the paper.

2 Background: Brief overview of the history of the buraku

In this section, we briefly introduce the historical background of the *buraku* class, a former outcaste group, and their residential neighborhoods (*buraku areas*). We mainly follow Teraki and Kurokawa (2016), who present a standard textbook treatment of the history of the buraku, to convey its widely accepted view.

Discrimination against the buraku class in the modern era is considered to typically stem from aversion toward people in stigmatized industries such as the leather industry and butchering.[5] The stigma dates back to the pre-modern period. They were stigmatized because killing animals is considered sinful in Buddhism and Shintoism. In the pre-modern period, they were called *eta* (literally meaning "greatly polluted").[6] The target of discrimination during this period was determined based on occupation, although occupation plays a smaller role in discrimination in the modern period (see Section 7.1). There is no convincing evidence that these discriminated people have distinctively different appearances from non-discriminated Japanese people, which are often the basis for discrimination in other contexts (e.g., skin color). Some subtle cultural differences between the two groups such as accents do exist (De Vos and Wagatsuma 1966). However, the cultures are quite similar in most aspects and even the slight differences have diminished over time. As the penetration of Buddhism into Japan had started around Kyoto area, the political center at that time, the discrimination toward the buraku started in the 10th century. At this initial stage of discrimination, while no formal discriminatory rule existed, the discrimination spontaneously started based on religious philosophies.

However, this discrimination was later formalized by samurai governments. Around 1600, they started a formal family and land registration system at the national scale. The registry noted some people as belonging to the discriminated class. The largest discriminated group was *eta*. Another

[5]In this sense, the buraku discrimination shares a lot with the Indian caste discrimination. In fact, Goonesekere (2001) reports that the buraku discrimination is similar to the Indian caste in the sense that discrimination is based not on visual appearance but on work and descent, and discrimination was legal but became illegal at some point. Moreover, the discriminated caste population often exhibits a high geographical concentration as the buraku population also does (Devulapalli, 2019). However, they are of course different in some respects. For instance, as raised by Teraki (2019), the Indian caste is strongly supported by Hinduism whereas religion plays only a partial role in the buraku discrimination, and the Indian caste has a stern hierarchy (i.e., jati) within the discriminated caste whereas the buraku discrimination does not.

[6]Depending on periods and regions, similar people were called by a different name (e.g., *kawata*). However, to avoid unnecessary confusion, we use the name *eta* throughout this study, which is a comprehensive name for the class of such people in the Edo period.

major example of a discriminated class was the *hinin* (literally meaning "not a human being"), who were mainly beggars and criminals. The first formal discriminatory control on the behavior of the discriminated classes (*fuzoku torishimari rei*) was issued in 1776 by the Tokugawa shogunate government. Several local governments (*han*) had already implemented specific controls on their life prior to 1776, while many other local governments implemented such control after 1776. After these orders, the interaction between discriminated and non-discriminated people was restricted, although non-discriminated people tended to voluntarily avoid interactions even before the order (Sumimoto and Itakura 1998).

The aversion and restriction toward interacting with discriminated groups led to their residential clustering. Combined with formal restrictions on geographical mobility in the Edo period, this created the residential areas for discriminated people.[7] The residential cluster was later called the *buraku* or *buraku area* and the residents in these areas were later called buraku people (*burakumin*).[8] The Japanese word "buraku" literally means a small residential community. However, it is also used to refer to the discriminated social class, rather than the residential clustering.[9] In this study, to avoid ambiguity, we use the term "buraku area" to refer to a historical neighborhood of buraku people and "buraku" to indicate the discriminated class. Buraku areas are spatially scattered and small, as we discuss in Section 4. Notably, buraku areas constitute only around 1.5% of the total area of Kyoto in our data. The small size of buraku areas reflects the small population share of such discriminated

[7]Restrictions on geographical mobility were imposed on almost all people during the Edo period, implying that people could not freely move into buraku areas nor move out of them. It does not mean, however, there was no mobility between buraku and non-buraku areas. In particular, people may become outcaste (*hinin*) by committing a crime and be forced to live in an outcaste community.

[8]Note, however, that all buraku areas in the modern era do not necessarily trace back to the historical residential communities in the pre-modern period because some new buraku areas were established after the Meiji restoration perhaps due to aversion toward new jobs such as coal mining (Sumimoto and Itakura 1998). However, buraku areas around the center of Kyoto city are known to have long histories (Kyoto City Government 1940). We show in Appendix G that focusing on such buraku areas does not change our main conclusion.

[9]This double meaning of the word "buraku" illustrates the close connection between the residential location and discrimination against the buraku people.

people, which was estimated to be less than 2% in the Edo period.

During the Meiji restoration following the fall of the Tokugawa shogunate, the liberation edict (*kaiho rei*) in 1871 eliminated all formal discrimination toward groups of people such as the eta and hinin. Specifically, the edict states (Teraki and Kurokawa 2016):

> The names eta, hinin, etc. shall be abolished. Henceforth, people belonging to these classes shall be treated in the same manner, both in occupation and social standing as commoners.

The edict clarifies that the former discriminated classes were abolished and ensures that formerly discriminated people are treated equally as other Japanese people. Notably, as the Meiji restoration permitted free occupational and residential choice, it also permitted this free choice for formerly discriminated people. Following the liberation edict, discriminated classes like hinin merged into the non-discriminated majority Japanese in most cases, potentially because they lost a reason to maintain the historical community as they mainly engaged in policing in the samurai period and they immediately lost their jobs after the samurai regime's decline (Teraki and Kurokawa 2016).

In contrast, the residential clustering of the eta, the largest discriminated group before the liberation edict, persisted in society.[10] The discriminatory mindset toward them also remained. One reason is that the religious stigma associated with the eta did not immediately disappear just by eliminating the discriminatory institutions. Moreover, somewhat ironically, the liberation edict might actually have worsened the socioeconomic conditions of the discriminated people as it also eliminated the entry barriers into the stigmatized industries for non-discriminated people (Research Center of Kyoto Buraku History 1991; Sumimoto and Itakura 1998). Poverty contributed to sustaining the discriminatory views. The entry of the non-discriminated people implies that the connection between occupation and discrimination against the (descendants of) eta became weaker, but discrimination remained

[10]One reason behind why they tended to remain in the same place is that unlike the hinin, they did not immediately lose their jobs after the regime shift. Thus, the historical communities provided advantages for their job even after the emancipation. However, migration inflows and outflows were also active (see footnote 35).

in society. This is best illustrated by the formation of *zenkoku suihei sha* in 1922, a renowned party of the buraku people aiming to eliminate discrimination, 51 years after the liberation edict. Thus, the stigma associated with buraku areas also persisted even after the emancipation.

In the 20th century, the government invested in buraku areas for improving the living conditions. Generally, the aim was to facilitate the integration of the discriminated people into the non-discriminated people. In 1920, the central government allocated 50 thousand yen specifically for improving the buraku issues. Local governments had also started such policies. For example, during the period between 1920 and 1942, Kyoto city spent on sanitation (public bathhouse), childcare, settlement houses (*rinpokan*), medication (preventing and curing chlamydia trachomatis), and infrastructure (Akisada 1972). Efforts to reduce discrimination accelerated since the late 1960's. From the late 1960s, the large place-based policy (*dowa taisaku jigyo*) has invested around 15 trillion yen to improve the living conditions of people in buraku areas by investing in infrastructure and housing. Consequently, today buraku areas receiving such public investment have few disadvantages in these dimensions (see Section 7.2 for more discussions). Almost concurrently, efforts were also made to reduce buraku discrimination by restricting access to one's history of residential addresses and the location information of buraku areas. We further discuss these efforts in Section 6.2.

Buraku discrimination has mitigated over the 20th century, possibly due to such efforts to combat discrimination (Teraki and Kurokawa 2016). However, public opinion seems to be divided as to whether buraku discrimination exists even today.[11] This paper provides novel evidence that buraku discrimination does exist even today.

Although discrimination in the modern period can take various forms, generally speaking, discriminating people tend to avoid interacting with the buraku, especially in the realm of marriage and the workplace (Okuda 2007). Other forms of discrimination, such as bullying, have also been reported. Various reasons for discrimination have been noted (e.g., Sumimoto and Itakura 1998;

[11]For instance, according to a survey by the Ministry of Justice in 2019, one-fourth of respondents state that buraku discrimination no longer exists, while the remaining three-fourth state it still exists (https://www.moj.go.jp/content/001327359.pdf, last accessed on March 8, 2024. In Japanese).

Okuda 2007; Teraki and Kurokawa 2016). For instance, as in the pre-modern period, people may think that buraku people are "polluted." Alternatively, Okuda (2007) argues that even if people do not spite buraku people themselves, people might still discriminate against the buraku because it signals that they do not belong to the buraku class and helps them avoid being discriminated against. Regardless of the reason, discrimination against the buraku would reduce utility either directly or indirectly through labor market outcomes. Our theoretical framework in Section 3 accommodates both channels.

Our empirical analysis focuses on Kyoto city for the reasons stated at the beginning of Section 4. To understand the generalizability of our results to other Japanese cities, note that the distribution of the buraku people has a large regional variation. Generally speaking, Western Japan, to which Kyoto belongs, tends to have more buraku people than Eastern Japan. Kyoto also has the longest history of discrimination, as discussed at the beginning of this subsection. Thus, Kyoto, our study area, has the most persistent discrimination over centuries and the discriminated class is relatively prevalent.[12]

3 Theoretical framework

We introduce a simple spatial equilibrium model a là Rosen (1979), Roback (1982), and Glaeser (2008) to guide our empirical analysis. This intra-city model yields the key regression equation showing that the disamenities, which capture the overall unattractiveness of buraku areas as a residence, capitalize into the land prices. In the main text, we present our main theoretical prediction and explain its intuition. A full description of the model and derivations are provided in Appendix A. Our main result is as follows:

Proposition 1. *Equilibrium land prices* r_n *satisfy* $\ln r_n = D_n + \eta X_n + \epsilon_n$ *for any location* n*, where* D_n *is the buraku disamenity of location* n*,* X_n *is a vector of locational characteristics, and* ϵ_n *is the unobservable idiosyncratic amenity. After parametrizing* D_n*, the ordinary-least-squares (OLS)*

[12]Right after the Meiji restoration, the former discriminated classes of people constitute around 3.3% of the population in Kyoto prefecture (Research Center of Kyoto Buraku History 1991), which was larger than the national average of around 1.5-2% (Sumimoto and Itakura 1998).

consistently estimates it provided that (D_n, X_n) *is orthogonal to* ϵ_n.

Proposition 1 shows that we can back out the buraku disamenity of location n by estimating the land price discount of buraku areas. To illustrate this, we specify that D_n equals some coefficient β times the dummy indicating whether location n belongs to the buraku area. Then, we can estimate β, the buraku land price discount, by using the OLS.[13] We focus on identifying the magnitude of the buraku disamenities in Section 6 by measuring buraku land price discount, while remaining agnostic about the sources of the buraku disamenity. In Section 7, we dig deeper into the mechanism and highlight that a higher risk of being regarded as the buraku class due to the surviving territorial stigma of buraku areas plays a key role.

The intuition behind Proposition 1 follows from the standard spatial equilibrium logic. Ceteris paribus, since the utility equalizes in spatial equilibrium, the land price gap between buraku and non-buraku areas equals the willingness-to-pay to avoid the disamenity of buraku areas D_n. Therefore, the buraku disamenity D_n capitalizes into land prices.

While Proposition 1 is shown with no idiosyncratic taste for buraku areas, we relax this assumption in Appendix A. We show that if people have idiosyncratic preferences for living in buraku areas, the land price penalty of buraku areas corresponds to the willingness-to-pay to avoid buraku areas for the marginal worker indifferent between buraku and non-buraku areas.[14] This captures the possibility that, for example. those born in buraku areas or those with buraku ancestors are more willing to live in buraku areas. We then argue that the marginal worker is likely to have positive but relatively low willingness-to-pay to avoid buraku areas because buraku areas only account for 1–2% of the study area. This implies that our quantification of the cost of the buraku disamenity based on land prices would be conservative for the entire population.

Such preference heterogeneity could introduce sorting of particular types of people into buraku

[13]Note that in Proposition 1, the population and income level of location n do not appear. See Appendix A for details.

[14]While we do not believe that the mobility cost is important in our context because of the long time horizon, introducing the mobility cost preserves our qualitative prediction (Yamagishi 2021).

areas. Notably, if poor people are relatively willing to live in buraku areas, they may sort into buraku areas and it could introduce lower land prices above and beyond the buraku disamenity D_n. In Section 7.2 we find its limited importance in explaining the buraku land price discounts.

4 Data

We use data from Kyoto city to estimate the effect of buraku areas (i.e., buraku disamenity) on land prices from 1912 to 2018. We focus on Kyoto city for several reasons. First, we have the novel GIS land price data of 1912 Kyoto, which allow us to investigate the magnitude of buraku land price discounts over a century. Second, Kyoto city did not experience the US air-raid bombing during WW2, which is exceptional among major Japanese cities (Davis and Weinstein 2002). Third, as discussed in Section 2, Kyoto has the longest history of discrimination toward the buraku and a relatively large share of the discriminated population, implying that Kyoto is one of the cities in which the buraku issue is most important. Below we describe the main features of our data (see Appendix C for more details).

Buraku areas. Buraku areas in Kyoto city are scattered throughout the city, as illustrated in Figure A2a.[15] They constitute only a small fraction of areas in the city as each of them is small. According to our definition of buraku areas that we explain in the next paragraph, in 1912, the total area of five distinct buraku areas was $0.54km^2$, implying an average size of around $0.11km^2$, and the buraku area covered about 1.3% of the areas covered by our land price data. In 2018, the total area of eighteen distinct buraku areas was $2.54km^2$, implying an average size of around $0.14km^2$, and the buraku areas covered about 1.5% of the areas covered in our land price data. Note that the number of buraku areas in our data increased from five in 1912 to eighteen in 2018 because Kyoto city expanded over the past century and many buraku areas got engulfed into the city area (see Appendix G).

In the main text, we adopt the definition of buraku areas by Kyoto City Government (1975),

[15]While we cannot visually illustrate the scattered nature of buraku areas because we cannot show a map (see footnote 17), we illustrate the scattered nature by computing the distance between buraku areas. In 2018, for each of 18 buraku areas in 2018, the mean distance to another buraku area is 6.8 km with the average standard deviation of 2.8km.

which was used for implementing policies toward buraku areas, throughout our sample period.[16] As a robustness check, we also re-define buraku areas based on an alternative data source: Kyoto City Government (1929). This allows us to identify the exact buraku borders even more accurately than the definition of Kyoto City Government (1975), which is based on block boundaries. However, the data contain only six buraku areas near the city center because Kyoto city at that time was smaller than it is today, which makes it unsuitable especially for contemporary data. Reassuringly, using this alternative definition of buraku areas does not alter our conclusion (see Appendix H).

Unfortunately, we cannot present the actual map of buraku areas we constructed due to our concern that showing such a map might provide easy access to identifying information of the buraku class and catalyze discrimination.[17] Instead, we briefly describe the typical history of buraku areas in our dataset (see Appendix G for more description). With some exceptions, buraku areas in the pre-modern period were located outside of historical urban areas of Kyoto due to people's aversion toward interacting with buraku people. However, they were not necessarily forced to live in areas having inferior conditions compared to their neighborhoods.[18] Over time, Kyoto's urban areas had rapidly expanded, and five buraku areas were engulfed into urban areas as of 1912. Kyoto's urban area city has spread further so that eighteen buraku areas are in the urban areas in 2018.

Land price data. We newly compile land price data covering all of Kyoto city from 1912 to 2018. Throughout, we take a representative point of land plots as our unit of observation. The 1912 land price data are from *Kyoto chiseki-zu*. For each land plot, it records assessed land prices for land

[16]The administrative boundary of buraku areas we use might differ from that envisioned by people. It would lead to an underestimation of the buraku effect if it induces a random classification error of land plots (Aaronson, Hartley and Mazumder 2021), although we empirically find a statistically significant discontinuity at the border.

[17] Although we use publicly-available data on the location of buraku areas, a judicial precedent ruled that showing a map may be illegal because providing easy access to such information may catalyze discrimination. Indeed, although exceptions apply, many scholarly papers on buraku refrain from showing an actual map. Only for academic purposes, the actual map used in this study may be available upon request from the authors on a case-by-case basis.

[18]Indeed, Appendix D documents that buraku areas do not necessarily have inferior natural conditions than nearby non-buraku areas.

taxation, which is based on market rental prices. We compute the land price per square meter and use its log as the outcome variable.

Our data for land prices in 2006–2018, *kotei shisan-zei rosenka*, also cover all of Kyoto city. *Kotei shisan-zei rosenka* are the administrative land price data for assessing property taxation. Each municipality (Kyoto city government in our case), after dividing streets into many segments, assigns the assessed land price to each segment. The assessment respects transaction prices while ignoring unusual aspects of each transaction. We take the centroid of each segment as the representative point of the land plot.[19] Figure A3 visualizes our land price data for 1912 and 2018.

For land prices in 1961, 1973, 1982, and 1991, we newly digitize *sozoku-zei rosenka*, which are the administrative land price data set by the National Tax Agency. Except that the property valuation is used for inheritance taxes, it is similarly constructed as *kotei shisan-zei rosenka* for property taxation: *sozoku-zei rosenka* is determined by referring to professional land price assessments and other professionally assessed land price data based on transaction prices. Besides land prices, we also digitize information on land use (i.e., residential, commercial, and industrial areas).

Throughout, we use the administrative assessment prices rather than the transaction prices not only because of their data availability but also comprehensive coverage. Since land transactions are only infrequent and buraku areas are quite small relative to the entire city, we do not observe enough actual transactions in buraku areas for statistical inference even if we pool multiple years of observations.[20] In contrast, our professionally assessed land price data cover every land plot while referring to the actual instances of transactions.

Reassuringly, evidence shows that our assessment price is closely related to the transaction price. For the land price data in the 21st century, in Appendix B, we show the strong positive correlation between the assessment and transaction prices ($\rho \simeq 0.824$), although the infrequency of land trans-

[19]Note that since the dataset does not record the prices of all land plots but rather has a price per each road, it has a smaller sample size than the 1912 data that record all land plots.

[20]This does not imply that land transactions are less frequent in buraku areas than in other areas. We can generally observe only a small number of transactions in a given small area, and the coverage of the publicly-available land transaction price data are limited.

actions tends to introduce idiosyncratic noises. Moreover, we estimate that a 1% increase in the assessment price is associated with roughly a 1% increase in the transaction price. These results imply that our buraku effect on the transaction prices can be reasonably approximated by the effect on the assessment prices. Moreover, although we could not find the market rental land price data for 1912 that our assessment price data are based on, Yamasaki et al. (2022) shows a very strong correlation between the two prices in the same data for Tokyo.

Control variables. In our main analysis in Section 6, we control for the following variables available throughout our sample period: transportation access (distances to the central business district (CBD) and nearest train station), topography (proximity to rivers, altitude, ruggedness), contemporary land use pattern, lot size, and geographical coordinates (i.e., latitudes and longitudes). Section 7 also considers urban health amenities, school districts, and the floor-to-area (FAR) regulation.

We report the summary statistics in Appendix C, separately for buraku and non-buraku areas. In Appendix D, we follow Bayer et al. (2007) and test whether the control variables in our main specification exhibit discontinuity at the buraku border. Overall, we do not find a discontinuity except for a few cases. Moreover, our regression coefficients on these characteristics suggest that the presence of such discontinuity, if any, tends to underestimate the price penalty in buraku areas. Thus, as long as unobserved characteristics work similarly to the observed ones, we expect that our main conclusion is robust to the unobserved confounders.

5 Empirical strategies

We now describe our empirical strategies to measure the land price discount of buraku areas by comparing the prices of land plots with similar characteristics but different geographical relationship to buraku areas. Specifically, motivated by Proposition 1, we estimate the following hedonic equation using the OLS:

$$\ln r_n = D_n + \eta X_n + \epsilon_n, \tag{1}$$

where D_n is the disamenity associated with each land plot n. r_n is the land price per m^2 of the land n, and ϵ_n is the error term.[21] We assume throughout that D_n is orthogonal to the error term after controlling for X_n. We also posit that exogenous characteristics X_n are orthogonal to the residual ϵ_n. These assumptions imply that the OLS estimation consistently estimates the effect of buraku areas on land prices. When available, we also report Oster's (2019) bound to show the robustness of our results to unobserved control variables. Moreover, given that unobserved variables might have a spatial correlation, we permit the spatial autocorrelation of the error term using Conley's (1999) standard error.[22]

For the OLS to be consistent, we need to assume that contemporary shocks to land prices are orthogonal to locations of buraku areas conditional on the control variables. This requires that the determinants of the location of buraku areas should be orthogonal to the contemporaneous error terms of land prices. This may be plausible in our context because they are determined in the pre-modern period, but this may not perfectly guarantee the orthogonality. For example, a buraku area may be more likely to be located in a place that historically had bad natural amenities, such as a high risk of flooding. To address this concern, we include control variables related to transportation access, topography, land use, lot size, and geographical coordinates.[23] These control variables are available throughout 1912 and 2018, and facilitate comparison across years. Besides explicitly controlling for confounders, we also use a border design that controls for spatially-continuous unobserved factors, which we introduce next.

Border design. As discussed above, for the OLS to identify the causal effect, our control variables

[21]To facilitate comparison across years despite different price levels, we normalize the log land price by subtracting the mean log land price in the given year so that the mean of the outcome variable is zero in all years. This normalization does not affect regression results except for the constant term.

[22]We calculate Conley's (1999) standard error using *acreg*, the Stata package developed by Colella, Lalive, Sakalli and Thoenig (2023). We assume that the spatial autocorrelation is confined within a circle with a $100m$ radius, and use the uniform kernel. We also tried a $300m$ radius and confirmed that our main results remain intact.

[23]In Appendix D, we additionally consider dummy variables that indicate the nearest buraku area to each land plot. Controlling for them hardly affects our estimates of land price discount (see Figure A8). See Appendix D for more details.

need to ensure that the remaining variation is orthogonal to the location of buraku areas. However, unobserved factors may induce endogeneity. To address this, we use the *border design* (c.f., Black 1999; Bayer et al. 2007; Dell 2010). We implement this in the same way as our OLS estimation but restrict the sample to land plots within 150 meters from the border of buraku areas.[24] Since the unobserved factors that are spatially continuous are nearly identical within this neighborhood, this approach eliminates the endogeneity stemming from such unobserved factors.

Parametric specifications of the disamenity of buraku areas. We parametrize the form of D_n to facilitate interpretation and gain statistical power. We try two specifications of D_n. Let b_n be the distance to the nearest border of buraku areas, which takes a negative value within a buraku area.

