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Property Tax and Land Use: Evidence from the 1990s reforms in Japan

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Property Tax and Land Use:

Evidence from the 1990s reforms in Japan♦

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Abstract

This paper examines the effects of property tax reforms at the beginning of the 1990s in Japan through theoretical and empirical investigation. Preferential treatment of farmland in the center of cities and inner suburbs is not favorable because it may hinder changing such land into residential areas and henceforth deter urbanization. We utilize a natural experiment provided by the aforementioned reforms. The results reveal that the proportion of farmland that might have impeded urbanization decreased after the reforms in major cities within metropolitan areas. However, landlords did not necessarily replace all of the land with housing lots, suggesting that the government should have conducted the reforms in a way to promote more conversion.

Key words: Property tax, Preferential treatment on farmland, Urbanization

JEL Classification: H22, H71, R52, R58

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1. Introduction

Public finance economists have reiterated that property tax on land is neutral with respect to resource allocation. However, the reality is that the tax rate differs depending on land use, which may affect landowners' decisions. A typical example is the preferential treatment of farmland. As summarized in Bird and Slack (2004), many countries around the globe apply a wide variety of treatments with regard to farmland.[1] Furthermore, all 50 states in the U.S. adopt some form of use-value assessment for farmland, which is generally lower than its real, fair market value and henceforth treats agricultural land preferentially.[2] Indeed, farmland conservation can be justified from various angles: local and national food security, employment in the agricultural industry, the efficient development of urban and rural land, and the protection of rural and environmental amenities (Lynch 2003). As stated in Brueckner (2011), if urban sprawl generates economic inefficiencies (such as traffic congestion and air pollution), preferential treatment of farmland reins in excessive urban expansion to the suburbs, which solves the inefficiencies. In this sense, preferential treatment of farmland in the urban fringe may be justified.

However, such preferential treatments sometimes generate another type of economic inefficiency.

[1] Bird and Slack (2004) raise four policies as preferential treatments: (1) lower assessments, (2) exemptions for part or all of the farm property, (3) lower tax rates on farms, and (4) farm tax rebates.
[2] For example, as shown in Wassmer (2009), the California Land Conservation Act of 1965 (the Williamson Act) allows landowners to receive property tax assessments – which are much lower than normal for a ten-year renewable term – if they agree to keep their land in agricultural production or open space.

Suppose that preferential treatment is given to farmland in the center of cities and inner suburbs (or metropolitan areas); landlords may have an incentive to keep their farmland as it is, and may be reluctant to convert it to another use. This impedes urbanization, which is not favorable because it gives rise to other kinds of economic inefficiencies. Indeed, Bruce (2000) mentions that keeping farmland in metropolitan areas is not beneficial because the higher value of alternative uses (e.g., housing lots or office buildings) is lost. Bruce (2000) discusses this by referring to Japan, as follows.

> Foreign visitors to Tokyo, Japan, are surprised to see farmers tending crops of broccoli and radishes amid high-rise office and apartment buildings … these are possibly the most expensive fruits and vegetables in the world. (Bruce 2000)

Following this, Bruce (2000) implies that keeping farmland in metropolitan areas is not advantageous. If this is the case, the government should rescind such preferential treatment of farmland, which will urge owners to change it, henceforth promoting urbanization. In this regard, it is worthwhile to investigate the relationship between the repeal of preferential property tax treatment (which hampers urbanization in the center of cities and inner suburbs) and its effects on land use. Despite the importance of this matter, the effects of amendments to such preferential property tax treatment on land use in metropolitan areas remain unexplored.

The purpose of this study is to examine the effects of a series of reforms with regard to preferential property tax treatment on land use in the early 1990s in Japan. To do so, we first construct a

theoretical model. Afterward, we perform difference-in-differences (DID) estimation before and after the reforms. Japan's property tax system has favorable practical characteristics to address this issue. First, the government gave preferential treatment to farmland owners, even in metropolitan cities, which led to the circumstances illustrated by Bruce (2000). Indeed, many major cities in the three metropolitan areas (Tokyo, Chubu, and Kansai) boast that they are eager to preserve farmland.[3] Second, as part of efforts to enhance the housing supply and foster urbanization, the Japanese government undertook fundamental reforms of preferential property tax measures so that owners are induced to transform farmland into residential lots in metropolitan cities. One is that the long-term agricultural operation system – which let many landlords keep their farmland as it was for ten years in designated cities within the three metropolitan areas (hereafter referred to as the designated cities)[4] – was revoked at the end of Fiscal Year (FY) 1991 (March 1992). This system was criticized because under its conditions, farmland to be converted into housing lots in the designated cities remained in agricultural use, which may have obstructed urbanization. In other words, the repeal aimed to convert farmland that might curb urbanization into another use. Another reform is the amendment of the Production Green Land (PGL) Law in September 1991. Under the revised PGL

[3] For example, a great portion of farmland is preserved – even in the center and inner suburbs of Tokyo. What is more, the city of Yokohama, one of the most famous and largest urban hubs, is also proud of its agriculture. For more details, please visit https://www.japanfs.org/en/news/archives/news_id035384.html.