Dummy specification. The first is the simple binary specification:

$$D_n = \beta \mathbb{1}(b_n < 0), \tag{2}$$

so that D_n is the size of disamenity in a buraku area relative to a non-buraku area. Since the outcome variable is in log, β is approximately interpreted as the percentage effect of being located in a buraku area on land prices. However, since the approximation is not accurate as the effect turns out to be large, we also report the implied buraku effect in percentage: a plot in a buraku area is estimated to have $(e^{\beta} - 1) \times 100\%$ lower land prices.[25] Note again that since we are estimating only the discontinuity at the border in Equation (2), the border design can identify β even if there are unobserved factors that are continuous in the space. Note also that this specification would conservatively estimate the

[24] We choose 150m based on the descriptive evidence in Section 6.1 that the land price penalty of buraku areas does not exist beyond 150m outside the border. As a robustness check, we also used the 100m bandwidth, which hardly affects the coefficients of interest. Using the the MSE-optimal bandwidth selection by Cattaneo, Idrobo and Titiunik (2019) also does not change our qualitative findings, although this method is not well suited for our purpose because we are not only in interested in the discontinuity at the boundary (β_1 in Equation 3) but also in the continuous effect of the distance from the border of buraku areas (i.e., β_2 and β_3 in Equation 3).

[25] $\ln(r_n(\mathbb{1}(b_n < 0))) - \ln(r_n(\mathbb{1}(b_n \geq 0))) = \ln(1 + \frac{r_n(\mathbb{1}(b_n<0)) - r_n(\mathbb{1}(b_n \geq 0))}{r_n(\mathbb{1}(b_n \geq 0))}) = \beta$. Taking the exponential of this and rearranging, $\frac{r_n(\mathbb{1}(b_n<0)) - r_n(\mathbb{1}(b_n \geq 0))}{r_n(\mathbb{1}(b_n \geq 0))} = e^{\beta} - 1$.

buraku land price discount if buraku areas have some negative effects on neighboring non-buraku areas, which are considered as the control group.

Linear specification. The second specification adds the additional effect depending on the distance:

$$D_n = \beta_1 \mathbb{1}(b_n < 0) + \beta_2 b_n + \beta_3 b_n \mathbb{1}(b_n < 0). \tag{3}$$

Besides the dummy specification (2), Equation (3) also includes the linear effect of distance to the nearest buraku area, whose slope can vary within and outside a buraku area. In this way, the linear specification allows for a continuous effect of distance to the buraku border on land prices. The specification implies that when we compare land plots located x meters within or outside the buraku border, the buraku plot has $(e^{\beta_1 - 2\beta_2 x - \beta_3 x} - 1) \times 100\%$ lower land price.

Note that in our context, the effect of the distance to the nearest buraku area is of interest in addition to the discontinuous jump because the negative disamenity of buraku areas might be spatially continuous due to the ambiguity of the border. The identification of the discontinuous jump at the border and continuous effect of distance relies on a different identification assumption. Identifying the discontinuous jump at the border (β_1) permits the presence of unobserved factors as long as one focuses on a sufficiently small neighborhood of the border and unobserved factors do not jump at the border. In contrast, the identification of the continuous effect of distance (β_2, β_3) requires no selection on unobservables even under the border design. In this sense, the identification assumption in the linear specification is stronger than in the dummy specification. However, under the additional identification assumption, the linear specification provides important information on the spatial configuration of the buraku effect.

6 The land price discount of buraku areas

We now estimate the land price penalties of buraku areas from 1912. According to Proposition 1, this corresponds to quantifying the overall level of the disamenities. Note that at this stage, we remain agnostic about the underlying mechanism of the lower land prices. In particular, we do not distinguish the surviving territorial stigma and other mechanisms that induce lower land prices even if the terrotirial stigma no longer exists today. We come back to analyzing the underlying mechanism of the buraku land price penalties in Section 7.

6.1 *Descriptive analysis*

We first descriptively analyze how land prices are related to buraku areas. In Figure 1a, we present the mean land price per square meter separately for buraku and non-buraku areas in 1912. As clearly shown, land plots in buraku areas have much lower unit prices: the land price in buraku areas is only around one-fourth of that in non-buraku areas. Figure 1b repeats the same for 2018. Again, the land price in buraku areas in 2018 is still lower than in non-buraku areas. However, the price difference is much smaller and at around two-thirds of that in non-buraku areas. This simple descriptive evidence suggests the persistent land price discount of buraku areas.

To further investigate the geographic pattern of land prices in relation to buraku areas, we present nonparametric regression results of log unit land price on the distance to buraku borders in Figures 1c and 1d. A negative distance means within buraku areas and vice versa. Note that since a nonparametric regression fits a smooth function, this analysis cannot detect a potential discontinuity at the buraku border by design. Figure 1c shows that the low land prices in 1912 are concentrated within the buraku border and the price quickly goes back to a normal level outside the border. In contrast to the sharp drop at the buraku border, the land price is roughly flat outside the buraku border. This suggests that buraku areas are special in their low land prices. Figure 1d shows that the land price in 2018 also has the same pattern as the 1912 data in Figure 1c, although the land price seems to decrease somewhat more gradually when approaching buraku areas. In both 1912 and 2018, the price gap disappears for plots more than 150m away from the border, implying that the spatial scope of the buraku effect is likely to be spatially concentrated, perhaps within 150m from the buraku border. Therefore, when we analyze samples around the buraku border, we focus on land plots within or outside 150m from the buraku border both for 1912 and 2018 to ensure comparability while accommodating the relevant spatial scope of buraku effects.[26]

Figure 1e shows the log land prices per unit while restricting the sample to observations within 150m from the border of buraku areas. Each dot represents the mean log land price in a bin with a 25m width and linear lines are fitted separately for within and outside buraku areas. Thus, unlike Figures 1c and 1d, the specification allows for discontinuity at the boundary. Figure 1e shows a clear discontinuous drop in land prices at the buraku border. The magnitude of the drop is estimated to be 0.50, which corresponds to an approximately 40% drop in land prices.

Figure 1f shows the log land prices around the buraku border in the same format as Figure 1e. The discontinuity at the buraku border in 2018 is much smaller than in 1912. The estimated size of the jump is now around 0.07, corresponding to an approximately 7% drop in land prices in buraku areas. The discontinuity has substantially decreased from that in 1912. However, 7% of land prices is still sizable from an economic point of view. Moreover, besides this discontinuity at the border, the land prices in 2018 substantially decrease as we go deeper inside the buraku areas from the border. In contrast, outside buraku areas, being further away from the buraku border increases land prices. Consequently, if we compare buraku and non-buraku land plots with the same absolute distance from the border, we see a larger land price difference. This pattern explains why we have substantially lower land prices in buraku areas in Figures 1b and 1d despite the relatively small discontinuity at the border.[27] Overall, our descriptive analysis is indicative of large land price penalty of buraku areas. The price gap is larger in 1912 than in 2018, although the gap in 2018 still seems substantial.

[26]We also experimented with land plots within 100m from the buraku border. Our conclusion hardly changed.

[27]A possible explanation for this is that the ambiguity of the buraku borders in people's minds increased over the past century. Although we are using the same objective definition of buraku borders both for 1912 and 2018, people might have less clear knowledge about the border in 2018 than in 1912, while they would clearly know the central location of buraku areas in both periods. The ambiguity of the border is likely to attenuate the discontinuity at the border but the core of the buraku areas do not suffer from this attenuation effect.

6.2 *Regression results*

Having described the relationship between buraku areas and land prices, we now turn to the estimation results of the regression model (1). The regression results are reported in two steps. We first report the regression results for 1912 and 2018 to provide a big picture. We then extend our analysis to intermediate years between 1912 and 2018, allowing us to describe the evolution pattern of the buraku land price discount.

Land price discounts in 1912 and 2018. Columns 1–3 of Table 1 present the regression results for 1912. Columns 1 and 2 use the dummy specification of disamenity in Equation (2). Column 1 implements a simple OLS regression using the entire sample. The estimate suggests that being in a buraku area lowers the land price by about 71% of land prices. To implement the border design, Column 2 confines the sample to observations within 150*m* from the border as in Figure 1e. The dummy specification of the disamenity implies that we estimate the difference in the mean land prices within and outside buraku areas around buraku borders. The buraku effect is now approximately 57%, which is somewhat smaller than Column 1 potentially because land plots near buraku areas also have relatively low land prices compared to those distant from buraku areas (see Figure 1a) but still substantially higher prices than those within buraku areas. For Columns 1–2, we also calculate Oster's (2019) bound to see the potential effect of omitted confounders. Accounting for them actually magnifies the estimated buraku effects.

Column 3 uses the linear specification of disamenities (3) in the border design. Thus, we now allow the distance to the nearest buraku border to influence land prices with the potential effect heterogeneity between locations within and outside buraku areas. Since this specification allows for heterogeneous buraku effects, we report four types of buraku effects: buraku effects by comparing two land plots that are just across the buraku border, land plots 25*m*/50*m*/100*m* within and outside the buraku border. We note that the comparison right across the border is likely an underestimation of the buraku effect because the buraku border might be only ambiguously understood by people in society. While the 100*m* comparison would be free of such an underestimation, it is more likely to suffer from unobserved confounding factors by comparing relatively distant land plots. This leads us to take the 25*m* comparison as a conservative estimate of the buraku effect and 100*m* comparison as a high-end estimate of the buraku effect, while the 50*m* comparison is our preferred estimate striking the balance between these two considerations. We prefer the estimate in Column 3 because it is least likely to suffer from omitted variables: it includes various control variables and is robust to unobserved continuous confounders thanks to the border design (c.f., Black 1999; Bayer et al. 2007; Dell 2010). Therefore, our preferred estimate of the buraku price penalty for 1912 is 53% in Column 3.

Columns 4–6 repeat the same analysis for the 2018 data. As suggested by our descriptive analyses, the estimated buraku effects in 2018 are much smaller than in 1912 but still substantial. As in the 1912 analysis, we take 14% from the 50*m* comparison of Column 6 as our preferred estimate.

In summary, in both 1912 and 2018, we find a large buraku effect on land prices that is both economically and statistically significant.[28] The estimated buraku effect in 1912 is 53% and that in 2018 is 14%.[29] Considering our model description in Section 3, this implies that living in a buraku area entails a substantial disamenity which is persistent over more than 100 years.

The time-series of the buraku price discount over 100 years. Having established how the land price discount in buraku areas changed from 1912 to 2018, we now examine the intermediate years to better understand its time-series pattern. In particular, it would be interesting to know if the mitigation of the buraku disamenity is still ongoing. Moreover, it might be informative of the effect of various efforts and large place-based policies to improve buraku areas and eliminate discrimination against the buraku, which were especially active from the late 1960s to 1970s. Despite not having counterfactual buraku areas that went through no such change, the time series would be suggestive of their impacts on the disamenity of buraku areas.

[28]To illustrate the magnitude of the buraku land price discount in a different way, we compare it the coefficients of our control variable, specifically distance to the city center. While we omit reporting coefficients of control variables to save space, we calculate that in Column 1, buraku dummy is almost equivalent to going from 1.4km away from the city center. In Column 4, it is equivalent to going 2.2km away from the city center. See Tables A2 and A3 for regression results of control variables.

[29]We find very similar estimates when we do not include the control variables (see Table A4).

We first briefly discuss some important events for the buraku from the late 1960s to the 1970s. In 1969, the special integration policy law (*dowa taisaku jigyo tokubetsu sochi hou*) was implemented following the preceding governmental report that required policies to eliminate discrimination (Dowa Policy Council, the Prime Minister's Office 1965). The law designates the buraku areas and invests in them, implying that it was a place-based policy. The law ended in 2002 and the project had spent 15 trillion yen in total. The law has significantly improved the living conditions of people, such as infrastructure and housing. Another important change is in the public education system: Classes emphasizing that buraku discrimination is unjustifiable started around 1970. Moreover, efforts to eliminate buraku discrimination have made it difficult to identify buraku people by restricting access to key information. First, it became more difficult for employers to know the location of buraku areas. This is due to a scandalous event in 1975, called *buraku chimei soukan jiken*, whereby many firms were found to have purchased a list of buraku areas to detect and reject applicants from buraku areas. These firms were publicly condemned and the list was banned. Although it is possible that firms secretly keep the list to identify buraku areas even after the scandal, the ban is likely to mitigate discrimination in the labor market by increasing the cost of knowing the location of buraku areas. Second, access to the family registry (*koseki*) became restricted more strictly since 1976. Since it records the history of residential addresses, accessing it facilitates identifying who has lived in buraku areas, thereby catalyzing discrimination. Such concerns led to a law amendment in 1976 to restrict the access to the records. Together, we may reasonably hypothesize that these changes since the late 1960's mitigated the disamenity of buraku areas, which would shrink the buraku land price discount.[30]

We now quantify the land price discount in 1961, 1973, 1982, 1991, and 2006–2015 using the same method as in Section 6. The time series of land price discount is summarized in Figure 2, showing the estimated land price penalty in percentage in each year, with the 95% confidence interval.

[30] Almost all aforemetioned policies would mitigate the disamenity of buraku areas. An exception might be the restriction of access to the family registry, which might increase the signaling value of living in buraku areas (see Section 7.1).

From 1912 to 1961, we observe a decline in the land price discount. However, the decline is no longer observed from 1961 to 1973. This implies that when the above-mentioned policies and efforts were introduced, the buraku disamenity had been strongly persistent. However, the decrease in land price discount appears fast from 1973 to 2006. Although we cannot unambiguously conclude due to the standard errors and absence of "control" buraku areas that did not go through such policies and efforts, this time-series pattern of the land price penalty supports the hypothesis that the policies and efforts to combat buraku discrimination indeed contributed to mitigating the disamenity of buraku areas.

Figure 2 also shows that after 2006, the buraku price penalty seems stable despite the declining trend throughout the 20th century. The point estimate for the 2006 land price discount is 11%, and we cannot reject the null that it was 14%, the same land price discount as 2018. Similarly, we also cannot reject the null that the land price discount was 14% for 2009, 2012, and 2015.[31] This suggests that the size of disamenity remained roughly constant in the 21st century, consistent with some sociological evidence that the mitigation of buraku discrimination is slow these days (Teraki and Kurokawa 2016). The stagnation starkly highlights the persistence of the disamenity of buraku areas. It also implies that even the large-scale policies and efforts did not fully eliminate the disamenity of buraku areas.

We also explore how the time-series of the buraku price discount is different in the city center and outskirts of the city. As discussed in Section 4, while five buraku areas are included in our 1912 land price data, Kyoto city gradually engulfed new buraku areas that initially existed outside the city as the city expands over time.[32] Figure A10a summarizes the land price discount of "old buraku

[31]Alternatively, we cannot reject the null that the land price discount is 11%, the 2006 estimate, for years 2009, 2012, 2015, and 2018.

[32]We believe that our results are not driven by the omission or new appearance of buraku areas. Although we could not find the detailed origins of buraku areas in the suburbs of Kyoto, Kyoto City Government (1953) reports the detailed origins of seven buraku areas in the center of Kyoto, which include all the buraku areas that are covered in our 1912 land price data. It states that they were already located at their current locations in the Edo period (i.e., from the early 1600s to the late 1800s). Moreover, all buraku areas covered by Kyoto City Government (1929) appear in Kyoto City Government (1975) and remain today. Thus, it would be reasonable to conclude that at least for the

areas" that are covered in our 1912 data, and Figure A10b summarizes it for "new buraku areas" that are not covered in our 1912 data. There area two key results. First, for both old and new buraku areas, land price dicount is significantly positive throughout the last 100 years. Second, there is some suggestive evidence that the buraku land price discount is smaller for new buraku areas.[33] In Section 7.1, we argue that this result is consistent with the interpretation that people in the periphery are less informed about the location of buraku areas and it weakened the territorial stigma of the new buraku areas.

Overall, the time-series pattern of the land price discount suggests the strong persistence of the disamenities of buraku areas. Although the large-scale policies to address buraku discrimination may have substantially mitigated the buraku disamenity, they did not succeed in fully eliminating it. The stagnated decline of the buraku land price discount in the 21st century further implies that the persistent disamenities may not disappear, at least in the near future.

7 Mechanisms behind the buraku land price discount

The previous section quantified the disamenities of buraku areas by estimating the buraku land price discount, and we found the substantial and persistent land price discount. However, we remained agnostic about what constitutes the disamenities of buraku areas and focused on quantifying the overall level of the disamenities. In this section, we investigate the main drivers of the disamenities of buraku areas.

In Section 7.1, we first argue that the persistence of the buraku stigma itself and associated discrimination risk by living in a buraku area seem to play an important role. Since buraku people have no visible distinction from other Japanese, living in a buraku area serves as a signal of group affiliation and increases the risk of being identified as the buraku class. Consequently, the cost of facing

center of Kyoto, there are no appearance or disappearance of buraku areas and locations of buraku areas have been quite stable.

[33]The difference of the land price gap between old and new buraku areas is larger for relatively older periods (1961–1982), while the gap is smaller and statistically insignificant in recent years (1991–2018).

a higher discrimination risk capitalizes into the land prices of buraku areas. Second, in Section 7.2, we assess the role of other mechanisms that may negatively affect the land prices even if the buraku stigma and accompanying discrimination risk no longer exist today. Specifically, we consider neighborhood quality, school quality, durable local capital, locational fundamentals, and policy discontinuity. We find the limited importance of these mechanisms in explaining the land price penalty, especially in recent years.

Overall, we conclude that the lower land prices of buraku areas in Section 6 are mainly driven by the persistent territorial stigma and associated higher risk of experiencing discrimination by being identified as the buraku class. Therefore, since the elevated discrimination risk capitalizes into land prices, the declining but persistent land price discount of buraku areas serves as the revealed preference evidence of the persistence of discrimination against the buraku people. In Section 7.3, we discuss the general implications for discrimination in other contexts.

7.1 *Persistent territorial stigma and the associated discrimination risk*

Evidence suggests that the territorial stigma of buraku areas exhibits strong persistence even after the purported reasons for buraku discrimination, the pre-modern caste system in Japan, was removed. Moreover, the territorial stigma is strongly associated with the risk of experiencing discrimination because the residence serves as a signal of affiliation with the buraku class.

The liberation edict in 1871 eliminated the discriminated class in a formal setting, implying that no formal definition of the discriminated class is available since then.[34] Thus, those trying to discriminate against the buraku need to *infer* who is strongly associated with the discriminated class. However, this is not a trivial task in Japan because the discriminated group has no clearly visible features, such as skin color. Furthermore, cultural factors such as accents are also quite similar and

[34]Although the central government intended not to record the former class of each person, the population registry created in 1872 (*Jinshin koseki*) sometimes mistakenly recorded the former class because some local public workers did not understand the government's directions (Teraki and Kurokawa 2016). However, Kyoto prefecture seems to have correctly understood the intention of the government and did not record it (Research Center of Kyoto Buraku History 1991).

indeed the purported buraku belong to the Japanese race just like the non-discriminated people (Dowa Policy Council, the Prime Minister's Office 1965). The invisibility of the discriminated group is a distinctive aspect of the discrimination against the buraku, which indeed motivated the title of the well-known book *Japan's invisible race* by De Vos and Wagatsuma (1966).

Without distinctive physical and cultural traits, the buraku may "pass" as non-discriminated people (De Vos and Wagatsuma 1966; Dahis et al. 2019), which forces discriminating people to use pieces of information in inferring who is actually associated with the buraku class. Two important candidates for a "signal" indicating the discriminated class would be occupation and residence (Okuda 2007). Regarding occupation, as discussed in Section 2, the discriminated people historically tended to engage in the leather and butchery industries. However, these industries were lucrative and many non-discriminated Japanese entered them after the liberalization order. Moreover, the former discriminated class of people started choosing different occupations as the industrial revolution began in Japan after the 1870s. Consequently, occupation has become less and less informative of the former discriminated class.

In contrast, living in a buraku area remains an important signal of the buraku class (De Vos and Wagatsuma 1966; Okuda 2007). Before 1871, discriminated people were forced to live in buraku areas. Despite the active migration between buraku and non-buraku areas after the abolition of mobility restrictions in 1871, the stigma of buraku areas remained.[35] This is presumably because despite the active migration flows, a sizable fraction of formerly discriminated people remained in buraku areas because of their business and attachment to the areas.[36] Consequently, living in a buraku area

[35] To illustrate the active migration in the prewar period, Research Center of Kyoto Buraku History (1985) shows that in one buraku area that had a total population of around 1500 in 1916, 226 people moved out while 296 people moved in over a single year. In another example, when a riot for affordable rice (*kome soudou*) broke out in a buraku area of Kyoto city in 1918, around 60% of the participants came from other places in Kyoto city or even from different prefectures (Research Center of Kyoto Buraku History 1991).

[36] For example, in buraku areas in Kyoto in the 1930's, approximately 8% of household heads had lived in the same area for more than 30 years (Kyoto City Government 1940). Moreover, even in 1993, the share of descendants of formerly discriminated people in buraku areas exceeded 40%

has remained an informative signal of the decendants of the former discriminated class. Even more strikingly, many researchers now think that the stigma of buraku areas is so strong that living in a buraku area might not just be a proxy for the former discriminated class but even become the definitive feature of the discriminated class (Okuda 2007). In other words, the definition of the discriminated class itself might have shifted from the descendants of the former buraku class to those living in the buraku areas, regardless of their ancestors.

To see the importance of residence in determining the discrimination risk, we introduce the result of a survey conducted by the Osaka prefecture government in 2005 (Okuda 2007). It asked each respondent about which information they thought people in society use to determine whether someone belongs to the buraku class.[37] The question then listed several potential factors that people might think are important in regarding someone as a buraku person. Multiple choices were allowed. Among eleven items, the most popular answer was "current residence," which 66.6% of the repondents marked as a key factor. Notably, this number is larger than the birthplace (48.4%), parental residence (38.5%), and occupation (25.0%).[38] The relative unpopularity of the occupation is interesting as discrimination against the buraku was historically associated with aversion toward stigmatized jobs, suggesting that occupation no longer plays the central role in buraku discrimination. The 2005 survey also asked whether the respondents avoid housing in buraku areas when they choose their residence. 67.6% of respondents stated that they avoid buraku areas. These results are consistently explained if people avoid living in buraku areas because they think doing so increases the risk of getting discriminated against.

Moreover, there are additional reasons not mentioned in the 2005 survey to suppose that current

(Management and Coordination Agency 1993).

[37]The sample size is about 3,500. When we calculate the frequency of answers, we exclude "not sure" or no answer from the denominator. We also note that similar results were obtained in the 2000 and 2010 surveys.

[38]In buraku discrimination, it is generally difficult to infer the buraku class from family names. Indeed, the survey did not even list family names as a potential signal for the buraku class. The question has the alternative "others" that might include family names, but only 1.6% of people marked it.

residence is even more strongly associated with experiencing discrimination. First is the availability of information. Most likely, current residence is easier to observe than other popular items such as birthplace and parental residence. Thus, current residence can be used as a handy proxy for other clues by which people identify the buraku class. Second is intergenerational consideration. In particular, even if people born outside buraku areas do not experience discrimination by residing in buraku areas, it makes their children's birthplace a buraku area and the children may be regarded as belonging to the buraku class due to their birthplace (Akisada 1972). As long as parents care about their children's utility, they might avoid living in a buraku area even if it does not cause discrimination against them.

Given these results, we do not contend that current residence is the only determinant of discrimination status. Those born in a buraku area might get discriminated against even if their current residence is outside of it once their background is revealed (Okuda 2007). Likewise, those who were born outside of a buraku area might avoid discrimination even if they currently reside in a buraku area once they credibly verify their background. Hence, the land price differential between buraku and non-buraku areas reflects the cost of increasing the *probability* of getting discriminated against at various occasions in life, rather than the cost of going from not being discriminated against at all to being fully discriminated against. This implies that measuring the cost of facing a higher discrimination risk using the land price discount would probably be conservative for the severity of buraku discrimination itself.

In Section 6 and Appendix G, we provide suggestive evidence that old buraku areas, which are located in the city center, might have larger land price discount than new buraku areas, which are located in the newly-developed periphery of the city. This is consistently explained if new residents in the periphery are not well informed about the location of the buraku areas because they might not have heard of the location from the incumbent residents that are familiar with Kyoto city. Indeed, if they do not know the location of buraku areas, living in these areas would not serve as a strong signal of minority group affiliation for people around these areas, leading to the relatively small land price discount. Moreover, the persistent land price discount in the city center is also consistent with intergenerational transmission of discriminatory attitudes against the buraku people, which has been documented in various other contexts (e.g., Voigtländer and Voth 2012; Schindler and Westcott 2021). That is, people in the city center may keep discriminatory attitudes over generations, and it also induces the information transmission of the location of buraku areas, the key identifying information of the buraku people. However, such intergenerational transmission would not work well for new residents in the peripheral areas, leading to a smaller land price discount. Overall, the contrast between the city center and the periphery is consistent with the importance of information sharing of buraku locations, either among the current residents or over generations, in inducing the persistence of the buraku land price discount.[39]

In summary, living in a buraku area still carries a stigma and leads to the risk of experiencing discrimination. More formally, the higher discrimination risk associated with buraku areas can be interpreted as a component of the buraku disamenity, denoted by D_n in our theoretical model in Section 3, and thus, capitalizes into land prices as shown by Proposition 1. So long as the discrimination risk jumps at around the border of buraku areas, the border design provides the quasi-experimental variation in minority group affiliation, which is rare in other contexts of discrimination (Sen and Wasow 2016). Note that the capitalization captures any negative effects of belonging to a discriminated group. This implies that the cost of the forms of discrimination that are usually unobserved, such as psychological bullying and social exclusion, are also reflected in land prices. Buraku land prices, therefore, provide the novel revealed preference evidence on the overall severity of discrimination. In particular, the evolution of the buraku land price discount summarized in Figure 2 implies that (i) buraku discrimination was especially severe in the past and (ii) buraku discrimination persists even in 2018, almost 150 years after the emancipation.

[39]It should be noted that other factors might also explain the smaller land price discount of new buraku areas. For instance, while we have assumed inelastic land supply in Section 3, land supply might be more elastic in peripheral areas and it could mute any capitalization effect of amenities.

7.2 *Investigating other potential factors behind lower buraku land prices*

Beyond the capitalization of discrimination risk we have investigated in Section 7.1, we also investigate other potential mechanisms behind the persistent buraku land price discount. The first is the adverse neighborhood quality due to poverty (Ambrus et al. 2020; Heblich et al. 2021). However, buraku areas today are no longer poorer than nearby non-buraku areas. Even in 1912, when buraku areas were poorer than nearby non-buraku areas, explicitly controlling for proxies of neighborhood income and a placebo analysis of poor non-buraku areas suggest the limited role of neighborhood quality. The second is the school quality (Black 1999; Bayer et al. 2007), but Japanese schools are highly standardized and controlling for school districts does not alter the results. The third is the durable local capital, such as residential housing and public goods (e.g., roads, parks, and community centers). On residential housing, the fast depreciation of Japanese housing (Yoshida 2020) and place-based policies that have improved housing conditions imply that the century-long persistence can hardly be explained by housing durability. Further, we find little evidence that buraku areas have substantially worse public goods than nearby non-buraku areas. The fourth is locational characteristics, such as natural conditions and transportation access. However, our border design, which controls for locational characteristics that are spatially continuous, and checking if locational characteristics jump at the border all suggest that they do not explain our estimates. The fifth is the aversion for interacting with people with outcaste ancestors. However, controlling for proxies of social networks does not affect our land price discounts. Moreover, even if our land price discount includes such aversion, it still serves as evidence of persistent buraku discrimination because this is simply another form of buraku discrimination. The last is the policy discontinuity at the buraku borders of buraku areas, especially the land-use regulation, but explicitly controlling for it does not change our results. Overall, these alternative mechanisms do not explain the persistent buraku land price discount over the last 100 years. See Appendix I for more details.

7.3 *Persistent buraku discrimination and its implications*

Taken together, the persistence of the territorial stigma itself and associated risk of being identified as buraku class by living in a buraku area are likely the main drivers of the land price penalty. As a result, the strong persistence of the land price penalty serves as novel evidence of persistent discrimination against the buraku people, even 150 years after the emancipation. This is consistent with persistence of discrimination found in other contexts, such as racial discrimination in the US (Boustan 2016; Derenoncourt and Montialoux 2021). However, our result is distinctive in three notable ways. First, we exploit a quasi-experimental variation in minority group affiliation to show the persistence of discrimination over 100 years. Importantly, this is not attained by an experimental approach of detecting discrimination because we cannot go back in time and conduct an experiment. Second, the buraku land price penalty is a marked-based quantitative measure that captures any adverse effects of being identified as a discriminated group member, implying that usually-unobserved forms of discrimination, such as psychological bullying and social exclusion, are also incorporated. Third, we show that discrimination can be quite persistent over a century despite few ethnic and cultural differences (De Vos and Wagatsuma 1966) and large-scale policies and efforts to combat discrimination (see Sections 2 and 6 for details). The strong persistence of discrimination despite these seemingly favorable conditions highlights the general difficulty of fully eliminating discrimination.

8 Conclusion

Analyzing the persistence of discrimination is important as discrimination may continue even years after the emancipation of the discriminated group. However, empirically identifying the persistence of discrimination has been difficult due to various empirical challenges, such as data availability, the lack of historical events that eliminated *de jure* discrimination long ago, and the lack of quasi-experimental variation in minority group affiliation. To overcome these challenges, we analyze the distinctive case of *buraku* discrimination in Japan, in which the risk of being identified as a minority group member is disproportionally high if one lives in historical neighborhoods of buraku people (*buraku areas*). We incorporate such a situation in a spatial equilibrium model, showing that the higher risk of being identified as buraku and experiencing discrimination is capitalized into the lower buraku land prices. Combining this theoretical prediction, 100 years of granular land price data, and a border design, we provide novel revealed preference evidence on the persistence of discrimination, even 150 years after the emancipation of buraku class that made the institutional reason for discrimination no longer relevant.

We begin by quantifying the land price discount of buraku areas using the newly constructed comprehensive land price data of Kyoto city spanning from 1912 to 2018. At this stage, we focus on quantifying the land price discount while remaining agnostic about whether the land price discount comes from the capitalization of the higher discrimination risk or some other mechanisms, such as persistent differences in locational characteristics. For identification, we use a border design that only compares land plots in a neighborhood of the border of buraku areas, allowing us to focus on a quasi-experimental variation in discrimination risk while controlling for any spatially continuous unobserved heterogeneity. We estimate that land prices in buraku areas were 53% lower in 1912 and 14% lower in 2018 than those in nearby non-buraku areas. By newly digitizing land price data in intermediate years, we also find that while the land price discount declined particularly fast during the period of extensive policies and efforts to mitigate buraku discrimination, the decline stopped in the 21st century.

We next investigate why buraku areas have persistently lower land prices. We explore various possible mechanisms, including neighborhood quality, school quality, durable local capital, locational fundamentals, aversion for interacting with minorities, and policies. We find that the most important mechanism is likely the persistence of the territorial stigma, and associated risk of being identified as the buraku class and experiencing discrimination. Since buraku people have few differences from the majority Japanese, living in a buraku area arguably serves as the most important signal of affiliation with this discriminated class (Okuda 2007). This distinctive role of residence in buraku discrimination implies that the discrimination risk is indirectly "traded" in the land market, and hence, capitalizes into land prices. Thus, the large and persistent land price discount serves as the novel revealed preference evidence of severe and persistent discrimination against the buraku people. Importantly, discrimination remains persistent even 150 years after the emancipation that eliminated the institutional reason for discrimination.

We believe that our results are insightful for other contexts, despite our focus on buraku discrimination in Japan. First, it is a common phenomenon all over the world that certain areas are stigmatized due to discrimination against a minority group (e.g., African American communities in the U.S., outcaste communities in Indian caste system, and Ghettoes and Roma communities in Europe). Our result suggests that such areas may suffer for a long time because the territorial stigma does not easily disappear. Second, the capitalization of the risk of being identified as buraku provides the novel revealed preference evidence on the strong persistence of discrimination. Our research design allows us to use an quasi-experimental variation in minority group affiliation to analyze the overall severity of discrimination over 100 years. Note that this is not attained by an experimental approach to detect discrimination because we cannot go back in time to measure discrimination in the past. Moreover, the persistence is observed in our context despite few ethnic and cultural differences, as well as large-scale policies and efforts to eliminate discrimination. This may highlight the general difficulty of eliminating discrimination even if equality under the law is achieved. In particular, if minorities have more differences from the majority in terms of ethnicity and culture, as in the racial discrimination in the U.S. and many other contexts, the persistence of discrimination could be even stronger than the case of buraku discrimination.

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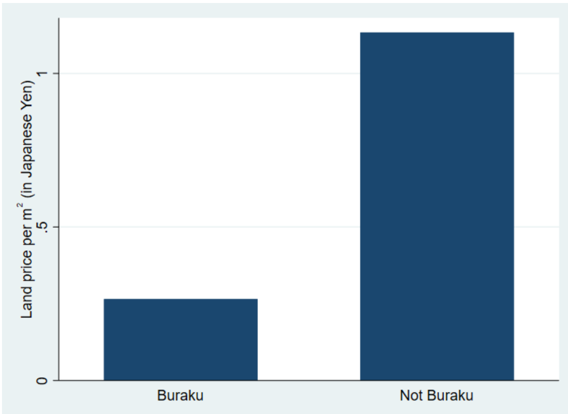
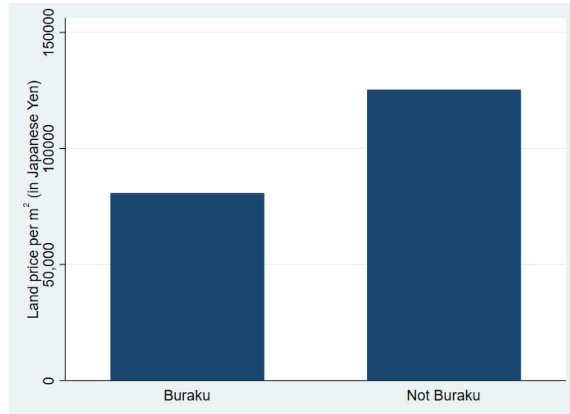
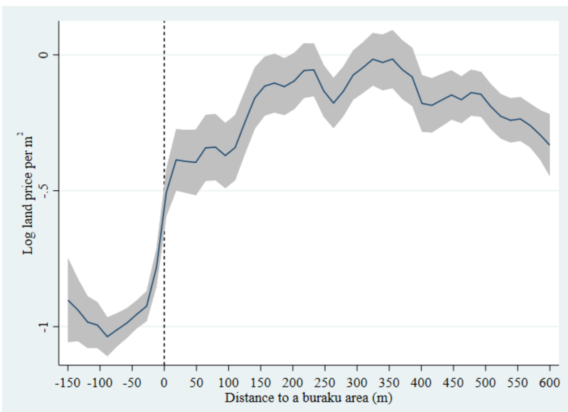


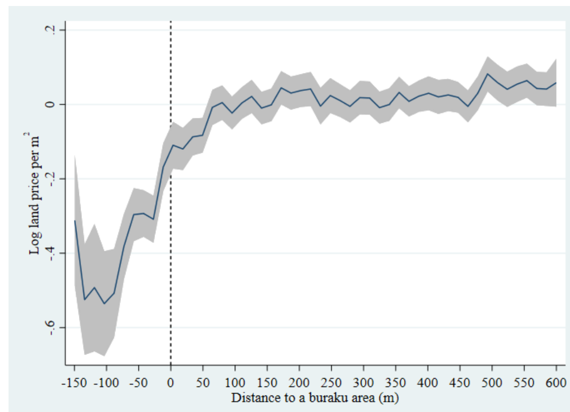
(a) Mean land price in 1912



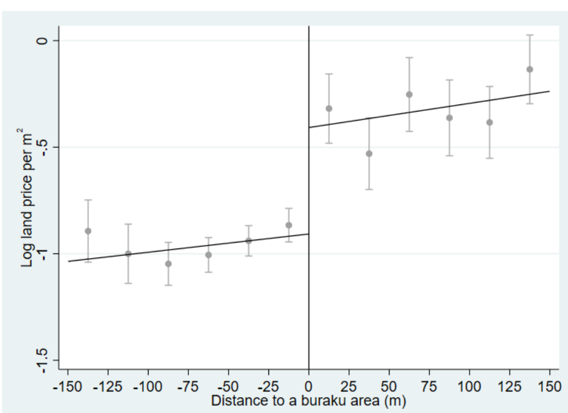
(b) Mean land price in 2018



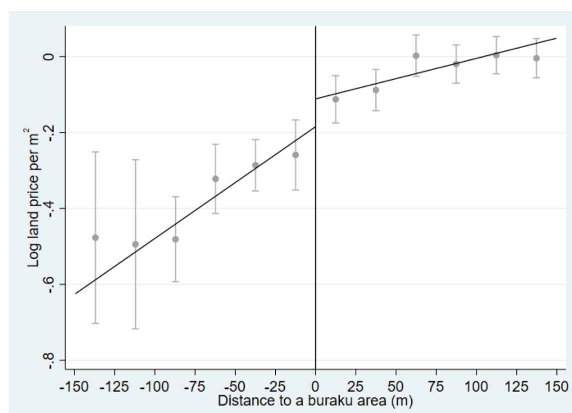
(c) Nonparametric regression of unit land price on distance to a buraku area (1912)



(d) Nonparametric regression of unit land price on distance to a buraku area (2018)



(e) Land price around buraku borders (1912)



(f) Land price around buraku borders (2018)

Figure 1: Description of Kyoto land prices in 1912 and 2018

Note: Figures (a) and (b) plot the mean unit land price inside and outside buraku areas. Figures (c) and (d) present the result of nonparametric regression of log land prices on distance to a buraku area. Figures (e) and (f) we confine the sample to land plots within 150*m* from buraku borders. The negative distance means that the plot is within a buraku area. We then divide the sample into 25*m* bins and plot the mean and 95% confidence interval. The separate local linear equations are fitted for each side of the border using the uniform kernel.

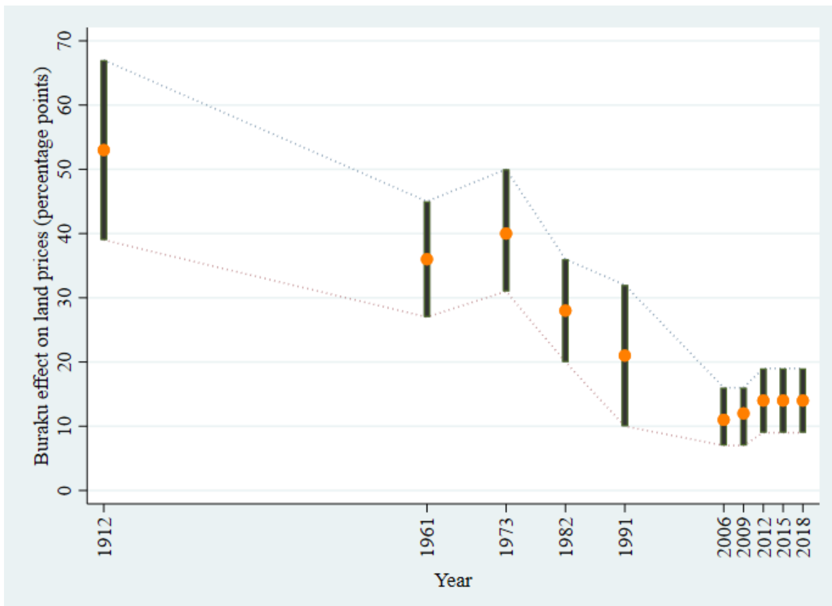


Figure 2: Time series of the land price discount of buraku areas

Note: The orange dots represent the point estimates of the buraku price penalty (50m comparison) in the border design with the linear specification of the buraku dummy (Column 3 of Table 1 for 1912 and Column 6 for 2018). Estimates for 1961–2015 are obtained in the same way (regression tables are omitted). The vertical bars represent the corresponding 95% confidence intervals. All numbers are rounded to the nearest integers.

	1912 land prices			2018 land prices		
	Full sample	Border sample		Full sample	Border sample	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Estimated regression coefficients						
Buraku dummy	-1.2387***	-0.8335***	-0.6849***	-0.2066***	-0.1665***	-0.0989***
	(0.1384)	(0.1140)	(0.1431)	(0.0338)	(0.0297)	(0.0451)
Distance to buraku (m)			0.0033*			0.0007**
			(0.0019)			(0.0003)
Distance to buraku (m) × Buraku dummy			-0.0052***			-0.0003
			(0.0019)			(0.0010)
Panel B: Effect of buraku areas calculated from regression coefficients (in percentage points)						
Buraku effect (Right across the border)	-71.03***	-56.55***	-49.59***	-18.66***	-15.34***	-9.42*
	(3.30)	(6.22)	(12.18)	(2.75)	(2.51)	(4.08)
Buraku effect (25m within vs outside)			-51.40***			-11.64***
			(9.40)			(2.69)
Buraku effect (50m within vs outside)			-53.15***			-13.80***
			(7.15)			(2.56)
Buraku effect (100m within vs outside)			-56.45***			-17.97***
			(5.50)			(5.18)
Oster's bound for buraku effect (in percentage points)	-73.51	-61.60	N/A	-14.80	-11.16	N/A
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	60339	2885	2885	38832	1892	1892
R^2	0.734	0.724	0.733	0.559	0.538	0.541

Heteroscedasticity and Autocorrelation Consistent (HAC) standard errors in parentheses (Conley 1999).
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 1: Regression results on log land prices per m^2 for 1912 and 2018

Note: This table presents the regression results on log land prices per m^2 for 1912 (Columns 1–3) and 2018 (Columns 4–6). Panel A reports the regression coefficients of buraku aras, β for the dummy specification in Equation (2), and $(\beta_1, \beta_2, \beta_3)$ in the linear specification in Equation (3). In Panel B, we calculate the percentage effect of being in a buraku area (with the designated distance from the border) compared to the corresponding location outside of the buraku using the formula $(e^{\beta} - 1) \times 100\%$ for the dummy specification and $(e^{\beta_1 - 2\beta_2 x - \beta_3 x} - 1) \times 100\%$ with $x = 0, 25, 50,$ or 100 for the linear specification. This formula provides the percentage penalty on buraku land prices. Note that "Distance to buraku" variable is coded as $-x$ at a location x meters inside the buraku area. The border sample only includes observations within 150m from the nearest buraku border. We report Conley's (1999) standard error that allows for the spatial autocorrelation of errors within the 100m neighborhood. We control for transportation access (distance to the central business district and distance to the nearest train station), topography (proximity to rivers, altitude, ruggedness), contemporary land use pattern, lot size (only for 1912 as the lot size is already standardized for the 2018 data), and geographical coordinates (i.e., latitudes and longitudes). All controls are included as quadratic, except for lot size that is included as cubic. The interaction between the latitude and longitude is also included. We calculate Oster's (2019) bound for the buraku effect right across the border. We set the maximal R^2 to 1.3 times the R^2 of each regression. We do not report Oster's (2019) bound in columns 3 and 6 because Oster's (2019) bound is not defined for specifications that include interaction terms with the treatment variable.

Online Appendix to "Persistent Stigma in Space: 100 Years of *Japan's Invisible Race* and Their Neighborhoods" (Not for Publication)

A Further details on the theoretical model

We consider a static spatial model with discrete N locations, where the land supply at each location $n \in \{1, 2, ..., N\}$ is fixed. We incorporate heterogeneity in workers by assuming that worker i is endowed with I_i units of effective labor.[A.1] Following the canonical Alonso-Muth-Mills monocentric city model (Fujita 1989), we assume that all workers commute to the city center and inelastically provide the labor, the production function is linear, and the output is freely-traded. This implies that the price of the effective unit of labor is 1 after normalization. However, the labor income is still location-dependent because factors such as commuting and discrimination might affect the effective labor supply. Particular locations (buraku areas), in which the discriminated people were forced to live in the pre-modern period, may entail disamenities. Each worker has the outside utility $\tilde{U}_i$ exogenously determined in the outside world. The spatial equilibrium condition across different locations in and outside the city determines the population configuration at each location.

Disamenity of buraku areas. V_{in}, the indirect utility of individual i living in location n, is given by the following:

$$V_{in} \propto s_n r_n^{-\gamma} I_i. \tag{A.1}$$

We later specify the microfoundation of this indirect utility function. The indirect utility is decreasing in the land price r_n due to the higher housing cost, where γ is the spending share for land.[A.2] The

[A.1]The human capital endowment is the only heterogeneity of workers in our main model. We do not distinguish a priori the buraku and non-buraku people by assuming that all people have the same utility function, reflecting the fact that they belong to the same race and have almost no visible distinction. Appendix A contains an extension in which people have heterogeneous preferences for living in a buraku area.

[A.2]We focus on land prices for two reasons. First, land is less elastic in supply than floor space, implying that changes in the demand for a certain location directly capitalizes into land prices. This is generally not the case for the floor space market unless cities are declining (Glaeser and Gyourko 2005). Second, Japan has a long tradition of taxing land, and hence, land price assessment data in indirect utility is also increasing in the effective units of endowed labor I_i. Importantly, the indirect utility is increasing in the amenity s_n, which captures the overall attractiveness of living in location n.[A.3]

We now suppose that the amenity in location n, $s_n > 0$, is given by the following equation:

$$\frac{\ln s_n}{\gamma} = D_n + \eta X_n + \epsilon_n, \tag{A.2}$$

where the division of $\ln s_n$ by γ is only for later notational convenience. X_n represents the exogenous characteristics of location n and η represents the associated coefficients. For example, X_n might include the natural conditions at location n and the commuting distance. ϵ_n is an idiosyncratic local characteristic at location n. We assume that ϵ_n is unobservable to econometricians, but its realization is known to workers so that workers make no decision under uncertainty. As discussed in Section 5, ϵ_n can be spatially auto-correlated.

D_n in (A.2) is the key object of interest: the "buraku disamenity" of location n. D_n is a measure of the unattractiveness of location n as a residence and varies depending on location n's geographic relationship to a buraku area. The simplest specification of D_n is binary: it takes a low value when location n is outside a buraku area and vice versa. However, a richer spatial configuration of buraku disamenity can be incorporated in our formulation, such as living next to a buraku area might also carry the stigma. Note that we cannot directly use (A.2) to estimate D_n because it is unobserved. Our main result shows that in spatial equilibrium, we can estimate D_n using land prices r_n instead of s_n.

Note that D_n summarizes the magnitude of overall bad effects of living in a buraku area. However, we have not specified how living in a buraku area affects utility. We focus on identifying the magnitude of the buraku disamenity in Section 6 while remaining agnostic about the sources of the buraku disamenity. In Section 7, we dig deeper into the mechanism and highlight that a higher risk of being regarded as the buraku class due to the surviving territorial stigma of buraku areas plays a

Kyoto are available throughout the 20th century.