[4] This wording follows Ishi (1991). The designated cities in the three metropolitan areas include: (1) ones designated by the government ordinance, whose population is over 500,000 (e.g., Osaka, Nagoya, and Yokohama); (2) those classified as existing urbanized areas by the National Capital Region Development Act; and (3) those earmarked for suburban development by the same act.

Law, farmland owners in the designated cities receive preferential treatment as long as they maintain the land as PGL, whereas they are not allowed to convert farmland to other uses for 30 years.[5] In this regard, farmland owners in the designated cities face stricter rules – as pointed out by Terai (2001) – which are expected to influence them to change farmland that might prevent urbanization into housing lots. From these perspectives, Japan is a quintessential case to address our issue.

To estimate the model using DID, we set the designated cities as the treatment group; we assumed the rest of cities to be the control group. Since the string of reforms targeted a group of the designated cities, it is quite natural for us to examine the reforms' causal effects by assuming the rest of the cities to be the control group.

Using the three periods theoretical model, over which land prices statistically evolve, we establish the hypotheses, as follows: (1) Property tax reforms decrease the amount of farmland that might disrupt urbanization (i.e., land to be converted into housing lots). However, (2) the effects of these reforms on the supply of housing lots are ambiguous, owing to the amendment of the PGL Law.

Our empirical results using the data before and after the reforms substantiate the hypotheses. First, the share of farmland that might hinder urbanization declined in the designated cities after the reforms of the 1990s. This is supported by DID estimation, as well as the observations of the data. Second, DID estimation did not report statistically significant results on the housing supply after the

[5] Regarding PGL, please also visit: https://unu.edu/publications/articles/japan-s-urban-agriculture-what-does-the-future-hold.html.

reforms. When it comes to the effects on farmland that might deter urbanization, the outcomes remain the same, even if we add other independent variables to check the robustness of our results.

To estimate the model, we use municipality level data. Another possibility is using data consisting of individual landlords. However, when we wish to examine landlords' behavior before and after the reforms, there are no household level data available in Japan.[6] Therefore, as a first approximation, we use municipality level data.

This paper contributes to the literature on preferential property tax treatment. A number of studies have addressed this issue: Brueckner and Kim (2003), Lynch (2003), Song and Zenou (2006, 2009), Anderson et al. (2015), Wassmer (2016), and Yagi and Garrod (2018). These studies focus on how preferential property tax treatment of farmland is useful to solve deficiencies of farmland resources and urban sprawl, and thus addresses the rationale for such treatment. However, little research has explored preferential treatment of farmland that impedes the supply of housing lots in metropolitan areas, thereby thwarting urbanization, which may undermine the efficiency of land use. In this regard, we provide new insights into preferential treatment regarding property taxes on land.

Furthermore, our research is also related to the literature on the effects of property tax reforms, using natural or quasi-experimental approaches such as the reforms' effects on fiscal competition

[6] The Survey of Housing and Land offers information about land use based on questionnaires given to individual households. However, this survey is conducted every five years, which makes it difficult for us to examine the effects before and after the reforms in terms of exact timing. Although Japan's Geospatial Information Authority gives us detailed data on land use, we cannot identify the difference between farmland that should be converted into housing lots and other types; this is crucial to our analysis.

(Lyytikäinen 2012, Skidmore et al. 2012), their impact on the real estate market (Dachis et al. 2012), the influence on housing investments (Löffler & Siegloch 2015, Lutz 2015, Gemmnell et al. 2017), and issues of tax collection (Stine 2003, Ross & Yan 2013). However, nobody has explored the reforms with respect to the preferential treatment of land use. Henceforth, we differentiate ourselves by utilizing a natural experiment provided by the series of 1990s reforms in Japan.

The rest of this paper is organized as follows. Section 2 explains the institutional background of Japan's property tax system. Section 3 presents our theoretical framework. Section 4 explains the data and discusses the assumptions to validate our DID estimation. Section 5 reports the empirical framework and results. Section 6.

2. Institutional background

2.1. Japan's property tax system

In Japan, unlike some developed countries, property tax is a principal item, especially for municipalities.[7] Figures 1 and 2 depict the shares of the tax revenue of local governments (the sum of prefectures and municipalities), as well as of municipalities. Property tax shares comprise about 20% of total tax revenue in Japan's local governments. Furthermore, when it comes to municipalities, the fraction amounts to 42%, suggesting that municipalities count on property

[7] According to the *Economist* (2018), property taxes have comprised approximately 6% of total government revenues in wealthy nations.

taxation substantially.