[A.3] s_n includes both the time and utility costs of commuting.

key role. Note that D_n includes the higher risk of experiencing both labor market discrimination and other forms of social discrimination (e.g., bullying) because the higher risk of being identified as the buraku class simultaneously induces both. Importantly, it captures the overall cost of being identified as a discriminated group member and includes forms of discrimination that are hard to observe, such as psychological bullying and social exclusion. In contrast, Section 7 argues that factors such as neighborhood quality, school quality, durable local capital, locational characteristics, and policies would not be the main components of the buraku disamenities D_n.

Microfoundation of the indirect utility (A.1). The utility function is assumed to be homogeneous across people and Cobb-Douglas:

$$U = s_n^{utility} l^{\gamma} x^{1-\gamma}, \tag{A.3}$$

where $s_n^{utility} > 0$ is the residential amenity of location n that directly affects utility, including the commuting cost in terms of utility. x is the freely-tradable composite goods, which is our numéraire, and l is the land consumption.

Worker i is endowed with I_i units of effective labor, implying that I_i also represents the level of their human capital. However, the actual labor supply is location dependent: $s_n^{labor} I_i$. $s_n^{labor} > 0$ captures the time cost of commuting and potential labor market discrimination. For example, discriminated people might face a higher risk of layoffs or difficulty in finding a new job, reducing the total labor supply throughout the year. Since the wage rate is $w = 1$ at the equilibrium, this implies that worker i in location n has disposable income $s_n^{labor} I_i$. Workers receive no revenue from land because we assume absentee ownership of land (Fujita 1989).[A.4]

[A.4] Note that we can introduce landlords without changing our results if they are immobile and we remove the land owned by such landlords from the model. However, the welfare implication might change as owners of plots in a buraku area receive lower land rents due to disamenity. As long as land of buraku areas tends to be owned by the residents, introducing the land ownership further magnifies the cost of discrimination through the wealth effect besides the discrimination baked in the amenity

After choosing location n, workers maximize the utility (A.3) subject to the budget constraint $x + r_n l = s_n^{labor} I_i$, where r_n is the unit land price and I_i is the income. This yields the following demand functions:

$$x_{in} = (1-\gamma) s_n^{labor} I_i, \quad l_{in} = \gamma \frac{s_n^{labor} I_i}{r_n}. \tag{A.4}$$

Thus, γ is the spending share on land, which is the feature of Cobb-Douglas utility (A.3).

Consequently, V_{in}, the indirect utility of individual i living in location n, is

$$V_{in} \equiv \gamma^{\gamma} (1-\gamma)^{1-\gamma} s_n r_n^{-\gamma} I_i, \tag{A.5}$$

where $\ln s_n \equiv \ln s_n^{utility} + \ln s_n^{labor}$. This corresponds to the indirect utility (A.1) in the main text. Note that regardless of whether residential amenities affect utility directly or indirectly through labor market, its total impact on indirect utility is summarized by the single index s_n.

Equilibrium conditions. In equilibrium, all workers and firms behave optimally, and all markets clear. Specifically, Equation (A.4) should be satisfied so that workers' consumption given residential choice is optimal. Firms' optimality and labor market clearing are trivially satisfied when $p = w = 1$ due to the linear production technology combined with inelastic labor supply. By assuming that the numéraire goods are freely traded with the outside world, the numéraire goods market also always clears.

The two remaining conditions are the land market clearing at each location n and the spatial equilibrium condition (i.e., optimality of location choice). For the land market clearing, let L_n be the land endowment at location n, which is inelastically supplied. The land market clearing condition is,

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s_n.

for all n,

$$\sum_{i \in \Phi_n} l_{in} = \frac{\gamma}{r_n} \sum_{i \in \Phi_n} s_n^{labor} I_i = L_n, \tag{A.6}$$

where Φ_n is the set of workers living in location n. Let N_n be the measure of Φ_n, that is, the population of location n. Note that Equation (A.6) implies that

$$\bar{I}_n \equiv \frac{\sum_{i \in \Phi_n} s_n^{labor} I_i}{N_n} = \frac{r_n}{\gamma \bar{N}_n}, \tag{A.7}$$

where $\bar{I}_n$ is the average income at location n and $\bar{N}_n \equiv \frac{N_n}{L_n}$ is the population density.[A.5]

We turn to the spatial equilibrium condition. Let $\tilde{U}_i$ be the utility that can be obtained outside the city, which differs across workers because of human capital heterogeneity. Assuming that the city is sufficiently small, we treat $\tilde{U}_i$ as exogenously given.[A.6] The spatial equilibrium condition says that the location choice of each worker i is optimal. For those living in the city, the utility of worker i living in region n must be greater than the utility achieved by living in another location n' or the outside world. Formally, for each worker i living in n,

$$V_{in} \equiv \gamma^{\gamma}(1-\gamma)^{1-\gamma} s_n r_n^{-\gamma} I_i \geq \max\{\max_{n' \neq n} V_{in'}, \tilde{U}_i\}. \tag{A.8}$$

For any worker i living outside the city, the maximum utility in the city must be weakly smaller than

[A.5] Equation (A.7) says that the average income at each location can be backed out from land prices, population density, and the spending share for land. Intuitively, the same amount of land demand can follow either by hosting many poor people, each of whom demands only a small amount of land, or many rich people each of whom demands a large amount of land. Although looking at the land price alone cannot distinguish these two cases, observing the population density allows us to separate these two scenarios.

[A.6] To exclude the case in which everyone lives in the city, we assume that the mass of population in the entire economy is sufficiently large such that in equilibrium, the city does not accommodate all people in the entire economy (i.e., someone chooses to live in the outside economy).

the outside utility.

$$\tilde{U}_i \geq \max_n V_{in}. \tag{A.9}$$

To simplify the analysis, we impose the following assumption on the outside utility:

Assumption 1. *$\tilde{U}_i = \xi I_i$, where $\xi > 0$ is exogenously given.*

This means that the outside utility is proportional to the human capital I_i. Assumption 1 is naturally satisfied when the outside economy has a similar structure as that of the city under study. Indeed, the equilibrium indirect utility within the city (V_{in}) also becomes proportional to I_i and independent of location n. We take ξ as exogenous to the city since we assume the small city that has no general equilibrium effect on the outside economy.

Proof of Proposition 1. We first prove the following lemma:

Lemma 1. *In the spatial equilibrium, $\gamma^\gamma(1-\gamma)^{1-\gamma}s_n r_n^{-\gamma}$ equalizes for all n, implying that V_{in} becomes independent of n and proportional to I_i. Under Assumption 1, $\gamma^\gamma(1-\gamma)^{1-\gamma}s_n r_n^{-\gamma}$ equalizes to ξ so that $V_{in} = \xi I_i$ for all i and n.*

Proof of Lemma 1. We first show that $\gamma^\gamma(1-\gamma)^{1-\gamma}s_n r_n^{-\gamma}$ equalizes for all n. Suppose $\gamma^\gamma(1-\gamma)^{1-\gamma}s_n r_n^{-\gamma} > \gamma^\gamma(1-\gamma)^{1-\gamma}s_{n'} r_{n'}^{-\gamma}$ for some locations n and n'. Then, for any i, $V_{in} > V_{in'}$ so that any individual i prefers location n to location n'. Thus, the spatial equilibrium condition (A.8) implies that n' is not inhabited. However, the demand for land in n' then becomes zero and the equilibrium land price must become zero. This implies $V_{in'} = \infty$, a contradiction to (A.8) because everyone has an incentive to move to n'.

Now let $\tilde{\xi}$ be the common value of $\gamma^\gamma(1-\gamma)^{1-\gamma}s_n r_n^{-\gamma}$. We show that $\tilde{\xi} = \xi$ under Assumption 1. Suppose $\tilde{\xi} > \xi$. Then, the spatial equilibrium condition (A.9) is not satisfied, implying that any individual in the outside economy has an incentive to live in the city. Thus, it contradicts that the city has the finite population at the equilibrium.[A.7] Next, suppose $\tilde{\xi} < \xi$. However, everyone prefers to live in the outside economy. This implies zero land price at every location in the city, again contradicting the spatial equilibrium condition (A.8). ■

In other words, for any worker i, the indirect utility is independent of location n and equals the outside utility given in Assumption 1. Moreover, the first part of Lemma 1 in turn justifies Assumption 1 by showing that the city equilibrium naturally implies the indirect utility proportional to I_i. Note that the first part of Lemma 1 does not use Assumption 1 because it follows from the migration condition between different locations in a city, and not from migration condition between the city and the outside economy.

Given Lemma 1, the spatial equilibrium condition (A.8) can be simply rewritten as follows: For any worker i in location n,

$$\gamma^{\gamma}(1-\gamma)^{1-\gamma} s_n r_n^{-\gamma} = \xi. \tag{A.10}$$

Taking the log of (A.10) and rearranging it using the amenity expression (A.2), we obtain the following hedonic regression equation,

$$\ln r_n = D_n + \beta X_n + \epsilon_n. \tag{A.11}$$

Equation (A.11) establishes Proposition 1.[A.8] ■

[A.7]As the city population approaches infinity, the equilibrium utility V_{in} approaches 0 for any i and n as land price r_n goes to infinity. However, this implies that (A.8) is not satisfied for a sufficiently large population given $\tilde{U}_i > 0$ due to our assumption in footnote A.6.

[A.8]Strictly speaking, we are abusing the notation slightly in that the constant term is different by $\frac{1}{\gamma}\ln\gamma^{\gamma}(1-\gamma)^{1-\gamma} - \frac{1}{\gamma}\ln\xi$ from the constant of the term in (A.2). This does not affect our regression results on D_n because X_n includes a constant term.

Note that human capital I_i does not enter the spatial equilibrium condition (A.10) because both the indirect utility V_{in} and the outside utility are proportional to I_i. Thus, given any equilibrium vector of locational characteristics (r_n, s_n), any worker i, regardless of her/his human capital level, is indifferent between any location n in the city. This implies that although we have human capital heterogeneity, no strict sorting incentive arises from the heterogeneity.[A.9] However, our model can still capture the sorting observed in the data because the indifference admits weak sorting motives. Since we can observe the realized population level, we can still back out the average income using (A.7) that is consistent with the equilibrium of our model. In Appendix E, we use this property to back out the local income consistent with the observed data.

Introducing heterogeneous preferences for living in buraku areas. We now discuss how our theoretical results may be affected by adding idiosyncratic preferences for buraku areas to the model. Different people may have different preferences for buraku areas because their willingness-to-pay to avoid the buraku disamenity differs. In an extreme case, some people might even positively evaluate living in buraku areas, possibly because they feel comfortable in respecting their original identity.

To simplify the argument, following Kline and Moretti (2014), we assume that the city has two locations: buraku ($n = B$) and non-buraku ($n = N$) areas. Then, for each worker i living in buraku area B, the spatial equilibrium condition (A.8) implies

$$\frac{\ln s_{iB}}{\gamma} - \ln r_B \geq \frac{\ln s_{iN}}{\gamma} - \ln r_N, \tag{A.12}$$

where s_{iB} and s_{iN} are worker i's evaluation of amenities of buraku and non-buraku areas, respectively. The indexing by i is the new element to capture the fact that the same amenity is evaluated heterogeneously across different workers.

Next, we parametrize the idiosyncratic preferences. We denote the idiosyncratic preference pa-

[A.9] Gaigné, Koster, Moizeau and Thisse (2022) recently show in a related model that homothetic preferences, which our Cobb-Douglas preference belongs to, exhibit such a property.

rameter by ζ_i. Then, we extend (A.2) as follows:

$$\frac{\ln s_{in}}{\gamma} = \zeta_i D_n + \eta X_n + \epsilon_n. \tag{A.13}$$

Since the buraku area has the disamenity, $D_B < 0$. In contrast, we assume that the non-buraku area has no disamenity, such that $D_N = 0$.

Note that our main specification (A.2) assumes the homogeneous evaluation of disamenity by implicitly imposes $\zeta_i = 1$ for all i. If ζ_i is positive but larger than one, it means that worker i strongly dislikes disamenity. Analogously, if ζ_i is positive but smaller than one, it means that worker i is relatively willing to accept disamenity at a smaller compensation. Note that $\zeta_i < 0$ is not excluded, implying that some worker i might even *like* living in the buraku area.

In equilibrium, the idiosyncratic preference implies that a threshold value $\zeta_i = \bar{\zeta}$ exists such that worker i with $\zeta_i = \bar{\zeta}$ is indifferent between buraku and non-buraku areas (c.f., Kline and Moretti 2014).[A.10] Workers with $\zeta_i < \bar{\zeta}$ strictly prefer living in the buraku area and workers with $\zeta_i > \bar{\zeta}$ strictly prefer living in the non-buraku area. Moreover, since disamenity is zero for the non-buraku area, workers preferring the non-buraku area are also indifferent between the non-buraku area and the outside economy.[A.11]

Then, combined with Equation (A.13), the spatial equilibrium condition (A.12) implies

[A.10] Strictly speaking, this argument requires that both buraku and non-buraku areas have strictly positive population in equilibrium. As discussed in the proof of Proposition 1, this is always satisfied in our model because the zero land price means infinitely large indirect utility.

[A.11] Otherwise, all workers with $\zeta_i \geq \bar{\zeta}$ have an incentive to perfectly cluster in the non-buraku area or the outside economy. As discussed in footnote A.7, we assume that the outside economy is also populated in equilibrium for this indifference condition to hold. Moreover, there is no equilibrium in which nobody lives in the non-buraku area because the land price of the non-buraku area becomes zero, which gives an incentive to move to the non-buraku area.

$$\ln r_n = \bar{\zeta} D_n + \beta X_n + \epsilon_n. \tag{A.14}$$

Therefore, as in Kline and Moretti (2014), the land price discount of the buraku area reflects the evaluation of disamenity by the *marginal* worker.

Implications of heterogeneous preferences for living in buraku areas. This result implies that the land price discount of the buraku area can still be interpreted as the willingness-to-pay to avoid the disamenity of buraku areas, although it is the willingness-to-pay of the specific group of workers (i.e., the marginal workers) in the presence of idiosyncratic preferences. This raises the question of who is the marginal worker. Although the unavailability of individual-level microdata in this study makes it difficult to precisely determine such a worker, some qualitative characterizations can be made. First, we empirically find that buraku areas have the significant land price penalty throughout 1912 and 2018. This means that $\bar{\zeta} > 0$ holds in all periods, that is, disamenity is always disliked by the marginal worker although some people (e.g., those born in buraku areas or those with buraku ancestors) might positively evaluate living in the buraku area. Moreover, given the small population share of buraku areas in the city, we may state that almost every worker i has $\zeta_i > 0$, meaning that living in the buraku area is almost unanimously agreed to entail disamenity. Second, since the population share of buraku areas is small, $\bar{\zeta}$ would be located at the tail of the distribution of ζ_i (say, at around 1 or 2 percentiles of the distribution). This implies that relative to the entire population of Japan, the marginal worker would have a rather small willingness-to-pay to avoid the disamenity, implying that our quantification of the buraku disamenity would be conservative for the entire population.

B Comparing the assessment and transaction data of land prices

For 2018, our analysis uses land price assessment data for property taxation (*kotei shisan-zei rosenka*). We validate the assessment data using the transaction data from the Land General Information System.[B.1] The transaction data are collected through a voluntary survey and all people who made a real estate transaction receive the questionnaire.[B.2] Since land transactions are not frequent, we pool the transactions from 2005 to the former half of 2021, and then exclude the bottom 1% and top 1% transaction prices per m^2 to eliminate the extreme idiosyncrasies of each transaction. To identify the location of each transaction, we use the centroid of the recorded geographical unit because the data do not reveal the exact location of the transacted plots. The geographical unit is basically comparable to the block level. However, some observations are reported at a less geographical granularity (e.g., *moto-gakku*).[B.3] We then divide Kyoto city into $250m \times 250m$ grids as shown in Figure A3, and compare the average assessment and transaction land prices in each grid. Note that since land transactions are not frequent, even averaging within a grid might not always eliminate the idiosyncrasies of each transaction. While we drop grids with less than four transactions to mitigate this issue, this limitation of our transaction data should be kept in mind.

Figure A1 presents the scatter-plot of the log assessment and transaction prices of each grid. A strong positive correlation is apparent: the correlation coefficient is $\rho \simeq 0.824$, despite the noises due to infrequent land transactions. We also plot the linear regression of these two variables. The estimated slope is 1.021 (s.e. 0.0239). Importantly, we cannot reject the null that the slope is 1 (p-value = 0.369), implying that a 1% increase in the assessment price is associated with a 1% increase in the transaction price. The unit elasticity is consistent with the well-known anecdote that different appraised land prices in Japan have a proportional relationship with each other. Our land price, *kotei shisanzei rosen-ka*, is said to be about 70% of the *kouji chika*, which is another major data source of assessed land prices in Japan. The *kouji chika*, in turn, is said to be about 10% lower than the transaction price. Together, we conclude that our estimated buraku effects in percentage directly

[B.1]https://www.land.mlit.go.jp/webland/servlet/MainServlet (In Japanese. Last accessed on September 28th, 2021).

[B.2]Using data from Tokyo, Shimizu, Nishimura and Watanabe (2016) shows that the housing prices from the voluntary survey closely track the distribution of the actual transaction prices.

[B.3]The smaller spatial resolution prevents us from accurately classifying whether each transaction took place in a buraku area or not.

translate into effects on transaction prices.

We discuss several additional concerns about the relationship between the two prices. First, we might suspect that the linear projection shown in Figure A1 might be invalid for areas with very high land prices because they seem to have systematically lower transaction prices than the projected values. However, such high prices are irrelevant for buraku areas. The dashed vertical line is the highest assessment price in buraku areas, implying that the "relevant region" for buraku areas is below this price. In this region, we observe no indication of systematic deviation from the linear projection.

Second, in the US context, Davis, Larson, Oliner and Shui (2021) point out two potential reasons that might bias tax assessments relative to transaction values. First, tax assessment data may fail to closely follow rapidly-appreciating market land prices. However, this concern seems limited in our context because our focus is on the long-run evolution of the land prices. Second, tax assessment data might be right-censored near the market value to avoid challenges by property owners. In practice, however, the threat of challenges is rather weak in Japan. For instance, in the 2000s, property taxation on land received challenges in only about 0.01% of all the cases.[B.4] Moreover, the assessment process is standardized with emphasis on transaction prices, leaving little room for systematically departing from transaction prices. Overall, it is reasonable to expect our tax assessment data to closely follow market prices, which we indeed find in this section.

Third, Avenancio-León and Howard (2022) show that minorities in the US face higher property assessment prices relative to the transaction prices because (i) adverse neighborhood conditions are not fully considered in the assessment prices, and (ii) appeals are less frequent and successful among the minorities. In our Japanese context, (ii) seems unimportant since appeals are rare, as just discussed above. We also do not think that (i) is essential because Figure A1 presents the proportional relationship between the assessment and transaction prices, implying that using the log land price as the outcome variable allows us to identify the results using the assessment price as those using

[B.4]According to Research Center for Property Assessment System (2013), property taxation on land received about 3,000 challenges per year, while the total number of taxpayers was around 29 millions.

the transaction price. Still, note that (i) tends to shrink the buraku penalty because the land price differential between non-buraku and buraku areas is understated, implying that our estimate would be conservative if (i) holds true. Overall, the issues raised in Avenancio-León and Howard (2022) would not fundamentally affect our conclusions.

Our analysis of the relationship between the assessment and transaction prices is limited to the 21st century due to the availability of transaction data. However, we expect that similar conclusions hold for other years of our data. First, our data during 1961 and 1991 come from *sozoku zei rosenka*, which is constructed very similar to our 21st century data (*kotei shisan-zei rosenka*). This implies that our result for the 21st century data would be applicable to the dataset for the period between 1961 and 1991. Second, for the 1912 data, we cannot find the market rental price data that our assessment price data are based on. However, Yamasaki, Nakajima and Teshima (2022) use the same data for Tokyo, and show that the assessment and market prices show a very strong correlation. We expect that their result naturally extends to Kyoto.

C Data sources

Buraku areas. Buraku areas in Kyoto city are scattered throughout the city, as illustrated in Figure A2a.[C.1] They constitute only a small fraction of areas in the city as each of them is small. According to our definition of buraku areas that we explain in the next paragraph, in 1912, the total area of five distinct buraku areas was $0.54km^2$, implying an average size of around $0.11km^2$, and the buraku area covered about 1.3% of the areas covered by our land price data. In 2018, the total area of eighteen distinct buraku areas was $2.54km^2$, implying an average size of around $0.14km^2$, and the buraku areas covered about 1.5% of the areas covered in our land price data. Note that the number of buraku areas in our data increased from five in 1912 to eighteen in 2018 because Kyoto city expanded over the past century and many buraku areas got engulfed into the city area (see Appendix G).

[C.1] Unfortunately, we cannot visually illustrate the scattered nature of buraku areas because we cannot show a map for a research ethic reason (see footnote 17). Therefore, we illustrate the scattered nature by computing the distance between buraku areas. In 2018, for each of 18 buraku areas in 2018, the mean distance to another buraku area is 6.8 km with the average standard deviation of 2.8km.

In the main text, we adopt the definition of buraku areas by Kyoto City Government (1975), which was used for implementing policies toward buraku areas, throughout our sample period. Kyoto City Government (1975) lists the names of blocks (*cho cho moku*), which are the smallest administrative units in Japanese cities, constituting each buraku area. Each block in Japan is granular and it tends to be even more so in Kyoto city. The boundaries of blocks are generally marked by roads. According to the 2015 population census, the median area of blocks in Kyoto city is $0.23km^2$ and the median population is 149. Kyoto City Government (1975) accurately identifies buraku areas using such granular geographical units. Because block names in Kyoto have hardly changed over the past half century, we can use the current digitized map available in the Basic Geospatial Information (*kokudo kihon joho*), Geographical Issue Authority of Japan, to make the shape file of the buraku areas and their outlines. Figure A2b illustrates how we define buraku areas. In Figure A2b, sixteen blocks numbered from 1 to 16 in an illustrative grid city are shown. Now, suppose that blocks 6, 7, and 10 are designated as a buraku area. We combine the area of these three blocks in a map and define it as a buraku area. The buraku border, shown in bold in Figure A2b, is the outline of this buraku area. We focus on observations around the buraku border when implementing the border design (c.f., Black 1999; Bayer, Ferreira and McMillan 2007; Dell 2010).

We make two remarks on our definition of buraku areas. First, the administrative boundary of buraku areas we use might differ from that envisioned by people. It would lead to an underestimation of the buraku effect if it induces a random classification error of land plots (Aaronson, Hartley and Mazumder 2021), although we empirically find a statistically significant discontinuity at the border. Second, at some occasions, Kyoto City Government (1975) states that a buraku area includes a part of a particular block (*cho cho moku*). However, it does not specify which part is included.[C.2] In this case, we follow Shima (2016) and classify the whole block as a buraku area, which is sensible because sharing the same block name as the buraku area entails a stigma. Indeed, Okuda (2006) presents survey evidence that homebuyers exhibit a strong aversion toward buying a house sharing

[C.2] Out of the 43 blocks mentioned, 13 blocks are partially in a buraku area (Kyoto City Government 1975).

the same block name as a buraku area even if the house itself is outside of it.