Table 1 outlines Japan's property tax system. Municipalities have the authority to impose property taxes, except for 23 special wards in Tokyo, where the metropolitan government is engaged in property tax administration. Property taxes cover land, houses, buildings, and depreciable business assets (tangible assets except for land and buildings). The statutory tax rate is set as 1.4%; there is little room for municipalities to change it. The upper limit is 2.1%. On top of that, not many local governments set the tax rate above 1.4%.

Property tax is levied annually based on the assessment value of the aforementioned three taxable assets. Each municipality assesses the value of taxable assets based on a unified formula set by the Ministry of Internal Affairs and Communications (hereafter referred to as MIAC). The assessed value of land is determined by considering the return on each item.

Figure 3 depicts the timing of property tax assessment and levies. As shown in the figure, tax liability is determined by ownership of the assets, based on the value as of January. This record becomes the basis for tax collection over the next fiscal year (from April to the following March).

2.2. Preferential treatment of farmland and the 1990s reforms

In principle, farmland in Japan is taxed much more lightly than housing lots. Concretely, the taxable value of farmland turns out to be lower than that of housing lots. This is defined as "preferential treatment of farmland."

However, there is one exception: Farmland of urbanization promotion areas (UPAs) in the designated cities should be taxed at the same rate as housing lots. The current City Planning Law (CPL), enacted in 1968, regards UPAs as urban zones where existing farmland should, in principle, be converted to housing use from the viewpoint of urban planning.[8] In this regard, UPA farmland in the designated cities can be defined as land "to be changed into housing lots."

Meanwhile, in the designated cities, not all UPA farmland has been transformed into residential use, which may give rise to the inefficiency of land use. The long-term agricultural operation system was enacted from FY 1982 to FY 1991, whereby the tax burden was mitigated if farmers operated large tracts of land over a period of ten years. As indicated by Ishi (1991), such lenient treatment of farmland in major cities occurred owing to farmers' special interests. In a practical manner, many farmland owners took advantage of this system and escaped a higher tax burden by "disguising" their property as farmland. Whereas the CPL aims to promote urbanization, the long-term agricultural operation system contradicts its objective because the system prevented landlords from converting the land into another use. In this regard, it is fair to say that UPA farmland in the designated cities may have prevented urbanization.

On the other hand, as addressed by Terai (2001) and Kabeya and Itaba (2009), two reforms were simultaneously executed in the designated cities in order not merely to decrease the proportion of

[8] For more details, please see Ishi (1991) and Ito (1994).

"disguised" farmland, but also to spur the development of housing lots there. The first reform repealed the long-term agricultural operation system at the end of FY 1991 (March 1992). Subsequently, the PGL Law was rectified in September 1991. Under the amended PGL Law, UPA landlords whose farmland area is 500 m^2 or greater in the designated cities face two options: (1) Convert farmland into housing lots; or (2) Preserve it as PGL. Provided that landlords maintain their land as PGL for 30 years, their tax burden is lowered because PGL is preferentially treated based on the same criteria as ordinary farmland.

In the meantime, an inheritance tax is also levied on land. The string of reforms in the early 1990s included one that changed the inheritance tax, whereby the tax burden is abated if landlords preserve land as PGL for 30 years. Here, the motivation behind holding farmland may be divided into twofold: (1) bequest and (2) option. Needless to say, the inheritance tax is related to the motivation as a bequest, whereas property tax affects whether landlords sell it in the future. In the present paper, we consider the effects of the inheritance tax to not be substantial, and thus focus on the property tax. There are three reasons. First, whereas the inheritance tax applies to landlords with heirs, the property tax is levied regardless of succession as long as landlords possess assets. Second, when it comes to the Japanese system, the basic deduction is set at 30 million yen (or approximately 300,000 USD) plus 6 million yen (60,000 USD) multiplied by the number of statutory heirs. Indeed, the share of inheritance cases subject to the inheritance tax (=the annual number of decedents subject to the

inheritance tax/annual number of deaths) has been less than 10% over the past three decades.[9] Finally, provided that life expectancy is uncertain, people do not necessarily factor in the long term. If this is the case, the assumption that landlords keep the land as PGL for 30 years as a bequest is not plausible.[10]

Figure 4 depicts the classification of farmland and the property tax burden in Japan before and after the two reforms in the 1990s. After the reforms, farmland was divided into two categories: (1) ordinary farmland and (2) UPA farmland. As stated earlier, the assessment of farmland is lower than that of a housing lot; thus, the tax burden on farmland is reduced. However, when it comes to UPA farmland, owners in non-designated cities also receive such preferential treatment. However, UPA farmland owners in the designated cities only benefit if they keep farmland as it is for 30 years. In this sense, the two reforms of the 1990s caused farmland owners in major cities to abide by stricter rules.

3. Theoretical foundation

We begin with developing a theoretical illustration of how preferential tax treatment of PGL influences land use. Land may be utilized for either residential or agricultural purposes. The model

[9] For these points, please visit: https://www.mof.go.jp/english/tax_policy/tax_system/asset/index.html#a01
[10] What is more, Horioka (2002) indicates that the selfish lifecycle model is rather applicable to Japan, which reinforces the argument that landlords do not maintain farmland as PGL for the purpose of inheritance.

contains three periods over which land prices stochastically evolve. Similarly, Anderson (1986) develops a dynamic model for the optimal timing of development (land improvement) with continuous time. However, the decision in his model is single dimensional (i.e., the timing of development), whereas the present model addresses different options of land holding, one of which is PGL. For example, consider farmland owners in the designated cites who decide when to sell their property. We assume that their decision is discrete for simplicity's sake, but the model can easily be extended to continuous choice, whereby landowners choose the size of land to sell. We also assume that they possess different prospects for future land prices and tax policies. Their expectations may be subjective rather than rational. Before the property tax reforms, we suppose that there is policy uncertainty during the second period regarding property taxes on farmland. Given that PGL is in place for 30 years, one period may refer to 10 years. Thus, it is plausible that landowners are not sure about future taxes. Hence, they may opt to sell land in the first period if they expect a higher property tax to be applied to their holding land afterward. The reform does not remove the uncertainty, but instead clarifies the tax treatment of UPA farmland. In the present context, PGL symbolizes government commitment to maintain preferential tax rates on farmland, and asks landlords to not sell their land during the first two periods. This corresponds to the institutional arrangement of the PGL, with the mandate of 30 years of cultivation, as mentioned earlier. In UPAs, landowners can choose not to receive preferential tax treatment, although they have to pay higher taxes according to the land value of residential use.

By doing so, they can exert their selling option before the last period. Thus, there is a tradeoff between favorable tax treatment and the option value of selling land.

Note that we focus on the representative landowner's selling decision, taken as the given price dynamics, thus abstracting the general equilibrium effect of property taxes on land prices. The model is close to the optimal timing of a job search. In this regard, the present model deviates from previous literature such as Brueckner (2001) and Brueckner and Kim (2003), which are based on spatial settings. They consider how property taxes on building improvements affect supply and demand for housing, which in turn alters population density and thus urban sprawl. Higher property taxes on improvements, working as a capital tax, discourage the housing supply in city centers, leading to the expansion of the city fringe. Such a distortive effect may be offset by lower taxes on farmland, which decreases the cost of holding it for owners, and undermines their incentive to convert it to housing use (Arnott 2005). Wassmer (2016) reviews theoretical findings as to how property taxes and urban sprawl interact. On the contrary, our model refrains from normative assessment, but address the incentive effect of differential tax treatment on landlords.

P_t denotes the market price of land corresponding to residential use at period t (=1, 2, 3). P_t may be interpreted as the net price, subtracting the cost associated with leveling the land. P_1 is known, whereas prices in subsequent periods involve uncertainty. Let $E[P_t|P_{t-1}]$ (t=2, 3) be the expected land price, conditional on the one during the previous period. As mentioned earlier, expectations may be

subjective and vary among landowners. Also, note that we consider the evolution of P_t to be exogenous, thus abstracting the capitalization of property tax in terms of land price. To clarify our theoretical hypothesis, we assume that in the last period, landlords always opt to sell their land.

(Assumption) $P_3 > R$ for all P_3

where R represents the return on farmland use, including non-market gains (such as recreation). This implies that landlords seek the timing for when they should sell their land, rather than intending to cultivate it. Figure 5 provides a timeline of their decisions. Written as $x_2\tau$, an effective tax is applied to farmland at period t=2 with $x_2 \leq 1$, where τ represents the property tax rate on housing lots. We consider that the reform is undertaken during the first period and becomes effective afterward. Accordingly, no effective tax is charged at t=1. x_2 is stochastic before the property tax reforms, but becomes $x_2 = 1$ after the reforms.