As a robustness check, we also experiment with two alternative definitions of buraku areas. The first alternative is to focus on buraku areas covered by our 1912 data throughout our sample period (1912-2018), which addresses the concern that the compositional change of buraku areas may drive our results.[C.3] Second, we re-define buraku areas based on an alternative data source: Kyoto City Government (1929). It identifies six major buraku areas which need special support to improve residential conditions and provides their detailed maps. We digitize them to obtain the shape file of the areas and their outlines. An advantage is that the detailed maps allow us to identify the exact buraku borders even more accurately than the definition of Kyoto City Government (1975), which is based on block boundaries. However, the data contain only six buraku areas near the city center because Kyoto city at that time was smaller than it is today, which makes it unsuitable especially for contemporary data. Reassuringly, using these alternative definitions of buraku areas does not alter our conclusion (see Appendix H).

Unfortunately, we cannot present the actual map of buraku areas we constructed due to our concern that showing such a map might provide easy access to identifying information of the buraku class and catalyze discrimination.[C.4] Instead, we briefly describe the typical history of buraku areas in our dataset (see Appendix G for more description). With some exceptions, buraku areas in the pre-modern period were located outside of historical urban areas of Kyoto due to people's aversion toward interacting with buraku people. However, they were not necessarily forced to live in areas

[C.3]Because of the expansion of Kyoto city, the buraku areas in 1912 are located in relatively central areas of the city. Therefore, this analysis also addresses the possibility that the buraku land price discount declines faster in central areas due to the massive inflow of new residents in the urbanization process.

[C.4]Although we use publicly-available data on the location of buraku areas, a judicial precedent ruled that showing a map may be illegal because providing easy access to such information may catalyze discrimination. Indeed, although exceptions apply, many scholarly papers on buraku, especially recent ones, refrain from showing an actual map. They also tend to use the de-identified names of buraku areas (e.g., buraku area A, B, C, ...) rather than the actual ones, which we also follow in this paper. Only for academic purposes, the actual map used in this study may be available upon request from the authors on a case-by-case basis.

having inferior conditions compared to their neighborhoods.[C.5] Over time, Kyoto's urban areas had rapidly expanded, and five buraku areas were engulfed into urban areas as of 1912. The current Kyoto urban areas have spread further so that eighteen buraku areas are included in urban areas in 2018.

Land price data. We newly compile land price data covering all of Kyoto city from 1912 to 2018. Throughout, we take a representative point of land plots as our unit of observation. The 1912 land price data are from *Kyoto chiseki-zu*. They cover all land plots in Kyoto city as of 1912. The comprehensive coverage is essential for our purpose because buraku areas constitute only a small fraction of the entire city. To identify the location of each land plot, we use the GIS version of *Kyoto chiseki-zu* created by geographers at Ritsumeikan University. To our knowledge, ours is the first study in economics to utilize this data.[C.6] For most observations, it records the price and lot size. Such information is based on *tochi daicho genbo*, which is the cadaster data that record all land plots with their assessed prices based on market rental prices.[C.7] We compute the land price per square meter and use its log as the outcome variable.[C.8] Potentially due to nonmarket idiosyncrasies or misrecording at some stage of transcription, some plots apparently have unreasonably extreme unit land prices. We drop observations with the unit land price below the 1st percentile and above the 99th percentile to avoid the influence of such outliers. We use the centroid of each land plot as its representative point.

Our data for land prices in 2006–2018, *kotei shisan-zei rosenka*, also cover all of Kyoto city. *Kotei shisan-zei rosenka* are the administrative land price data for assessing property taxation. The assessment aims to capture the "normal transaction price" by referring to actual instances of transactions

[C.5] Indeed, Appendix D documents that buraku areas do not necessarily have inferior natural conditions than nearby non-buraku areas.

[C.6] See Salat, Murcio, Yano and Arcaute (2018) for its usage in other fields.

[C.7] *Kyoto chiseki-zu* records re-evaluated residential land prices following the act revising the prices of residential land (*takuchi chika shusei hou*) in 1910 for improving the land taxation system. The revised prices were based on an assessment that refers to observed market rental prices. Yamasaki et al. (2022) show the strong correleation between the assessment prices and the market rental prices.

[C.8] To mitigate the influence of outliers, we drop land plots smaller than $4.2m^2$ or larger than $3600m^2$, which roughly corresponds to dropping 0.5% extreme values on each side. However, our results change little if we do not drop such extreme values.

while ignoring unusual aspects of each transaction (Research Center for Property Assessment System 2018, p4). For this goal, each municipality (Kyoto city government in our case), after dividing streets into many segments, assigns the assessed land price per square meter to each segment by referring to professional land price assessments and other professionally assessed land price data (e.g., *kouji chika*). Note that land prices are assessed separately from building prices so that building quality does not affect our land price data. The assessed price is for the "standard" land plot and the same price per unit applies to all land plots facing the same segment of a street.[C.9] To identify land plots in a buraku area, we first classify each segment as belonging to a buraku area if and only if the entire segment lies in a buraku area.[C.10] We then take the centroid of each segment as the representative point of the land plot. Note that since the dataset does not record the prices of all land plots but rather has a price per each road, it has a smaller sample size than the 1912 data that record all land plots. In 2018, the number of observations is about two-thirds of the 1912 data despite the expansion of Kyoto city.

Figure A3 visualizes our land price data for 1912 and 2018. We divide Kyoto city into $250m \times 250m$ grids and plot the average unit land price in each grid. Two points are noteworthy. First, the city area has grown substantially, which reflects the expansion of the boundary of Kyoto city over the past century. Second, despite its growth, Kyoto city has a similar monocentric structure in both 1912 and 2018. Areas around *Kawaramachi* and Kyoto stations, which are approximately $2km$ away from each other, have the highest land prices. The land price gradually declines as we move away from this central area. This pattern is consistent with our monocentric city model in Section 3.

For land prices in 1961, 1973, 1982, and 1991, we newly digitize *sozoku-zei rosenka*, which are the administrative land price data for assessing inheritance taxation set by the National Tax Agency.

[C.9]In actually implementing the property taxation, adjustments are made to consider specific characteristics of each land plot. We ignore such details as we are interested only in standardized land prices.

[C.10]To avoid erroneously classifying non-buraku land plots as buraku plots, we drop exceptional observations in which the entire segment is not contained in a buraku area but the centroid lies within a buraku area.

Except that the property valuation is used for inheritance taxes, it is similarly constructed as *kotei shisan-zei rosenka* for property taxation: *sozoku-zei rosenka* is determined by referring to professional land price assessments and other professionally assessed land price data based on transaction prices. Besides land prices, we also digitize information on land use (i.e., residential, commercial, and industrial areas). We digitize all observations in the 1961 land price data given its importance as the midpoint of 1912 and 2018. For other years, we digitize only land plots in and around buraku areas.

Throughout, we use the administrative assessment prices rather than the transaction prices not only because of their data availability but also comprehensive coverage. Since land transactions are only infrequent and buraku areas are quite small relative to the entire city, we do not observe enough actual transactions in buraku areas for statistical inference even if we pool multiple years of observations.[C.11] In contrast, our professionally assessed land price data cover every land plot while referring to the actual instances of transactions.

Reassuringly, evidence shows that our assessment price is closely related to the transaction price. For the land price data in the 21st century, in Appendix B, we show the strong positive correlation between the assessment and transaction prices ($\rho \simeq 0.824$), although the infrequency of land transactions tends to introduce idiosyncratic noises. Moreover, we estimate that a 1% increase in the assessment price is associated with roughly a 1% increase in the transaction price. These results imply that our buraku effect on the transaction prices can be reasonably approximated by the effect on the assessment prices. Moreover, although we could not find the market rental land price data for 1912 that our assessment price data are based on, Yamasaki et al. (2022) shows a very strong correlation between the two prices in the same data for Tokyo.

Transportation access. We proxy for transportation access by calculating the distance to the CBD,

[C.11] This does not imply that land transactions are less frequent in buraku areas than in other areas. We can generally observe only a small number of transactions in a given small area, and the coverage of the publicly-available land transaction price data are limited.

measured by distance to the central train station of Kyoto city, and the distance to the nearest train station. Regarding the CBD, Figure A3 shows that the neighborhoods of Kawaramachi and Kyoto stations, which are just about $2km$ away from each other, have the highest land prices in both 1912 and 2018. We thus measure the distance to the CBD by calculating the minimum distance to one of these two major central stations. Using QGIS, we also compute the distance (in kilometers) to the nearest train station for each land plot. In calculating both distances, we use the location data of train stations from the Digital National Land Information (*kokudo suchi joho*). In 1912, Kyoto had a different public transportation system than today, such as trams. We obtain the location data of past train stations from the Digital National Land Information (*kokudo suchi joho*). The data have information on all lines and stations including trams from 1950 in Japan. For years before 1950, although the line opening year is available, the station opening year is not. Hence, we first pick up the lines already available in 1912, and then choose the stations on them that already existed in 1913 by referring to Kyoto maps at that time. Here, we utilize the three maps of Kyoto in January 1913, March 1913, and July 1913, which are made available online by the International Research Center for Japanese Studies, Kyoto, Japan. Through such a procedure, we can obtain the information on stations that already existed in 1913 and survived at least until 1950. However, we lose the information on stations that existed in 1913 but were abolished by 1950. Unfortunately, we cannot pin down the accurate locations of stations abolished by 1950. Although this is the limitation of our analysis in controlling the distance to stations for 1912, we believe it is not crucial because the abolished stations were abolished because they were inconvenient and not used frequently, implying that our station data still serves as a good proxy for the transportation system at that time.

Proximity to rivers. We obtain the locations of rivers from the National Land Information (*kokudo suchi joho*). The data are as of 2008 and we assume that the locations of rivers are approximately constant throughout our sample period. For each land plot, we compute the distance to the nearest river using the $NNjoin$ package in QGIS.

Altitudes. The altitude of each lot is calculated using the API provided by Geospatial Information Authority of Japan. We assume that altitudes are constant over time so that the API gives the correct altitudes throughout our sample period.

Ruggedness. We use a ruggedness measure as of 2011 made available in the Digital National Land Information (*kokudo suchi joho*) by the Ministry of Land, Infrastructure, Transport and Tourism. It first divides the plane into $250m \times 250m$ grids. It then computes the average slope in each grid based on the altitude data calculated at the $50m \times 50m$ grid level. We assign this slope to each land plot within the grid. We assume that ruggedness is constant so that the contemporary data provide a good approximation to the ruggedness throughout our sample period.

Current land use. The 1912 data record the current land use of each land plot and we control dummies for each land use.[C.12] Our data for 1961–1991 report the standard use of land in the neighborhood (*chiku kubun*), which is determined by the National Tax Agency based on the current state of neighborhoods and zoning regulations, and we include dummies for them. For the 2006–2018 data, we include fixed effects of the standard use of land in the neighborhood (*youto chiku*), which is determined by the Kyoto city government based on the current state of neighborhoods and zoning regulations.

Urban health amenities. As the best available proxies for urban health amenities, we use the dataset constructed by Inoue (2019) that granularly records the incidence rate of typhoid, proportion of tap water usage rather than water wells, and locations of hospitals in Kyoto city in the early 1920s.[C.13]

[C.12]We focus on four land uses: housing, rice fiends (*ta*), non-rice fields (*hatake*), and forest. These land uses account for almost all priced land plots in the data. Note also that zoning regulation did not exist regulation in 1912 because the city planning act, which was a basis of the zoning regulation, was enacted in 1919.

[C.13]As the share of tap water usage is recorded at a somewhat less granular level (*gakku*) than the

These variables would capture the heterogeneous urban health amenities within a city.[C.14] We do not control for these variables but use them in investigating the mechanism behind the buraku land price penalty in Section 7.

School districts. Although there are private schools, public schools are by far the most popular option in Japan. In Kyoto prefecture, 95.7% of students attended a public elementary school and 86.3% attended a public junior-high school in 2017. In Japan, different public (or equivalently, municipal) school districts are set for elementary and junior high schools, which we control for separately. Since the geocoded map of school districts in Kyoto city is not publicized, we purchased one from GEO·K, Inc. (sold on consignment by ESRI Japan, Inc), which collects information on school districts from each municipality and sells its geocoded map.

Road width. Road width can be important in modern periods because it is an important public good and is related to the floor-area-ratio (FAR) regulation. In Section 7, we account for the road width by using a functional form that captures the regulation schedule.[C.15] Geospatial data on the road edge and road center lines are available in the Basic Geospatial Information (*kokudo kihon joho*), which is a digitized map issued by the Geographical Issue Authority of Japan. Using QGIS, we first create points along the road center lines at three-meter intervals, and then compute the road width at each center point by measuring the distance between the center point and the edge of the road. We then

block level, we improve the measurement for buraku areas by using Kyoto City Government (1929) that records the prevalence of tap water supply in each buraku area. However, not conducting this data augmentation hardly changes our results.

[C.14]Moreover, the construction of the sewage system in Kyoto city did not start until 1930 and electricity was used almost at every location within Kyoto city at least in 1930s (Kyoto City Government 1940; Inoue 2019), implying that the influence of other urban infrastructure as of 1912 would be limited.

[C.15]The regulation states that if the road width of the front road is less than $12m$, a smaller FAR (a coefficient times the road width in meters) might apply. Moreover, if the width of the frond road is less than $4m$, new buildings cannot be built on some portion of the land for a future enlargement of the road.

allocate the centroid of each *rosenka* segment to the road width of the nearest road center point. To mitigate the influence of miscalculated values, we drop samples with road width above the top 1% or below the bottom 1% of the calculated road width distribution in analyses using the road width variables.

Parks, public facilities, and community centers. We take the data for 2018 from the Digital National Land Information (*kokudo suchi joho*) by the Ministry of Land, Infrastructure, Transport and Tourism. The point data of parks are as of 2010, those of public facilities (public offices, schools, hospitals, post offices, social welfare facilities etc) are as of 2006, and those of community centers are as of 2010. While the timing of the data does not exactly match 2018, we assume that these data approximate well the situation in 2018. We obtain the data of public facilities (public offices, schools, hospitals, post offices, police stations, and temples and shrines) by newly digitizing a map of Kyoto city in 1912 (*seishiki chikei zu*).

Population density. We use the population census data at the block level (*cho cho moku*) to calculate the population density around each land plot. In Japan, the population census has been conducted every five years starting from 1920. We use the 1920 census data to approximate the population density in 1912 and the 1965 census to approximate the population density in 1961. The GIS data of these two population censuses are taken from Kirimura (2011). For 2018, we use the GIS 2015 population census data downloaded from e-Stat (https://www.e-stat.go.jp/en). To assign population density to each representative point of the land plot, we first create a 10m buffer around each land plot point in our data. We then calculate the size of overlap with each block. Assuming that the population is uniformly distributed within each block, we can calculate the number of people living in each overlap. We finally calculate population density around each land plot by dividing the sum of the population of all overlaps by the sum of the area of all overlaps.

Local average income. As the data of 2018 local income level, we use two independent estimates at the *cho cho moku* level by ZENRIN CO., LTD. (ZENRIN) and NIPPON STATISTICAL CENTER CO., LTD (NSC). The ZENRIN data is based on the statistical imputation from the Population Census and the Housing and Land Survey. The NSC data is based on the statistical imputation from the Population Census, the Basic Survey of Wage Structure, Employment Status Survey, and other supportive datasets. We assign the local income level to each land plot in our sample to conduct our analysis on the local average income.

The local income data is not available for 1912 and 1961, but such information is needed to identify poor but non-buraku neighborhoods. For this purpose, we exploit the theoretical prediction of the model in Section 3 and Appendix A to back out the income at the local level.[C.16] Specifically, the land market clearing condition, Equation (A.7), shows that observing land prices, population density, and the spending share for land are sufficient to recover the local average income. We first take each point in our land price data as a different location n in the model. We then use Equation (A.7) to obtain the local income level at this point. We calibrate the spending share of land $\gamma = 0.14$ for 1912 and $\gamma = 0.11$ for 2018 based on available information. However, the choice of γ does not affect our analysis on income because it is just a scaling parameter (see Equation A.7).

Table A1 presents summary statistics for 1912 and 2018, separately for buraku areas and non-buraku areas. We omit summary statistics in other years (available upon request).

D On the discontinuity of characteristics at the buraku border

A threat to our identification assumption in border design is that some unobsevable confounding characteristics are discontinuous across the buraku border. Although this assumption itself is not testable, we follow Bayer et al. (2007) and investigate the discontinuity in observable characteristics to gauge the seriousness of the threat to the identification assumption.

[C.16] A potential concern is the data quality of the local income level backed out from our theoretical model. Reassuringly, we can confirm that our measure of local income level in 2018 is positively correlated with the above-mentioned local income data at the *cho cho moku* level. Although such validation can be done only for 2018, this reinforces the plausibility of our local income variable.

Figure A4 graphically represents the estimated discontinuity at the buraku border in 1912 for six characteristics: plot size, distance to the CBD, distance to a river, altitude, ruggedness, and the share of plots currently used for housing. Since we are interested only in the discontinuous change in this analysis, we use the MSE-optimal bandwidth and report the point estimate as well as the p-value that considers bias (Cattaneo, Idrobo and Titiunik 2019). We find that the discontinuity is insignificant at the 1% level for all characteristics. However,the distance to the CBD, the distance to the nearest station, and altitude are significant at the 5% level. However, we argue that these discontinuities do not imply that our buraku effects on land prices are spuriously driven by unobserved confounders. Regarding the distances to the CBD and nearest station, they are actually closer for buraku areas, implying that buraku areas are located in an *advantageous* position. Second, in our regression in Table 1, the coefficients of altitude are insignificant in the border design and altitudes are negatively associated with land prices in the full sample (not reported). Thus, if any, buraku areas are again at advantageous locations. Thus, our negative effect on land prices cannot be explained by such discontinuity.

Figure A5 repeats the same analysis using 2018 data. No characteristic exhibits statistically significant discontinuity at the 5% level. The slope exhibits some discontinuity at the 10% level, but in the regression of Table 1, the estimated regression coefficients of altitudes on land prices are insignificant in border design.[D.1]

To address potential discontinuity at the border of buraku areas, we also presents our land price estiamtes after controlling for buraku-name fixed effects. If composition of relevant buraku areas in our sample is systematically correlated with distance from the border of buraku areas, it may induce discontinuity of counfounding factors and result in the discontinuous land price penalty.[D.2] Figure A8 shows that the land price penalty hardly changes from our main results in Figure 2 even after

[D.1]Although it is significant in the full sample, the coefficient is negative and buraku areas are predicted to have higher land prices since they are located in a flatter place.

[D.2]Consistent with this, we find smaller point estimates (in absolute value) of discontinuity of observed locational characteristics after controlling for these fixed effects (see Tables A5 and A6). However, it does not necessarily eliminate statistical significance of such discontinuities.

controlling for the dummy variables of nearest buraku areas. This limits the importance of such discontinuous counfounders in our context.

Overall, we do not find significant discontinuity of characteristics around the buraku border that might explain the lower land prices in buraku areas for both 1912 and 2018. Thus, there is no indication that our estimated negative buraku effect on land prices is driven by unobserved characteristics that are discontinuous at the buraku border.

E Income level in buraku areas

We have seen that land prices in buraku areas are lower than those in non-buraku areas. In this section, we investigate whether buraku areas are "slums" in the sense that they have a lower average income than other areas. While sociological and historical literature has suggested that residents in buraku areas had low income in the past (e.g., Akisada 1972), the lower income of buraku areas might be no longer observed today (Shima 2016). We investigate whether the poor cluster in the buraku areas of Kyoto city in recent years.

We provide two evidence indicating that buraku areas might be no longer characterized by lower income. First, we analyze two independent estimates of the local income at the spatially granular (*cho cho moku*) level. We first use the data provided by ZENRIN and the same specification as Table 1 but using the log local average income as the dependent variable, we find that buraku areas have about 15% *higher* income in 2018, although the standard error (10%) implies that this relationship is not statistically significant ($p = 0.144$). In the data provided by NSC, the point estimate is 0.02% with the standard error 1.11% ($p = 0.983$). Overall, we find no evidence that buraku areas have lower income today than nearby non-buraku areas.

Second, we investigate whether buraku areas have higher crime rates, which are likely to be correlated with the local income. We analyze whether buraku areas are characterized by more occurrence of thefts.[E.1] Figure A12d shows that buraku areas have, if any, lower occurrence of thefts. Overall, we

[E.1] We take the list of theft incidences from the DPSS Data Bank Project of Unviersity of Tsukuba (https://commons.sk.tsukuba.ac.jp/data_en, last accessed on February 14, 2024).

find little evidence that buraku areas today are characterized by lower local income level of residents.

F Population density in buraku areas

Using population density at each location n as the dependent variable in the specification used in Table 1, we examine population density of buraku areas relative to nearby non-buraku areas. We find that population density of buraku areas was about 99% higher than that of non-buraku areas in 1912, 54% higher in 1961, and 22% lower in 2018 (all numbers are from 50m comparisons).[F.1] The population density was substantially higher in the past but is decreasing over time. In 2018, buraku areas now have lower population density, although the result is statistically significant only for the core of buraku areas. Notably, the combination of lower land prices and lower density in 2018 suggests that buraku areas are likely characterized by disamenities.[F.2]

G Old and new buraku areas

This section examines how the time-series of the land price discount is different for old buraku areas, which tend to be located near the city center, and new buraku areas that are newly engulfed into Kyoto city as the city expanded.

To that end, we briefly explains how Kyoto city and its Densely Inhabited District (DID) areas have expanded over the past century. The former is a municipal unit whereas the latter represents its urbanized areas. DID areas consist of adjacent census districts, each of which has a population density of 4,000 or more per square kilometer, and the total of which has a population of 5,000 or more. From 1912 to 2018, the administrative area of Kyoto city has expanded through a few steps.

[F.1] The standard deviations are, respectively, 23.4%, 16.9%, and 6.7%.

[F.2] If all workers have the same human capital endowment in our model, buraku areas have lower land prices and population density in equilibrium. To see this, buraku areas should have lower land prices in equilibrium because of the spatial equilibrium condition. This lower land prices induces more land consumption per capita, leading to lower local population density. This consistently explains today's situation of buraku areas. Our results that buraku areas had higher population density in 1912 and 1961 can be explained if the poor, who have smaller land consumption per capita, sort into buraku areas in these periods. This pattern is consistent with the poverty of buraku areas in the past (Akisada 1972; Shima 2016) but no income gap today (see Section E).

Major expansions took place in 1918, 1929, 1931, and 2005. Figure A9 represents such a process.

The current Kyoto city is depicted as the inner area of the black bald line. The deep orange area is Kyoto city in 1920, which is limited only to the center of the current Kyoto city. Kyoto city in 1960 is much larger, and the expansion of the Kyoto city from 1920 to 1960 is represented by the orange area. In 2005, Kyoto city further expanded due to the great merger of municipalities in the Heisei era. As a result, the thin orange area also became a part of Kyoto city. Figure A9 also depicts the DID areas in Kyoto city: the DID areas in 1960 are represented by the areas shaded by slashes whereas those in 2015 are represented by the areas shaded by backslashes. During the past century, both Kyoto city and its DID areas expanded from the center to the suburbs. Despite such expansion, however, Kyoto city retained its monocentric city structure as we have demonstrated in Figure A3.

In 1920, only the "old buraku areas," which are covered by our 1912 data throughout our sample period, located within Kyoto city. Meanwhile, among the "new buraku areas" that are not covered by our 1912 data, one located at the edge of Kyoto city whereas the remaining ones located outside of Kyoto city. After that, all the new buraku areas are engulfed into Kyoto city by 1960.[G.1] Note further that no buraku areas dropped from our sample.