Designate j=H, A and G respectively, and farmland owners have three options: (1) Sell and convert the land to housing lots at period 1; (2) Hold their property as farmland in UPAs; or (3) Maintain their land as PGL. There may be another option of lending land for housing use to gain rent revenue. We include it in j=H, interpreting P_t as the present value of rent. In the case of j=H, the payoff to the landlord equals $V_H = P_1$. If the owner opts for the PGL after the reform, the owner commits to cultivating the land during the first two periods. At t=3, the preferential tax treatment expires, and the owner chooses to sell land at price P_3, or to hold it as farmland, paying property tax at the rate of τ

according to the price of residential use. Then, his payoff is given by[11]

$$(1) \quad V_G = (1+\beta)R + \beta^2 E[E[P_3|P_2]|P_1]$$

where β<1 is the discount factor. The second term is the expected price at t=3 from the first period perspective, which is given as the function of the conditional expectation at t=2. For simplicity's sake, we assume zero property tax on the land for agricultural use. As we assumed that $P_3 > R$, the latter is always dominant. Alternatively, the owner can delay selling, although this may trigger a high property tax afterward. Before the tax reform, given that x_2 is stochastic, the payoff from j=A becomes:

$$(2) \quad V_A = R + \beta E\left[Max[P_2, R - \tau x_2 P_2 + \beta E[P_3|P_2]|P_1\right]$$

With j=A, the owner can keep the option of selling land at t=2 if it exceeds the expected return from further holding farmland. The tax reform determines $x_t = 1$ at t=2 and 3 for certain. The above pay-off after the reform is written as:[12]

$$(3) \quad \begin{aligned} \hat{V}_A &= R + \beta E\left[Max[P_2, R - \tau P_2 + \beta E[P_3|P_2]|P_1\right] \\ &= V_G + \beta\left\{E\left[Max[0, P_2 - (R - \tau P_2 + \beta E[P_3|P_2]])|P_1\right] - \tau E[P_2|P_1]\right\} \end{aligned}$$

The second term refers to the option value of selling land at period 2; such an option is not allowed

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[11] In the last term, we use the iteration of expectation as $E[P_3|P_1] = E[E[P_3|P_2]|P_1]$

[12] The last line of Eq. (3) comes from

$$\begin{aligned} \hat{V}_A &= R + \beta E\left[Max[P_2, R - \tau P_2 + \beta E[P_3|P_2]|P_1\right] \\ &= R + \beta E\left[Max[0, P_2 - (R - \tau P_2 + \beta E[P_3|P_2])|P_1\right] + \beta E\left[R - \tau P_2 + \beta E[P_3|P_2])|P_1\right] \\ &= R + \beta E\left[R + \beta E[P_3|P_2])|P_1\right] + \beta E\left[Max[0, P_2 - (R - \tau P_2 + \beta E[P_3|P_2])|P_1\right] - \beta E\left[\tau P_2|P_1\right] \end{aligned}$$

under j=G, whereas the last term represents the property tax burden, given that the tax base is assessed based on residential use after the reform. Thus, there is a tradeoff between the option and the tax burden at t=2. Such a tradeoff does not occur before the reform. Indeed, we have $V_A \geq \breve{V}_G$ whereby the right side symbolizes the pre-reform pay-off from the commitment to farming at t=2, as required by the PGL, and is defined by

(1') $\breve{V}_G = (1+\beta)R - \beta E[\tau x_2 | P_1] + \beta^2 E[E[P_3, | P_2] | P_1] (\geq V_G)$

The difference from Eq. (1) is that $x_3\tau$ replaces τ, and the tax may be charged at t=2 before the reform.

To sum up, the following lemma establishes a relationship among the pay-offs.

[Lemma 1]

(i) $\hat{V}_A \leq V_A$

(ii) $V_A \geq \breve{V}_G$

(iii) $\hat{V}_A < V_G$ if $P_2 < R + \beta E[P_3 | P_2]$ for all P_2

The first statement of the lemma implies that the option of j=A turns out to be less attractive after the reform, as a high property tax is surely charged on farmland in UPAs. The result is straightforward as Eq. (2) is declining with x_2 and the reform let x_2 =1. Before the reform, j=A dominates commitment to holding farmland, as addressed above; j=A adds the option value of selling land during

the earlier period, whereas the government does not yet commit to preferential tax treatment for j=G.[13] On the other hand, during the post-reform stage, insofar as $P_2 < R + \beta E[P_3|P_2]$ so that the second term in the last line of Eq. (3) takes zero,[14] the landlord prefers to maintain farmland by t=3. Hence, the PGL (j=G) becomes more beneficial for holding farmland (j=A) due to the preferential tax treatment.

Before the reform, at t=1, owners choose between j=H and j=A, and the latter is favored if – and only if – $V_H = P_1 \leq V_A$. In anticipation of land price increases and lower tax payments in the future, the owner opts to refrain from selling. The property tax reform introduces the PGL, whereas farmland is taxed according to residential use after t=2 lowers the payoff from j=A (i.e., V_A) and adds j=G, yielding the payoff of V_G in the owner's choice.