Figure A10 compares the results under the two definitions: Figure A10a focuses on the old buraku areas whereas Figure A10b focuses on the new buraku areas.[G.2] Three results stand out. First, for both old and new buraku areas, we find statistitally and economically significant land price discount.[G.3] Second, the magnitude of the land price discount is larger for old buraku areas throughout our sample period. That said, this difference is quite small in the 21st century.

[G.1] However, since our land price data do not cover relatively less developed areas, the number of buraku areas covered in our data was increasing even after 1960 (14 buraku areas in 1961, 15 in 1973–1982, 18 in 1991–2018).

[G.2] Note that the interpretation of the time-series of new buraku areas requires some caution because the number of buraku areas covered by our dataset slightly increases during 1961 and 1991 (14 buraku areas are included in the 1961 data, 15 in the 1973–1982 data, 18 in the 1991–2018 data). Focusing on the 14 buraku areas present in the 1961 data throughout 1961–2018 does not change our main conclusion.

[G.3] The statistical significance is quite strong, except that it is marginal only for new buraku areas in 1991 ($p \simeq 0.11$).

H Alternative definition of buraku areas

This section probes the robustness of the estimated land price discount of buraku areas, summarized in Figure 2, under alternative definitions of buraku areas by Kyoto City Government (1929).

Overall, Figure A11 suggests the following conclusions, just like our main result in Figure 2. First, the buraku discount substantially declined from 1912 and 1961. Second, the decline is no longer observed from 1961 to 1973. Third, the decline is again observed in the period 1973–2006, which largely coincides with the large-scale place-based policy (*dowa taisaku*, 1969–2002). Finally, the decline is no longer observed during 2006–2018. Therefore, our main qualitative conclusion does not depend on the specific definition of buraku areas.

Despite the agreement with the main qualitative results, some notable differences exist. First, within the place-based policy period (1973–2006), the timing of the sharp decline in the land price discount differs. Specifically, in our main analysis (2), the land price discount declined steadily throughout 1973 and 2006. Meanwhile, Figure A11 suggests that that the decline is concentrated in the period from 1991 to 2006. Second, the results from Kyoto City Government (1929) in Figure A11 yields somewhat larger land price discounts than our main estimates in Figure 2. Finally, the standard errors are relatively larger under the alternative definitions in Figure A11, which likely reflects the smaller sample size as the alternative definitions cover a smaller number of buraku areas.

The results in Figure A11 mitigate several concerns. First, it ensures that our results are not driven by a specific way of defining buraku areas. Second, since we have clear evidence that the six buraku areas in Kyoto City Government (1929) date back to the pre-modern period (Kyoto City Government 1940), shocks to contemporary land prices are unlikely to be correlated with the locational determinants of these areas (Ciccone and Hall 1996). Finally, since buraku areas in 1912 data and Kyoto City Government (1929) are around the center of Kyoto city, it excludes the possibility that the diminishing buraku effect is spuriously induced by the inclusion of new buraku areas due to the expansion of the city. This result is analogous to Figure A10a that focuses on five buraku areas covered in our 1912 data.

Using the boundary definition of Kyoto City Government (1929), Figure A11b restricts our focus to "old buraku areas", which we discussed in Appendix G. Relative to Figure A11, it amounts to dropping one buraku area since 1961 as Kyoto City Government (1929) covers six buraku areas. [H.1] Overall, while we find somewhat larger land price penalties, we find similar land price penalty as in Figure A10a.

I Other potential mechanisms

This section evaluates the role of alternative mechanisms that induce lower land prices of buraku areas even if buraku areas no longer have the territorial stigma: neighborhood quality, school quality, durable local capital, locational fundamentals, aversion for interacting with buraku people, and policy discontinuity. Overall, we find the limited importance of these mechanisms.

I.1 *Neighborhood quality*

Buraku areas might have lower land prices even in the absence of discrimination risk if they have lower neighborhood quality. Although the border design admits the heterogeneous neighborhood quality that is spatially continuous, the poor might sort into the buraku areas and may induce discontinuously bad neighborhood characteristics (Bayer et al. 2007; Ambrus, Field and Gonzalez 2020). We now consider the extent to which our main results reflect lower neighborhood quality.

We empirically analyze whether buraku areas are characterized by lower neighborhood quality. We use three datasets: the two distinct datasets on the estimated local average income data in 2018 and the crime dataset (see Appendix C for details). In all datasets, we do not find that buraku areas today are characterized by lower neighborhood quality.[I.1] These results imply that the unobserved

[H.1] Note that one of the six buraku areas under the definition of Kyoto City Government (1929) is located exactly on the border of Kyoto city, and it is not covered by the 1912 land price data. The 1912 land price data cover only the inside of Kyoto city and do not cover its border.

[I.1] Consistent with this, the current buraku areas are not urban slums. In fact, Management and Coordination Agency (1993) surveyed the buraku areas all over Japan and concluded that living environments in buraku areas are comparable to those in other areas. It provides several evidences for this view: for instance, it found little difference in the sewerage coverage rate and average lot area per household.

neighborhood quality would not explain our result in 2018.[I.2]

In contrast, our results for 1912 might be partially driven by the lower neighborhood quality due to poverty. We assess its role in 1912 in two ways. First, we explicitly control for observable urban health amenities in buraku areas (see Appendix I.7.1 for details).[I.3] Poor areas might have unhealthy sanitary conditions and may crucially depend on the income level, especially in historical times (Ambrus et al. 2020). We control for their best available proxies recently digitized by Inoue (2019): the incidence rate of typhoid, prevalence of tap water usage, and location of hospitals. We find that controlling for them actually magnifies the estimated land price penalty for buraku areas.[I.4]

Second, we investigate the land price penalty for non-buraku areas with low income level (see Appendix I.7.1 for details). If such areas also have a land price penalty as large as that for buraku areas, it indicates that the buraku price penalty is driven by neighborhood quality (measured by average income). Specifically, we split the city into $250m \times 250m$ grid cells as shown in Figure A2. After dropping the cells overlapping a buraku area, we define the same number of cells with the lowest average income as the non-buraku poor areas. Repeating the same analysis as in Table 1, we find that such areas have 16% lower land prices. This land price penalty is way smaller than the 53% land price penalty for buraku areas. Thus, although we cannot fully rule out that some of the land price penalty of buraku areas is driven by lower neighborhood quality, neighborhood quality alone cannot explain it.[I.5]

In summary, the low neighborhood quality in buraku areas is unlikely to be the main factor in-

[I.2] We have also confirmed that controlling for the available local average income data in 2018 does not change our conclusions in Table 1.

[I.3] Another potential proxy for the neighborhood quality is the crime rate. Although the crime rate has not been documented separately for buraku and non-buraku people after WW2, available data in the pre-WW2 period suggest that the crime rate did not seem markedly different between the two groups (Aoki 2022).

[I.4] Moreover, buraku areas have better urban heath amenities in some dimensions (see Appendix I.7.2).

[I.5] As we have digitized all land plots in 1961, we can also conduct the same analysis for 1961. Similar to 1912, we find that the land price penalty for poor non-buraku areas is substantially smaller than that of buraku areas.

ducing the low land price in buraku areas. We do not find evidence that it can explain a large part of the land price penalty of buraku areas in 1912. Buraku areas in 2018 are no longer characterized by poverty, which limits the importance of neighborhood quality in explaining why buraku areas are characterized by lower land prices in recent years.[I.6]

I.2 *School quality*

While school quality is an important determinant of children's outcomes that can change discontinuously at the borders of school districts (e.g., Black 1999; Bayer et al. 2007), we expect that school quality is not a main driver of the land price discount of buraku areas because Japanese public schools are standardized in terms of the curriculum and funding. Indeed, the capitalization of public school quality into land prices is smaller for Japan than other developed countries (e.g., Kuroda 2022). Our analysis is consistent with this claim in suggesting that the buraku land price penalty is not driven by the school quality.

To empirically confirm that school quality indeed does not drive the buraku land price discounts, Appendix I.7.3 re-estimates the buraku effect in 2018 while additionally controlling for public primary and junior-high school fixed effects.[I.7] We find that our estimates hardly change, implying that the above concerns do not seem to affect our results. We do this only for 2018 as we do not have accurate data on the boundary of school districts in other years. Still, we also have suggestive evidence that school districts did not matter for our results in 1912. Out of five buraku areas, one buraku area almost coincides with the school district (*moto-gakku*), implying that school quality might jump at the boundary of this buraku area. Therefore, if school quality matters the most, dropping this buraku area would substantially reduce our estimate of the land price penalty. However, our results change

[I.6] We also find that buraku areas in 2018 have lower population density than nearby non-buraku areas. This is consistent with our theoretical model in Section 3, where buraku disamenities induce both lower land prices and population density if there is no income gap. See Appendix F for more details.

[I.7] Sharing the same school district with a buraku area may induce more social interactions with buraku residents. Thus, controlling for the school districts also addresses the possibility that the aversion toward interacting with buraku residents may yield a disamenity of buraku areas.

little by dropping this buraku area.[I.8]

I.3 *Durable local capital*

Buraku areas may have persistently lower land prices because of their disadvantage in durable local capital. For instance, poor residents may invest less in their housing and the durablity of the housing structure may induce a persistently negative impact on housing values (Glaeser and Gyourko 2005). Public goods are also important durable local capital. If the government has discriminated against the buraku and invested less in buraku areas, it may induce persistently lower land prices. The level of durable public goods may also be poorer when they are voluntarily provided, potentially because of inferior income or social capital in buraku areas (DiPasquale and Glaeser 1999).

We first argue that in our context, the durability of residential housing is unlikely to have a persistently negative impact on land prices for several reasons. Most importantly, our land price data evaluate the value of land when it is empty and do not include the value of the structure on it. Even if the land price appraisal of the empty land is affected by housing characteristics of neighbors, two reasons limit their importance on the persistence of buraku land price penalty. First, Japanese housing units depreciate much faster than those in the US and other countries for reasons such as differences in construction materials (Yoshida 2020; Yamagishi 2021). Indeed, Yoshida (2020) estimates that the annual depreciation rate is 6% for Japanese housing while it is 1% for US housing. This high depreciation rate may make it difficult to explain the century-long persistence of buraku land price penalty solely by housing durability because few housing survives for 100 years. Second, the place-based policies (*dowa taisaku*) mentioned in Section 6 improved housing conditions in buraku areas through slum clearance and new construction.[I.9]

We now turn to public goods, especially durable investments by the government. In recent years, we a priori expect little inferiority of public goods in buraku areas because the place-based policies

[I.8]Specifically, we get the buraku land price discount of 56.66% (S.E., 8.25) in our preferred specification when we drop this buraku area, while the corresponding number in Table 1 is 53.15% (S.E., 7.15) when we do not drop this buraku area.

[I.9]Indeed, Uehara (2009) states that "every buraku area that went through neighborhood improvement now looks like an ordinary residential area."

(*dowa taisaku*) improved the public goods provision in buraku areas. Indeed, we do not find evidence that buraku areas today are characterized by poorer public goods. First, focusing on areas within 150m from the border of buraku areas, Appendix I.7.2 investigates the location of parks, public facilities (e.g., schools, hospitals, and post offices), and community centers. We find limited evidence that there are fewer parks and public facilities in buraku areas. We also find that community centers are, if any, *more* likely to be located in buraku areas. We also do not find that more thefts occur in buraku areas, which might imply that buraku areas are not inferior not only in physical capital but also in social capital. Second, we also do not find that infrastructure quality is inferior in buraku areas. In particular, road width is not narrower in buraku areas (Appendix C) and sewage system conditions are equivalent to non-buraku areas (Management and Coordination Agency 1993).

We also find relatively limited evidence that buraku areas in 1912 have poorer public goods than the neighboring non-buraku areas. First, we find that public facilities may be, if any, *more* likely to locate in a buraku area. Second, we investigate urban health amenities that are public goods: the infection rate of typhoid, prevalence of tap water, and location of hospitals (Inoue 2019).[I.10] Around the border of buraku areas, we find that the tap water is significantly more prevalent outside buraku areas, but buraku areas have *lower* infection rates of typhoid and *more* hospitals. Therefore, it is not necessarily the case that buraku areas have inferior public goods compared to nearby non-buraku areas. Moreover, as discussed in Appendix I.1, controlling for these variables actually magnifies the land price discount of buraku areas.

I.4 *Locational fundamentals*

Buraku areas might have lower land prices due to disadvantageous locational characteristics, possibly because discrimination may have forced buraku people to choose unfavorable locations.[I.11] However, note that our main regression analysis in Section 5 has already taken account of locational characteristics. First, our border design accounts for any heterogeneity of locational characteristics,

[I.10] The infection rate of typhoid may be considered as a proxy of the local sanitary condition, which is a local public good.

[I.11] Relatedly, Villarreal (2014) documents bad drainage conditions in poor areas of New York.

as long as it is continuous across the buraku border. Second, we have analyzed the discontinuity of observable locational characteristics (distance to the nearest train station, distance to the city center, distance to a river, altitude, ruggedness) in Appendix D. We do not find a discontinuity that may explain the buraku land price discount. Finally, we explicitly control for the observable locational characteristics in Table 1 and Oster's bounds exhibit little indication that buraku land price penalty can be explained by unobserved locational characteristics.[I.12]

I.5 *Aversion for interacting with minorities*

In Section 7.1, we have argued that the land price discount is driven by the higher discrimination associated with living in stigmatized buraku areas. However, buraku discrimination could potentially induce lower land prices in buraku areas even in the absence of association between discrimination risk and residence. To illustrate, suppose that the buraku group affiliation is determined by the ancestor's caste, and people with buraku ancestors tend to live in buraku areas. Then, as long as people discriminate against these people and avoid interactions with them, buraku areas might have lower land prices even if living in buraku areas does not increase the risk of being identified as buraku.

Our empirical results suggest that this possibility is likely of limited importance. First, as long as the intensity of interactions is continuous across space, our border design eliminates this effect. Second, we could think of school districts as a proxy of social networks as many local activities are organized at the school district level. Indeed, Okuda (2007) demonstrates that some people avoid buying a house that shares the same school district as buraku areas to avoid interacting with them, even if the house ifself is outside the buraku areas. As shown in Appendix I.2, however, controlling for school district dummies does not change our results. Therefore, our estimates based on the border design are unlikely to be substantially driven by aversion for interacting with buraku people.

Note that such aversion for interacting with buraku people is plausibly regarded as another form

[I.12]Note also that even if some inferior locational conditions still exist, the infrastructure quality as good as non-buraku areas (Section I.3) is likely to mitigate its impacts on land prices. For instance, modern hazard maps reveal no difference in the disaster risk of buraku areas and nearby non-buraku areas, which is partially attributed to infrastructure such as flood control.

of buraku discrimination. That is, regardless of whether the target of discrimination is residents of buraku areas or people with buraku ancestors, it stems from the same discriminatory attitudes against the buraku people. In this sense, even if such aversion for contacting people with buraku ancestors is reflected in our estimates of land prices, they still serve as evidence of persistent buraku discrimination. Indeed, if buraku discrimination had already disappeared, both increased risk of being identified as buraku by living in buraku areas and the aversion for interacting with buraku people would not yield any land price discount.

I.6 *Policy discontinuity*

We consider the possibility that the buraku land price penalty is induced by a policy that happens to change discontinuously at the border of buraku areas. We focus on two salient policies. The first is the floor-to-area ratio (FAR) regulation, which can greatly affect land prices by changing land use efficiency.[I.13] In Japan, the FAR regulation did not exist in 1912 but was in effect in 2018. The FAR regulation is closely tied with the width of the front road, in which the narrower front road mandates a lower FAR. In Appendix I.7.4, we re-estimate the regression for 2018 while additionally controlling for the width of the front road. While the width of the front road is associated with land prices consistently with the actual FAR regulation schedule, it has little impact on our buraku effects. Thus, the heterogeneous FAR regulation is unlikely to explain our results.

The second policy is the place-based policies, especially the *dowa taisaku jigyo* described in Section 6, to improve buraku areas. It is hard to empirically assess its impact on land prices because there is no buraku area in our sample that did not receive this place-based policy. That said, as long as this policy positively affected buraku areas as intended, it shrinks the land price discount of buraku areas. Yet, we find a significant land price discount, even in recent years.[I.14]

[I.13]Note that our regression analysis also accounts for zoning regulation by controlling for the governmental classification of the neighborhoods (see Appendix C).

[I.14]Furthermore, the *dowa taisaku jigyo* ended in 2002.

I.7 *Details on the mechanisms*

I.7.1 *Neighborhood quality*

Urban health amenities. As a manifestation of adverse neighborhood quality, poor areas might have poor sanitary conditions, especially in historical times. Table A7 repeats the regression analysis in Table 1 , but controlling for proxies of urban health amenities: infection rate of typhoid and share of tap water usage, and dummies of the hospital location (Inoue 2019). Using the same procedures as those used in Section 6, the estimated buraku effect is approximately 70% of land prices, which is larger than 53% in our main analysis. This suggests that while our variables indeed capture urban health amenities, buraku areas tend to have somewhat better urban health amenities (conditional on our other control variables). Overall, we find little evidence that urban health amenities drive our buraku effects.

Poor non-buraku areas. We investigate the land price discount of poor non-buraku areas. We identify the poor non-buraku areas in the following procedure. First, we divide Kyoto city into $250m \times 250m$ grid cells as shown in Figure A2. To focus on non-buraku areas, we drop the cells including a buraku area.[I.15] Then, we rank all remaining cells according to the average income within the cell and define the same number of cells with the lowest average income as the non-buraku poor areas.[I.16] We then repeat the analysis as in our main text to estimate the land price penalty, now treating the poor non-buraku areas like buraku areas. These poor non-buraku areas have lower income than that of buraku areas in both 1912 and 1961, implying that their neighborhood quality can be poorer than that of buraku areas. This might imply that the land price penalty of the poor non-buraku areas reveals an upper-bound of the effect of neighborhood quality.

Table A7 reports the result for 1912. We find that the poor non-buraku areas have 16% lower

[I.15] We drop 28 cells in 1912 and 51 cells in 1961.

[I.16] Note that we do not have the income data at the spatial granularity, except for the estimated income data for 2018 (see Appendix C). Therefore, we back out the income level implied by our model for this analysis (see footnote A.5).

land prices in 1912 and 11% lower land prices in 1961. Although significant, these are substantially lower than the corrsponding numbers for buraku areas (53% and 36%, respectively). This suggests that the neighborhood quality can, if any, only partially explain the buraku price penalty.

I.7.2 *Public goods*

Figure A12 plots the density of public goods in a 150m neighborhood from the border of the buraku areas. Figures A12a and A12c show that in 2018, parks and public facilities are not concentrated either in buraku or non-buraku areas. Figure A12b shows that in 2018, community centers are disproportionally located in buraku areas, which may reflect the place-based policies that provide community centers in buraku areas. Figure A12e shows that in 1912, public facilities are, if any, more likely to locate in a buraku area.

Turning to the safety level in 2021, Figure A12d shows that thefts occur less in buraku areas than nearby non-buraku areas.

Figure A12 also shows the discontinuity at the border of buraku areas in several observable characteristics related with public goods. Figure A12f shows that in 1912, buraku areas were characterized by *lower* incidence rate of typhoid, suggesting better public health conditions than nearby non-buraku areas. Figure A12g shows that in 1912, the tap water usage was less prevalent in buraku areas. Figure A12h shows *more* hospitals in buraku areas than nearby non-buraku areas.[I.17] Table A7

[I.17]Lower incidence rates of typhoid in buraku areas can be explained, for example, as follows. First, although the data on incidence rates of typhoid come from the survey by Kyoto prefectural government and hence are comprehensive, it is still possible that investigation of the deep parts of buraku areas was hard to conduct due to concealment by residents. Second, according to Saito (2003), in the early modern period, the share of workers engaging in the pharmaceutical industry was higher in buraku areas than out of them for various reasons. This might have alleviated the damages of the typhoid pandemic. Finally, government's intensive preventive measures against buraku areas could have played a significant role. In fact, during the late 1800s, Japan experienced serious cholera pandemics. As Kobayashi (2001) summarize, Kyoto was no exception and damages were severe in poor areas including buraku areas, which induced the Kyoto prefectural and cit governments to take intensive preventive measures against poor areas. Such measures might have worked effectively in the typhoid pandemic, which occurred a few decades after the cholera pandemics.

shows that controlling for these variables (urban health amenities) does not reduce the buraku land price penalty.

I.7.3 *School districts*

Table A7 presents the 2018 regression results after controlling for primary and junior high school districts. The estimated buraku effects change little from our main estimate in Table 1, implying that our buraku effects are not driven by school quality and factors closely correlated with it.

Figure A12i shows that in buraku areas in 2018, the width of the frond road of each plot is similar to that in nearby non-buraku areas. This suggests that buraku areas in 2018 are not characterized by poorer road infrastructure. Table A7 shows that controlling for the road width has little effect on the buraku land price penalty.

I.7.4 *Policy discontinuity (floor-to-area ratio regulation)*

We consider the potential road of the floor-to-area ratio (FAR) regulation that was in effect in 2018. The regulation restricts how much floor space one can build for a given land area. Table A7 presents the results after controlling the width of the front road. The results are quite similar to our main specification in Table 1, suggesting that heterogeneity in the FAR regulation does not seem to drive our results. We also check that the road width has significant explanatory power, especially for road width below $4m$.[I.18] This suggests that our calculated road width reasonably captures the actual regulation pattern.

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[I.18] If the front road is narrower than $4m$, one must "set back" from the road to secure the $4m$ width in the future expansion of the road. This means that if the width of the front road is less than $4m$, a significant portion of the land plot cannot support any structure.

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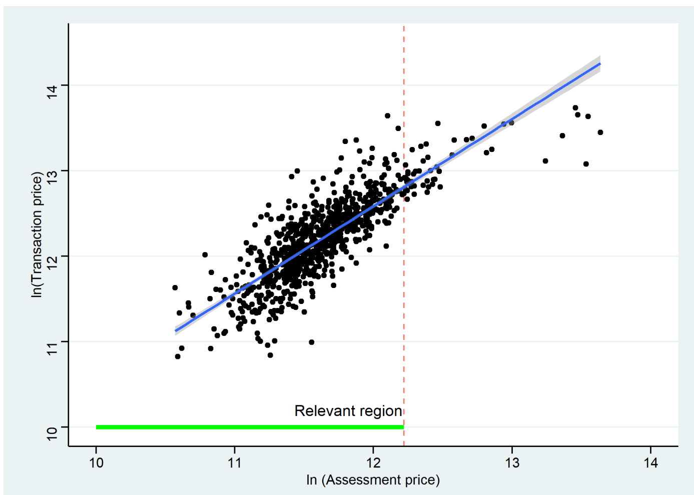
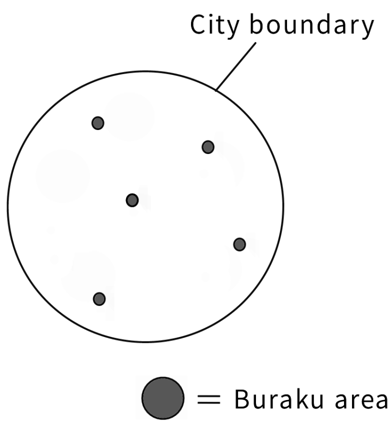
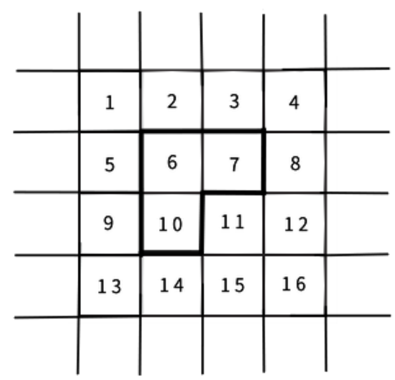


Figure A1: Comparison between assessed land prices and land transaction prices

Note: The horizon axis is the log transaction land prices and vertical axis is the log assessed land prices. We plot the average land prices in each $250m \times 250m$ grid as each dot. The linear least-square relationship is also shown. The vertical dashed red line represents the maximum assessment price in buraku areas. The 95% confidence interval of the regression line is depicted in gray. We show regions below this maximum price as the "relevant region" for buraku areas.