Table 2 provides a configuration of the relationships among the pay-offs before and after the reform. For instance, suppose that $V_H \leq V_A$ originally and $V_H \leq \hat{V}_A < V_G$ at the ex post reform stage. Then, the reform alters the owner's choice from j=A to j=G. It may be the case that $V_H \leq V_A$ but $V_H > Max[\hat{V}_A, V_G]$, implying that the owner prefers to sell land at t=1 after the reform. We can also have the relationship as $V_G > V_H > V_A$. This illustrates a circumstance whereby the owner changes his choice from j=H (i.e., selling land at t=1) to j=G, holding his property as PGL. The owner may

[13] Given that $V_G \geq \breve{V}_G$, this statement does not rule out the relationship of $V_G > V_A$, which is so if $P_2 < R + \beta E[P_3|P_2]$ and x_2 is likely to take the value of 1 so that $\hat{V}_A \approx V_A$.

[14] Note that $Max[0, P_2 - (R - \tau P_2 + \beta E[P_3|P_2]] = 0$

have been concerned about future tax increases, so he decided to sell land at t=1, whereas the production green tax exempts him from paying a high property tax.

Given that different landowners may form different expectations, they would act differently in the table. However, the table reveals that overall, they become less likely to select the option of maintaining farmland in UPAs. Meanwhile, the reform effect on the decision to sell land at t=1 is ambiguous, given that the PGL is presented as an additional option. Indeed, aggregating the owners' decisions at the level of UPAs, we can write supplies of farmland and housing as $A = E[Q(V_A - V_H, V_A - V_G)]$ and $H = E[F(V_H - V_A, V_H - V_G)]$ where Q and F are the probabilities that the landowner opts for j=A and j=H, respectively. These probabilities increase with the pay-off of the option relative to those of the other options. Then the property tax reform alters the supplies, as follows:

(4) $\Delta A = E[Q(\hat{V}_A - V_H, \hat{V}_A - V_G)] - E[Q(V_A - V_H, V_A - \breve{V}_G)]$ and

(5) $\Delta H = E[F(V_H - \hat{V}_A, V_H - V_G)] - E[F(V_H - V_A, V_H - \breve{V}_G)]$

Eq. (4) becomes negative given that $\hat{V}_A \le V_A$ and $V_G \ge \breve{V}_G$. This may be obvious since the tax reform raises the tax burden on holding farmland. On the other hand, Eq. (5) cannot be signed since the first variable in the equation augments, whereas the second is lowered with $\breve{V}_G \le V_G$. The choice of selling land at t=1 becomes more advantageous relative to holding it as farmland, but the reform introducing the PGL makes the commitment to cultivate until t=2 more attractive due to preferential

tax treatment or the government commitment not to tax. Therefore, we can establish the following hypotheses, which should be empirically confirmed:

(Hypothesis 1) Property tax reform decreases farmland in UPAs at the time that the reform is conducted.

(Hypothesis 2) The property tax reform effect on the supply of housing lots at the time of the reform is ambiguous.

4. Data and discussion on the validity of DID estimation

4.1. Data, sample period, and the scope of cities

All data on land area, property value, and property tax base come from the *Brief Report on the Value of Properties* provided by MIAC. We use these data in order to calculate the ratios of UPA farmland, ordinary farmland, and housing lots. These are obtained by dividing each item by total land (the sum of UPA farmland, ordinary farmland, and housing lots). Meanwhile, after the reforms, a proportion of UPA farmland preserved as PGL has been classified into farmland in the official statistics.

In Section 5, we estimate the model by adding additional explanatory variables to the estimation equation: the effective tax rate of UPA farmland, agricultural income, local government tax revenues per total local government revenue, population density, and shipments.[15]

The coefficient of the effective tax rate, with respect to UPA farmland, is expected to be negative when we estimate the model by letting the UPA farmland ratio be a dependent variable. We also use this as an independent variable when the housing lot ratio is used as a dependent variable, where the coefficient would be estimated to be positive. By doing this, we would like to capture the path whereby the proportion of UPA farmland is reduced due to the higher tax burden on it; thus, the land is converted into housing lots. To calculate the effective tax rate, we use two procedures. First, the tax revenue is determined by multiplying tax base by the statutory tax rate (=0.014) as follows.

$$\text{Tax revenue} = \text{tax base} \times 0.014.$$

Then, we calculate the effective tax rate by dividing the tax revenue by the property value.

We add agricultural income following Kanemoto et al. (1987). Usually, if the revenue from cultivation is larger, landlords do not spontaneously convert their property into other uses. Therefore, the coefficient is expected to be positive when we use the UPA farmland ratio as a dependent variable; on the flip side, the coefficient is estimated to be negative if the housing lot ratio is

[15] Regarding possible additional variables, the age structure and share of primary and secondary industries can be considered. Although the National Census can provide such data, the census is a quinquennial survey in Japan. Therefore, it would not be adequate to use data collected every five years in a framework that compares outcomes before and after treatment.

assumed as a dependent variable. Local government tax revenue per total local government revenue, population density, and shipment capture the social and economic factors of each city. As a whole, the more urbanized a city is, the larger the housing lots and farmland that should be converted into the lots. Henceforth, these variables are estimated to be positive in both cases.

The data on local government tax revenue and total local government revenue comes from the Statistics of the Final Accounts of Municipal Governments, and population data is from the Basic Resident Register. MIAC provides these data, as well as (total) land area data. The data on agricultural income come from the Production Agricultural Income Statistics, provided by the Ministry of Agriculture, Forestry, and Fisheries. The data on shipments come from the Industry Statistics provided by the Ministry of Economy, Trade, and Industry.

To be consistent with our theoretical model, we focus on the duration before and after the reforms. Therefore, the sample periods of DID estimation are FY 1992 and FY 1993. Please recall that the collection of property taxes between April and the following March (the fiscal year in Japan) is based on information from January of the previous fiscal year. FY 1992's data (April 1992–March 1993) are calculated based on the information from January 1992. However, the long-term agricultural operation system was still effective during that month since the act was rescinded in March 1992. Therefore, we set the data from FY 1992 as "before" the reforms. Likewise, we assume FY 1993 to be the period "after" the reforms.

We focus on 389 cities throughout the periods from FY 1985 to FY 1995.[16] We choose these cities, as follows. First, we omit cities without ordinary or UPA farmland. Second, during our sample period, the central government did not designate certain cities as ordinance cities before FY 1992. When we examine the placebo effect, the city's characteristics should be the same.[17] Therefore, it would be best not to include such cities. Third, there was an amalgamation of municipalities – even in the 1980s and 1990s, which makes it difficult for us to obtain coherent data throughout that period for such cities. Therefore, we omit cities where merged or disappeared from 1985 to 1995. Finally, when it comes to the control group, we limit municipalities to cities whose population is over 50,000 on average. Although there are some exceptions, in principle, under Japan's local public finance system, the population should be higher than 50,000 to be classified as a city. Whereas most designated cities (treatment group, 183) meet this requirement, this is not the case for the rest. In order to make both groups comparable, it is recommendable to limit the number of cities with regard to the remaining ones. Based on this point, we limit the cities to 206 whose population is over 50,000 on average throughout our sample period.

As a result, we single out 389 cities. Here, the treatment group comprises 183 designated cities, and

[16] For the purpose of a placebo test, we choose the period of FY 1990–FY 1991. Whereas the duration of the asset price bubble periods was from December 1986 to February 1991, the period between FY 1990 and FY 1991 contains the peak and collapse of asset bubbles in Japan. Since the business cycle fluctuation in these periods affects both groups, the common trend assumption is not violated, as argued later. However, just to be sure, we also conduct a placebo test for FY 1985–FY 1986, with the placebo treatment variable equal to 1 for FY 1991, which shows that no results are estimated to be significant. Following this, we choose FY 1985 as the initial period.

[17] For example, Chiba became a city designated by government ordinance in FY 1992. Although Chiba may be classified as an existing urbanized area or a suburban development even before that time, we omit this city following the argument above. Likewise, we do not include Sendai as part of the control group, because Sendai was not designated as an ordinance city until FY 1989.

the control group has 206. We set this as the basic case and call it “Case 1.” Regarding the control group, we also limit to the number to 104 cities whose population is over 100,000 as an alternative. This is “Case 2,” and the total number of cities is 287.

In the meantime, although the *Brief Report on the Value of Properties* includes data on Tokyo’s 23 wards, such data is aggregated; information is not provided for individual wards. Therefore, our data exclude the 23 wards.

4.2. Observation of tax reforms and the validity of DID estimation

Figures 6a to 7c show the average of the ratio for each item with regard to land use (each item per total area, respectively) between the designated cities (the treatment group) and the remaining cities (the control group) from FY 1990 to FY 1995. According to Figures 6a and 7a, in FY 1993, when the long-term agricultural operation was repealed and the amended PGL Law came into force, the share of UPA farmland fell dramatically in the designated cities; this figure did not change before or after the reforms in the remaining cities. Therefore, the two reforms were implemented concurrently to solve the distortions caused by preferential tax treatment, which might be useful for the three metropolitan areas.

On the other hand, Figures 6b and 7b suggest that landlords did not convert PGL farmland into housing lots after the reforms, although the housing lot ratio has been increasing throughout the

periods. If the owners had converted most PGL farmland into housing lots following the amendment of the PGL Law, the proportion would have increased dramatically in FY 1993. However, Figures 6b and 7b suggest this would not have been the case.