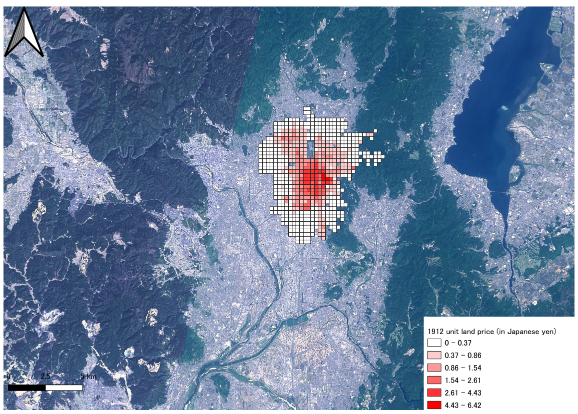


(a) How buraku areas are located in a city

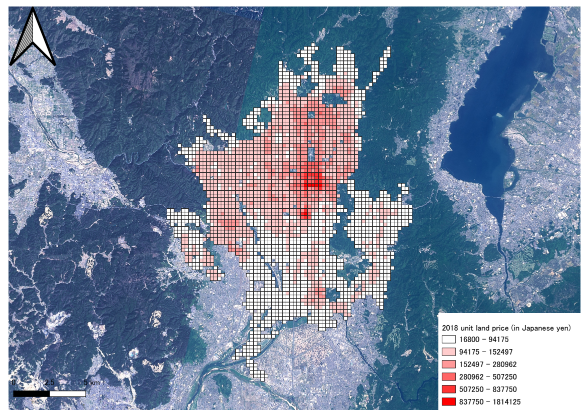


(b) Defining buraku areas from Kyoto City Government (1975)

Figure A2: Illustrations of buraku areas



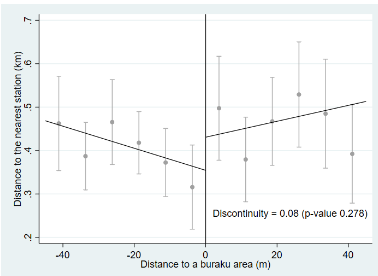
(a) 1912



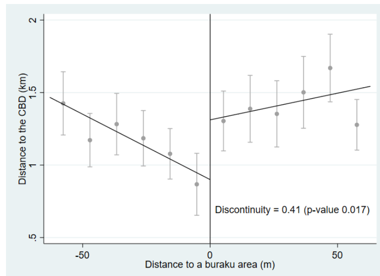
(b) 2018

Figure A3: Unit land prices in Kyoto in 1912 and 2018

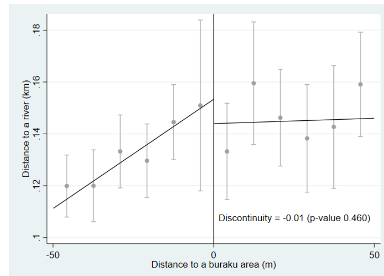
Note: The figure plots the average unit land price within each $250m \times 250m$ grid cell. To avoid the influence of extreme values and misrecording, we exclude land plots with the top and bottom 1% unit land prices for the 1912 data. A few grids that are made discontinuous from the city due to this trimming are also dropped. As a background map, we use the aerial image of Kyoto from *chiriin chizu* (https://cyberjapandata.gsi.go.jp/), Geospatial Information Authority of Japan. As an aerial photograph from 1912 is unavailable, we use the contemporary one for both 1912 and 2018, and overlay the data for these two different years over the same aerial photograph.



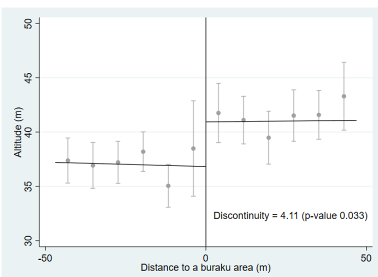
(a) Distance to the nearest station in 1912



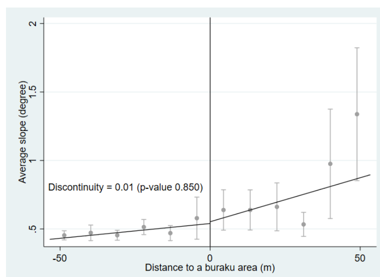
(b) Distance to the CBD in 1912



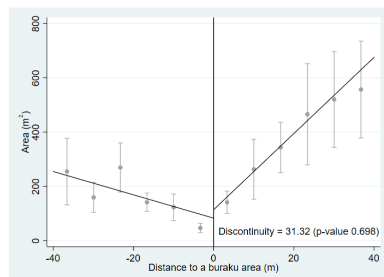
(c) Distance to a river in 1912



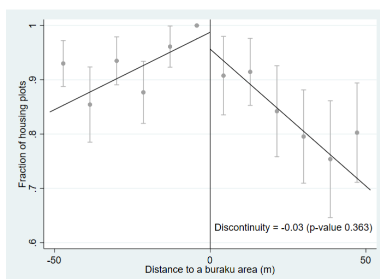
(d) Altitudes in 1912



(e) Slope (ruggedness) in 1912



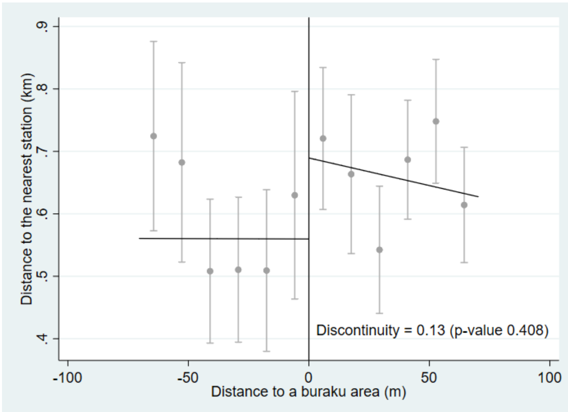
(f) Area (plot size) in 1912



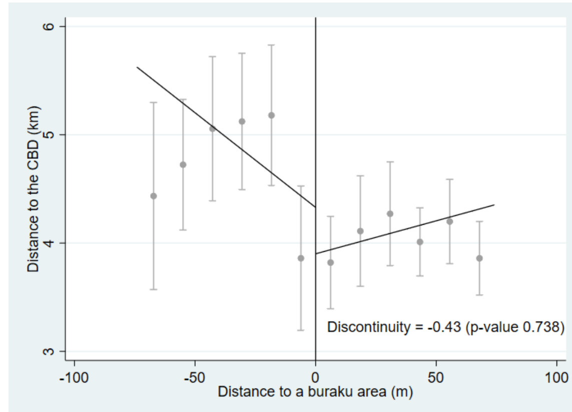
(g) Share of housing plots in 1912

Figure A4: Discontinuity of characteristics around the buraku border (1912) (See Figure A5 for the detailed caption)

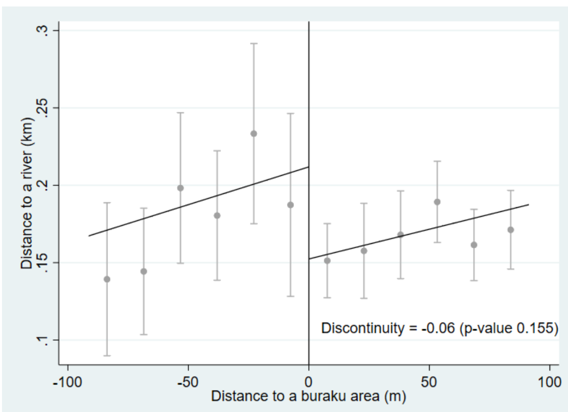
Note: We show the discontinuity of characteristics at the buraku border in 1912. On each side of the border, we fit the local linear equation using the triangular kernel. We also plot the mean and 95% confidence interval for observations in a bin. The bandwidth is selected using the MSE-optimal criterion and we use the bias-corrected standard error to calculate p-values (Cattaneo et al. 2019).



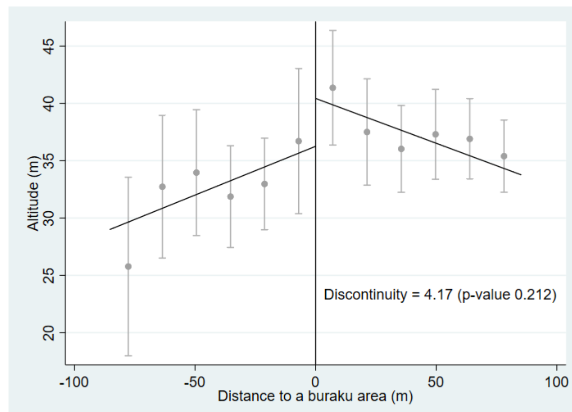
(a) Distance to the nearest station in 2018



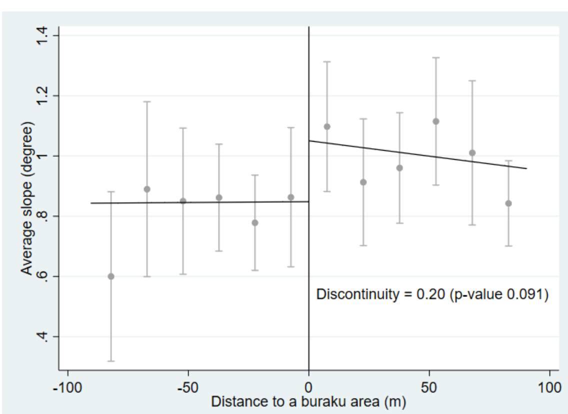
(b) Distance to the CBD in 2018



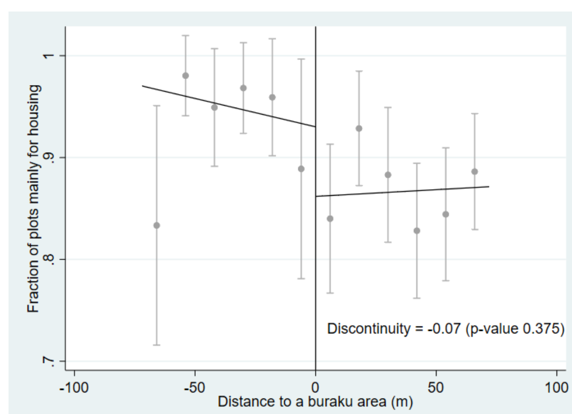
(c) Distance to a river in 2018



(d) Altitudes in 2018



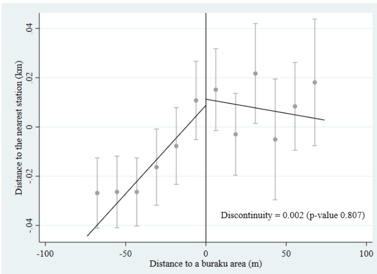
(e) Slope (ruggedness) in 2018



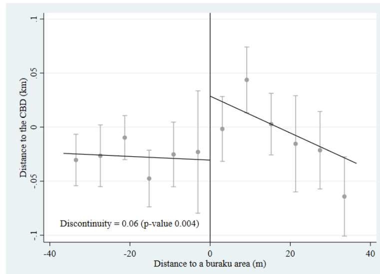
(f) Share of housing plots in 2018

Figure A5: Discontinuity of characteristics around the buraku border (2018).

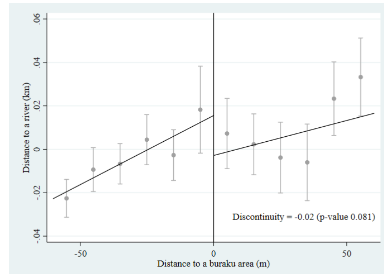
Note: We show the discontinuity of characteristics at the buraku border in 2018. On each side of the border, we fit the local linear equation using the triangular kernel. We also plot the mean and 95% confidence interval for observations in a bin. The bandwidth is selected using the MSE-optimal criterion and we use the bias-corrected standard error to calculate p-values (Cattaneo et al. 2019).



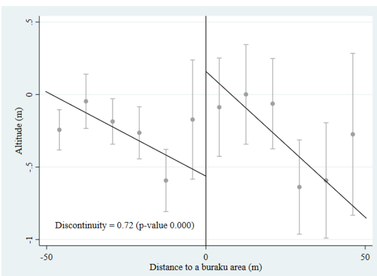
(a) Distance to the nearest station in 1912



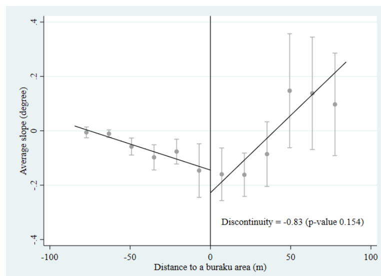
(b) Distance to the CBD in 1912



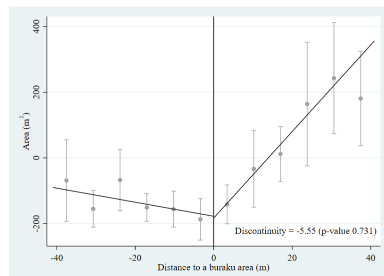
(c) Distance to a river in 1912



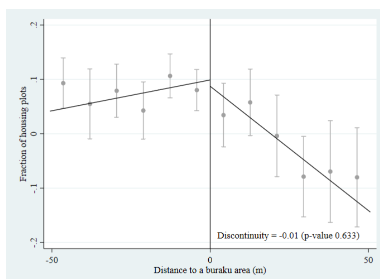
(d) Altitudes in 1912



(e) Slope (ruggedness) in 1912



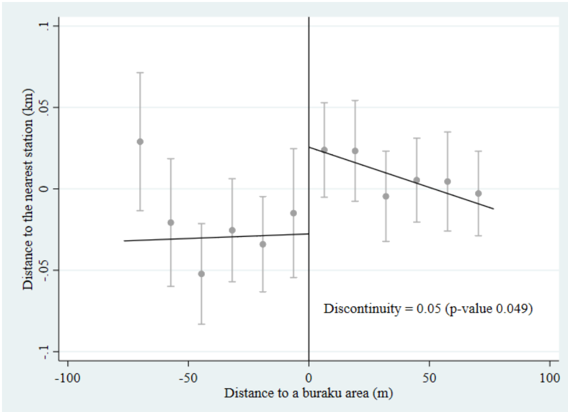
(f) Area (plot size) in 1912



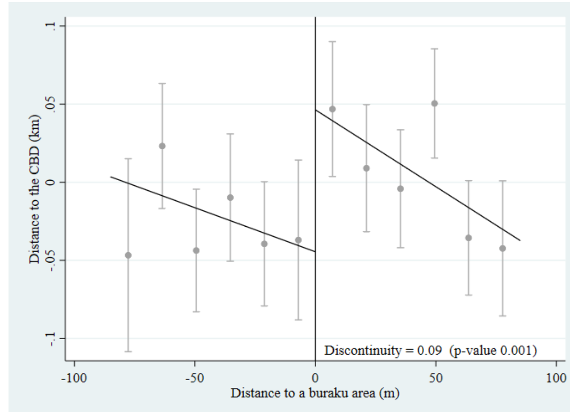
(g) Share of housing plots in 1912

Figure A6: Discontinuity of characteristics around the buraku border (1912) after including buraku fixed effects

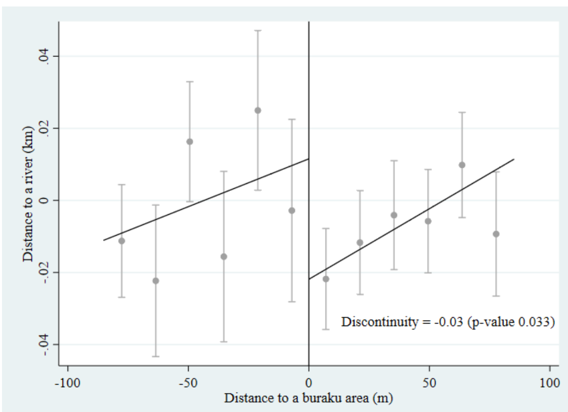
Note: We show the discontinuity of characteristics at the buraku border in 1912. On each side of the border, we fit the local linear equation using the triangular kernel. We also plot the mean and 95% confidence interval for observations in a bin. The bandwidth is selected using the MSE-optimal criterion and we use the bias-corrected standard error to calculate p-values (Cattaneo et al. 2019). To construct the outcome variable, we first regress log land prices on the dummy variables of the nearest buraku area. We use the residual from this regression as the outcome variable.



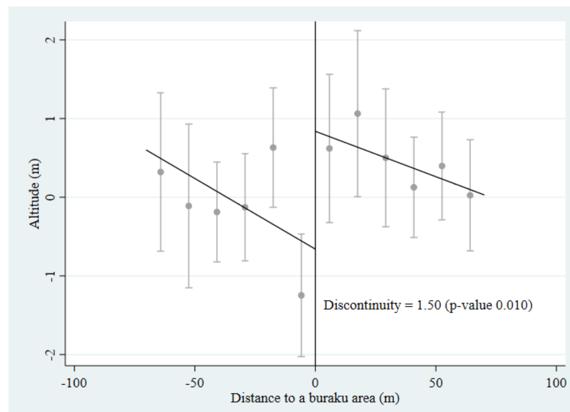
(a) Distance to the nearest station in 2018



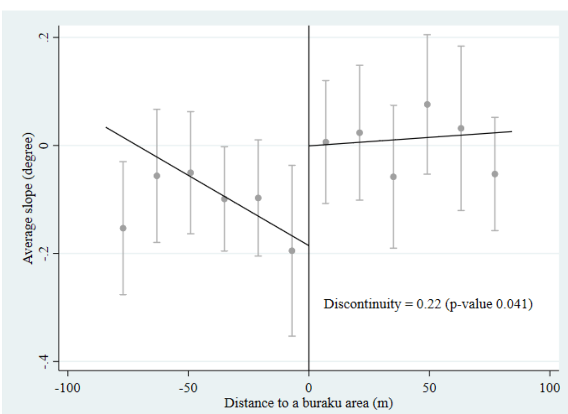
(b) Distance to the CBD in 2018



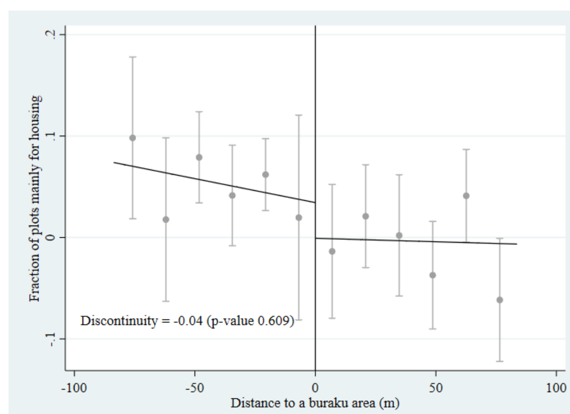
(c) Distance to a river in 2018



(d) Altitudes in 2018



(e) Slope (ruggedness) in 2018



(f) Share of housing plots in 2018

Figure A7: Discontinuity of characteristics around the buraku border (2018) after including buraku fixed effects

Note: We show the discontinuity of characteristics at the buraku border in 2018. On each side of the border, we fit the local linear equation using the triangular kernel. We also plot the mean and 95% confidence interval for observations in a bin. The bandwidth is selected using the MSE-optimal criterion and we use the bias-corrected standard error to calculate p-values (Cattaneo et al. 2019). To construct the outcome variable, we first regress log land prices on the dummy variables of the nearest buraku area. We use the residual from this regression as the outcome variable.

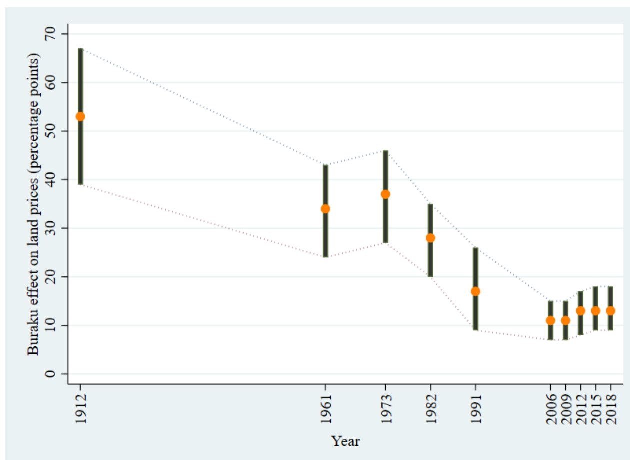


Figure A8: Time series of the land price discount of buraku areas after controlling for buraku-name fixed effects

Note: The orange dots represent the point estimates of the buraku price penalty (50m comparison) in the border design with the linear specification of the buraku dummy (Column 3 of Table 1 for 1912 and Column 6 for 2018). Estimates for 1961–2015 are obtained in the same way (regression tables are omitted). The vertical bars represent the corresponding 95% confidence intervals. All numbers are rounded to the nearest integers. Unlike Figure 2, this controls for the buraku-name fixed effects, where each land plot is assigned to the name of the nearest buraku area.

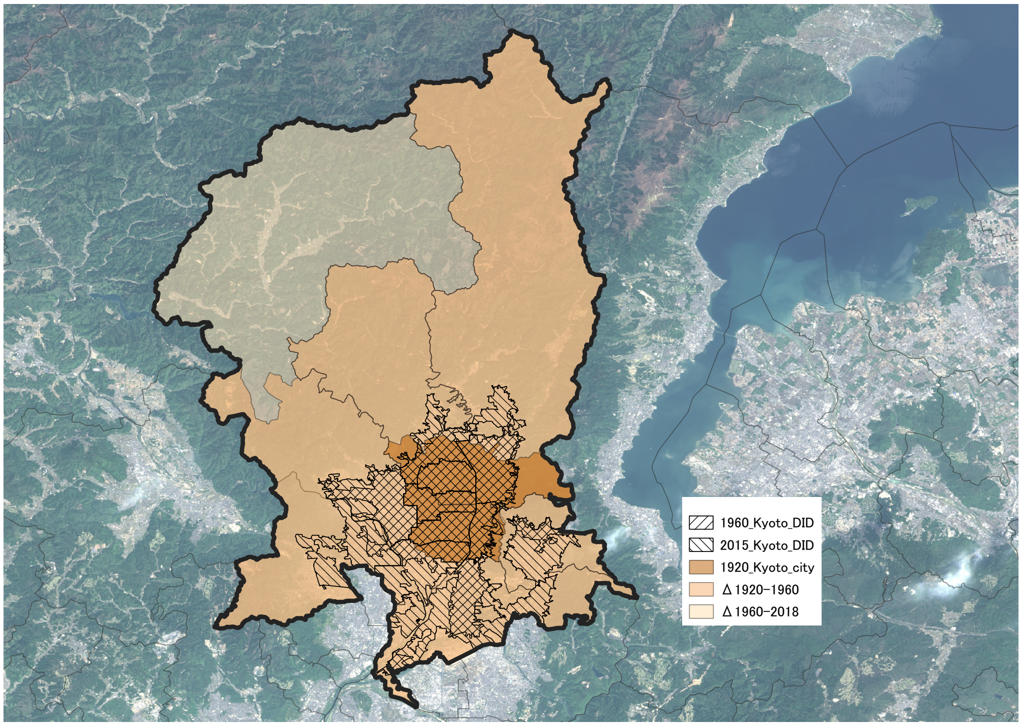
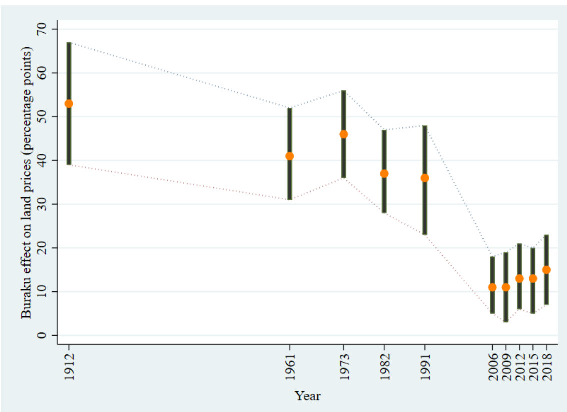
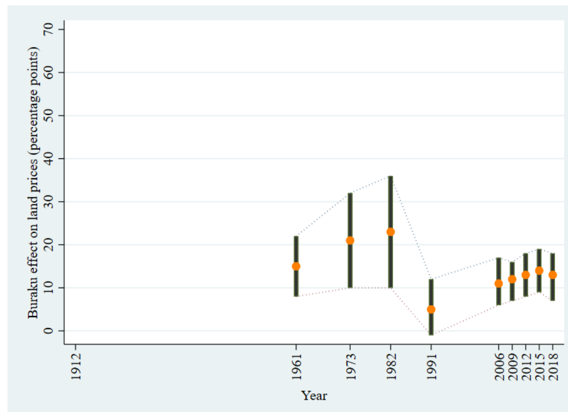


Figure A9: Expansion of Kyoto

Note: The current Kyoto city is depicted as the inner area of the black bald line. The deep orange area is Kyoto city in 1920. The orange and thin orange areas represent the expansion of the Kyoto city from 1920 to 1960 and from 1960 to 2018, respectively. The areas shaded by slashes and backslashes describe the DID areas in 1960 and 2015, respectively. Data on the transition of Kyoto city areas and DID areas are obtained from the National Land Information, National Spatial Planning and Regional Policy Bureau, MLIT of Japan (https://nlftp.mlit.go.jp/ksj/gml/datalist/KsjTmplt-N03-v2_2.html, January 30, 2024, last accessed, and https://nlftp.mlit.go.jp/ksj/gml/datalist/KsjTmplt-A16-v2_3.html, February 1, 2024, last accessed).



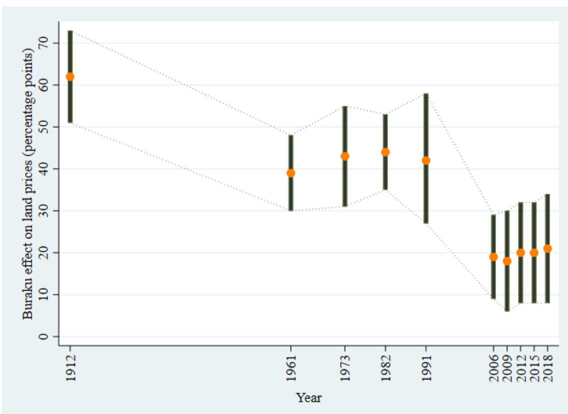
(a) Buraku areas covered by 1912 data



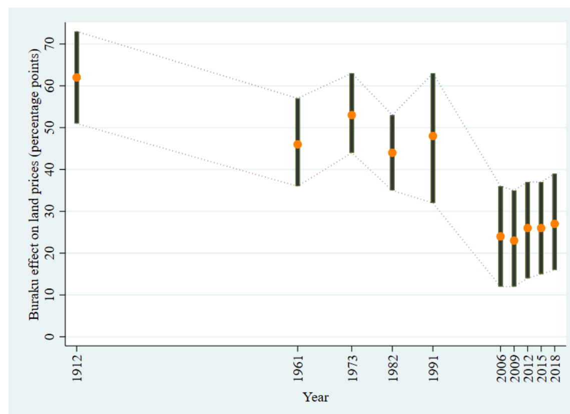
(b) Buraku areas not covered by 1912 data

Figure A10: Time series of land price discount in old and new buraku areas

Note: The orange dots represent the point estimates of the buraku price penalty from the border design with control variables. The buraku price penalty is from our preferred specification of the 50m comparison between the inside and outside buraku areas. The vertical bars represent the corresponding 95% confidence intervals. All numbers are rounded to the nearest integers. The figures are constructed in the same way as Figure 2. However, Figure A10a focuses on five buraku areas present in our 1912 data throughout 1912 and 2018, Figure A10b focuses on buraku areas not covered in our 1912 data. This series starts from 1961 as the land price discount estimate in 1912 is, by definition, unavailable for these buraku areas.



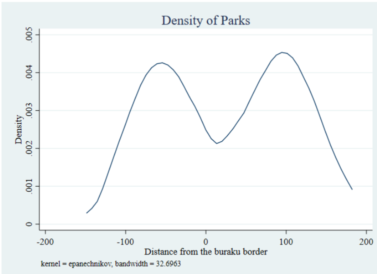
(a) Alternative data source on buraku areas (*furyo jyutaku*)



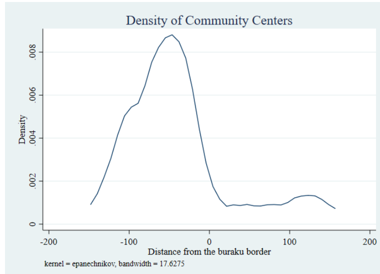
(b) Alternative data source on buraku areas (*furyo jyutaku*, five buraku areas in the 1912 data)

Figure A11: Time series of land price discount in buraku areas (alternative definitions of buraku areas)

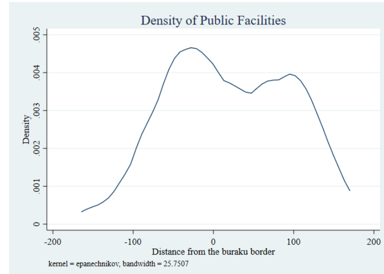
Note: The orange dots represent the point estimates of the buraku price penalty from the border design with control variables. The buraku price penalty is from our preferred specification of the 50m comparison between the inside and outside buraku areas. The vertical bars represent the corresponding 95% confidence intervals. All numbers are rounded to the nearest integers. The figures are constructed in the same way as Figure 2, but uses an alternative definition of buraku areas by Kyoto City Government (1929).



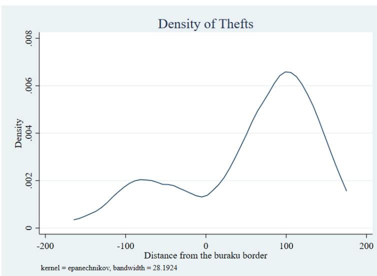
(a) Density of parks (2018)



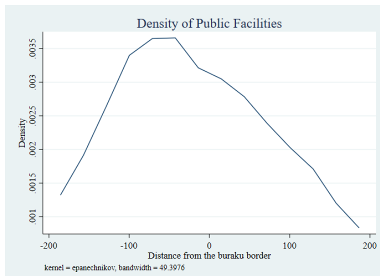
(b) Density of community centers (2018)



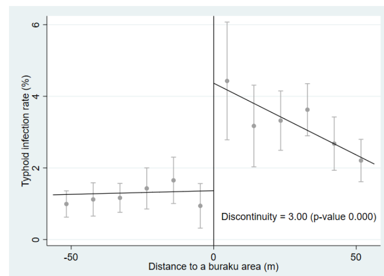
(c) Density of public facilities (2018)



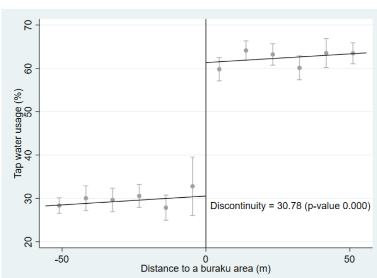
(d) Density of thefts (2021)



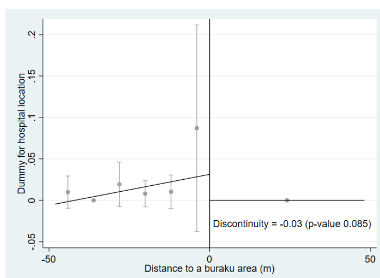
(e) Density of public facilities (1912)



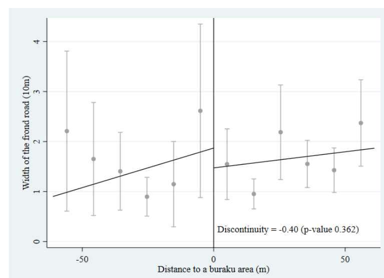
(f) Infection rate of typhoid in 1912



(g) Share of tap water usage in 1912



(h) The presence of hospitals in 1912



(i) Road width in 2018

Figure A12: Distribution of public goods around buraku borders

Note: Figure A12a plots the density of parks in 2018, Figure A12b plots the density of community centers in 2018, Figure A12c plots the density of public facilities in 2018, and Figure A12e shows the density of public facilities in 1912. We use the Epanechnikov kernel with Silverman's rule-of-thumb bandwidth selection. In Figures A12f–A12h, we show the discontinuity of the infection rate of typhoid, share of tap water usage, and the presence of hospitals at the buraku border in Kyoto in the early 1920's. Figure A12i investigates the width of the frond road of each land plot in 2018. On each side of the border, we fit the local linear equation using the triangular kernel. We also plot the mean and 95% confidence interval for observations in a bin. The bandwidth is selected by the MSE-optimal criterion and we use the bias-corrected standard error to calculate p-values (Cattaneo et al. 2019)

Panel A: Buraku areas in 1912	Mean	SD	Min	Max	Observations
Land price per m^2 (in Japanese yen)	0.265	0.172	0.004	3.025	1358
Distance to the buraku border (m)	-63.466	41.228	-206.736	-2.579	1358
Plot size (m^2)	206.571	382.137	6.612	3587.113	1358
Distance to the CBD (km)	1.287	1.253	0.174	3.376	1358
Distance to the nearest river (km)	0.110	0.072	0.000	0.351	1358
Distance to the nearest train station (km)	0.473	0.481	0.039	1.680	1358
Altitude (m)	36.780	10.749	23.400	63.200	1358
Slope (ruggedness, degree)	0.450	0.223	0.200	1.900	1358
Currently used for housing (dummy)	0.903	0.296	0.000	1.000	1358

Panel B: Non-buraku areas in 1912	Mean	SD	Min	Max	Observations
Land price per m^2 (in Japanese yen)	1.134	1.383	0.002	8.470	58981
Distance to the buraku border (m)	1212.684	624.402	0.090	3161.686	58981
Plot size (m^2)	327.008	423.288	4.231	3599.013	58981
Distance to the CBD (km)	1.945	1.175	0.008	5.468	58981
Distance to the nearest river (km)	0.418	0.276	0.000	1.413	58981
Distance to the nearest train station (km)	0.442	0.410	0.001	3.330	58981
Altitude (m)	44.584	14.415	19.400	373.300	58981
Slope (ruggedness, degree)	0.962	1.600	0.100	24.800	58981
Currently used for housing (dummy)	0.857	0.350	0.000	1.000	58981

Panel C: Buraku areas in 2018	Mean	SD	Min	Max	Observations
Land price per m^2 (in 1,000 Japanese yen)	80785	34181	18000	203000	419
Distance to the buraku border (m)	-63.290	52.443	-260.632	-0.494	419
Distance to the CBD (km)	4.810	2.587	0.173	9.358	419
Distance to the nearest river (km)	0.175	0.183	0.001	0.818	419
Distance to the nearest train station (km)	0.646	0.494	0.001	1.977	419
Altitude (m)	29.693	18.878	10.800	114.300	419
Slope (ruggedness, degree)	0.732	0.775	0.100	5.500	419
Normal housing area (dummy)	0.938	0.242	0.000	1.000	419

Panel D: Non-buraku areas in 2018	Mean	SD	Min	Max	Observations
Land price per m^2 (in Japanese yen)	125326	141860	13700	3460000	38413
Distance to the buraku border (m)	1332.403	992.529	0.053	7501.827	38413
Distance to the CBD (km)	4.437	2.154	0.003	11.682	38413
Distance to the nearest river (km)	0.272	0.230	0.000	1.365	38413
Distance to the nearest train station (km)	0.706	0.593	0.000	3.700	38413
Altitude (m)	48.175	30.707	9.500	206.500	38413
Slope (ruggedness, degree)	1.919	2.889	0.000	28.600	38413
Normal housing area (dummy)	0.847	0.360	0.000	1.000	38413

Table A1: Summary statistics

	(1)	(2)	(3)	(4)	(5)	(6)
	1912 log land prices					
Buraku dummy	-0.9744***	-1.2387***	-0.8335***	-0.9824***	-1.1829***	-0.6849***
	(0.1384)	(0.1140)	(0.1431)	(0.1896)	(0.1703)	(0.2416)
Lot size (m^2)		-0.7399***	-0.1302		-0.7057***	-0.2293
		(0.0840)	(0.3141)		(0.0830)	(0.2944)
Lot size squared		0.2021***	-0.0848		0.1937***	-0.0032
		(0.0703)	(0.2581)		(0.0688)	(0.2439)
Lot size cubed		-0.0125	0.0392		-0.0103	0.0231
		(0.0155)	(0.0545)		(0.0151)	(0.0517)
Distance to the city center (km)		-1.0966***	-0.8073*		-1.1155***	-0.8485**
		(0.0866)	(0.4733)		(0.0864)	(0.4306)
Distance to the city center squared		0.1439***	0.1639		0.2064***	0.1278
		(0.0293)	(0.2063)		(0.0302)	(0.2068)
Distance to rivers (km)		-0.0408	-0.4825		0.0250	-0.1508
		(0.2132)	(1.2172)		(0.2065)	(1.1870)
Distance to rivers squared		0.1648	-0.2130		-0.0183	-1.5045
		(0.1982)	(3.4605)		(0.1969)	(3.4278)
Distance to stations (km)		-0.4754***	0.3614		-0.2994**	0.5190
		(0.1228)	(0.5724)		(0.1256)	(0.5412)
Distance to stations squared		0.2274***	-0.2929		0.0952*	-0.2965
		(0.0553)	(0.4325)		(0.0562)	(0.4028)
Altitude (m)		-0.0014	0.1684		-0.0188***	0.1681
		(0.0065)	(0.1397)		(0.0067)	(0.1333)
Altitude squared		0.0000	-0.0008		0.0000*	-0.0009
		(0.0000)	(0.0012)		(0.0000)	(0.0011)
Slope (degree)		-0.2644	-1.9971*		-0.5987**	-2.0893**
		(0.3088)	(1.0715)		(0.2933)	(0.9700)
Slope squared		0.0551	1.4261		0.2514*	1.4752*
		(0.1457)	(0.9123)		(0.1350)	(0.8283)
Latitude		2.4118*	-16.2974		2.3732*	-18.4831
		(1.3199)	(13.6062)		(1.2906)	(12.7116)
Longitude		1.3209***	3.1277*		1.4570***	2.4738
		(0.3466)	(1.8568)		(0.3283)	(1.7799)
Latitude squared		-0.0935***	-0.2105*		-0.1328***	-0.1928*
		(0.0214)	(0.1158)		(0.0216)	(0.1098)
Longitude squared		-0.0009***	-0.0021*		-0.0009***	-0.0017
		(0.0002)	(0.0012)		(0.0002)	(0.0012)
Latitude × Longitude		-0.0027	0.0212		-0.0026	0.0241
		(0.0017)	(0.0176)		(0.0017)	(0.0165)
Distance to buraku (m)				0.0000	0.0004***	0.0033*
				(0.0001)	(0.0000)	(0.0019)
Distance to buraku (m)× Buraku dummy				-0.0005	-0.0036***	-0.0052***
				(0.0022)	(0.0013)	(0.0019)
Constant	-0.0000	0.0000	0.0000	-0.0000	0.0000	0.0000
	(0.0416)	(0.0173)	(0.0478)	(0.0416)	(0.0169)	(0.0423)
Sample	Full	Full	Border	Full	Full	Border
Specification of buraku disamenity D_n	Dummy	Dummy	Dummy	Linear	Linear	Linear
N	60339	60339	2885	60339	60339	2885
R^2	0.012	0.734	0.724	0.012	0.743	0.733

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A2: 1912 full regression result

	(1)	(2)	(3)	(4)	(5)	(6)
	2018 log land prices					
Buraku dummy	-0.3570***	-0.2066***	-0.1665***	-0.3573***	-0.2269***	-0.0989**
	(0.0441)	(0.0338)	(0.0297)	(0.0573)	(0.0447)	(0.0451)
Distance to stations (km)		-0.2218***	-0.0810		-0.2402***	-0.0931
		(0.0208)	(0.1131)		(0.0210)	(0.1136)
Distance to stations squared		0.0512***	-0.0690		0.0571***	-0.0599
		(0.0079)	(0.0714)		(0.0079)	(0.0723)
Distance to the city center (km)		-0.0051	0.0489		-0.0075	0.0507
		(0.0102)	(0.0340)		(0.0101)	(0.0335)
Distance to the city center squared		-0.0386***	-0.0109		-0.0383***	-0.0103
		(0.0022)	(0.0082)		(0.0021)	(0.0081)
Distance to rivers (km)		0.2196***	0.1680		0.2329***	0.1166
		(0.0514)	(0.2374)		(0.0519)	(0.2399)
Distance to rivers squared		-0.0775	-0.8114**		-0.0740	-0.7374**
		(0.0604)	(0.3507)		(0.0615)	(0.3539)
Altitude (m)		0.6625***	0.4651		0.6218***	0.4029
		(0.0735)	(0.5975)		(0.0716)	(0.5924)
Altitude squared		-0.5499***	-0.2165		-0.5135***	-0.1603
		(0.0360)	(0.3816)		(0.0347)	(0.3736)
Slope (degree)		-0.4400***	-0.0566		-0.4278***	-0.1110
		(0.0410)	(0.4443)		(0.0398)	(0.4492)
Slope squared		0.1372***	0.0760		0.1335***	0.1142
		(0.0237)	(0.4754)		(0.0229)	(0.4850)
Latitude		0.4652***	0.2477		0.4183***	0.2361
		(0.0452)	(0.2082)		(0.0445)	(0.2081)
Longitude		-0.4475***	-0.0776		-0.4604***	-0.0704
		(0.0307)	(0.0944)		(0.0305)	(0.0942)
Latitude squared		0.0364***	0.0080		0.0373***	0.0072
		(0.0024)	(0.0092)		(0.0024)	(0.0091)
Longitude squared		0.0003***	0.0000		0.0003***	0.0000
		(0.0000)	(0.0001)		(0.0000)	(0.0001)
Latitude × Longitude		-0.0005***	-0.0002		-0.0004***	-0.0002
		(0.0001)	(0.0003)		(0.0001)	(0.0003)
Distance to buraku (m)				-0.0001***	-0.0000***	0.0007**
				(0.0000)	(0.0000)	(0.0003)
Distance to buraku (m)× Buraku dummy				0.0023***	0.0005	-0.0003
				(0.0005)	(0.0005)	(0.0010)
Constant	-0.0000	-0.0000	0.0000	-0.0000	-0.0000	0.0000
	(0.0077)	(0.0042)	(0.0132)	(0.0075)	(0.0042)	(0.0131)
Sample	Full	Full	Border	Full	Full	Border
Specification of buraku disamenity D_n	Dummy	Dummy	Dummy	Linear	Linear	Linear
N	38832	38832	1892	38832	38832	1892
R^2	0.005	0.559	0.538	0.048	0.562	0.541

Standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A3: 2018 full regression result

	1912	2018
Right across the border (dummy specification)	60.70 (S.E. 5.81)	25.66 (S.E.3.48)
Right across the border (linear specification)	48.46 (S.E. 10.96)	8.61 (S.E. 5.62)
25m comparison (linear specification)	52.57 (S.E. 7.92)	14.99 (S.E. 3.85)
50m comparison (linear specification)	56.35 (S.E. 6.33)	20.92 (S.E. 3.31)
100m comparison (linear specification)	63.03 (S.E. 7.29)	31.57 (S.E. 5.04)

Table A4: Buraku land price penalty when no control variable is included

	No buraku-name dummy	With buraku-name dummies
Distance o the nearest station (km)	0.08	0.002
Distance to the CBD (km)	0.41	0.06
Distance to a river (km)	-0.01	-0.02
Altitudes (m)	4.11	0.72
Slope (degree)	0.01	-0.83
Area (plot size, m^2)	31.32	-5.55
Share of housing plots	-0.03	-0.01

Table A5: Discontinuity of characteristics around the buraku border (1912)

	No buraku-name dummy	With buraku-name dummies
Distance to the nearest station (km)	0.13	0.05
Distance to the CBD (km)	-0.43	0.09
Distance to a river (km)	-0.06	-0.03
Altitudes (m)	4.17	1.50
Slope (degree)	0.20	0.22
Share of housing plots	-0.07	-0.04

Table A6: Discontinuity of characteristics around the buraku border (2018)

Regression Specification	Land price penalty (in percentage)
Controlling for Urban health amenities in 1912	70.60
	(11.04)
Poor non-buraku areas in 1912	16.38
	(4.65)
Poor non-buraku areas in 1961	10.74
	(2.04)
Controlling for School districts in 2018	12.65
	(2.30)
Controlling for Road width (FAR regulation) in 2018	12.32
	(2.62)

Table A7: Additional regression results for Appendix I

Note: The table summarizes the regression results in Appendix I, which are variants of our main regression in Table 1. In the "urban health amenities" specification, we additionally control for the quadratic of the infection rate of typhoid and share of tap water usage, and dummies of the hospital location and zero incidence of typhoid besides our main 1912 specification in Table 1. In the "poor non-buraku areas" specification, we estimate the land price penalty of poor non-buraku areas in 1912 using the same specification as Table 1 for buraku areas. In the "school districts" specification, we additionally control for school district dummies of public primary and junior high schools to the main 2018 specification in Table 1. In the "road width (FAR regulation)" specification, we additionally control for the width of the front road of each land plot on top of the main 2018 specification in Table 1. To flexibly capture the regulation schedule, we allow the coefficients of the road width to be different in ranges [0, 4], [4, 12], and [12, ∞) by including interaction terms and we also include dummy variables for roads narrower than 4m and wider than 12m. Throughout, the regression numbers are taken from the 50m comparison inside and outside the buraku borders in the border design. Conley's standard errors in parentheses.