In the meantime, PGL is included in farmland data. Although it is impossible for us to extract PGL from MIAC data, Figures 6c and 7c suggest that the farmland ratio temporarily rose between FY 1992 and FY 1993 for the designated cities. This implies that landlords might decide to keep farmland as PGL after the reforms. Indeed, as shown in Table 3, the area of PGL skyrocketed in FY 1993.

These figures imply that our hypotheses may be plausible. To substantiate them, we should perform an econometric investigation using the DID approach. We discuss the validity of this method by focusing on the UPA farmland ratio.

The identifying assumption of our DID specification is that both the designated and remaining cities would have to follow the same time trend in the absence of the 1990s reforms. If this common trend assumption holds, our empirical strategy allows us to control for all unobserved differences between the two groups.

Here, we check the common trend assumption using Figures 6a and 7a. The average of the share of UPA farmland moved almost in parallel in both the designated and remaining cities between FY 1990 and FY 1991, with the proportion of UPA farmland declining slightly in the two groups. Therefore, these graphs provide strong visual evidence of treatment and control cities, with a

common underlying trend for untreated periods.[18]

Furthermore, we discuss the common shocks assumption. The Japanese government implemented several measures for land-related taxes in the early to mid-1990s. For example, the land-value tax was enacted in FY 1992. The government has set the assessed value of land at 70–80% of the market value since FY 1994. It might also be possible that some landlords responded in advance. However, these packages were carried out not for a certain group, but for all municipalities. Therefore, the common shocks assumption is not violated within our framework.

5. Empirical framework and results

5.1. Empirical framework

This section establishes the empirical methodology and results. In doing so, we give basic specifications of the regression, as follows.

$$(6) \quad L_{it} = \beta_0 + \beta_1 T_i + \beta_2 REFORM_t + \beta_3 (T_i \times REFORM_t) + \beta_4 C_{it} + \varepsilon_{it},$$

where L_{it} is the share of UPA farmland or the one of housing lots, T_i is the dummy variable that takes 1 if it is a designated city within the three metropolitan areas and the others are 0, $REFORM_t$ is the dummy variable that takes 1 for FY 1993 and 0 for the others, C_{it} is the other control variable, and ε_{it} is the disturbance.

[18] Meanwhile, we also implement Autor's (2003) type Granger Causality test to check whether landlords change their behavior before the reforms. For both cases, the null hypothesis is accepted.

When it comes to the UPA farmland ratio, if β_3 is estimated to be negative and significant, we conclude that the first hypothesis is substantiated. We also estimate Eq. (6) by using the housing lot ratio as a dependent variable. We do so in order to check whether reduced UPA farmland was converted into housing lots. Meanwhile, the farmland ratio can be also used as a dependent variable to capture the change in PGL. However, as long as we cannot extract the data on PGL from our farmland data, the results may not necessarily be plausible to capture the switch.[19]

For other control variables, as stated in Section 4.1., we add the effective tax rate, local government tax revenue per total local government revenue, agricultural income, population density, and shipments.

5.2. Empirical results

Before discussing the estimation results over the periods from FY 1992 to FY 1993, we present the results of the placebo test for the case whereby the UPA farmland ratio is used as a dependent variable for FY 1990 and FY 1991. This is done to further verify the common trend assumption. The placebo treatment variable is equal to 1 for FY 1991. No results in Table 4 are statistically significant, and there are no differences between the designated and remaining cities before the reforms.

Tables 5a and 5b report the estimation results of simple DID estimation. When it comes to the case

[19] Just to be sure, our appendix reports the results of letting the farmland ratio be a dependent variable, which shows that while β_3 is estimated to be positive and significant in Case 1 with simple DID estimation, the coefficients are not estimated to be insignificant for other cases.

whereby the UPA farmland ratio is used as a dependent variable, the coefficients of β_3 are estimated to be negative and significant for all cases. However, if we take the housing lot ratio as a dependent variable, the coefficients of β_3 are not statistically significant.

We also estimate Eq. (6) by adding some other variables. Tables 6a and 6b present the results. When it comes to the model whereby the UPA farmland ratio is used as a dependent variable, the coefficients of β_3 (T*Reform) are estimated to be negative and statistically significant for all cases. However, we cannot show statistically significant results when we estimate Eq. (6) using the housing lot ratio. Meanwhile, the coefficients of the effective tax rate are estimated to be negative and significant in the case, whereby the UPA farmland ratio is used as a dependent variable. On the other hand, the coefficients are estimated to be positive and significant when we use the housing lot ratio as a dependent variable. This suggests that while a hefty effective tax rate reduces UPA farmland, the reduced land would be converted into housing lots. The coefficient of the logarithm of population density is estimated to be positive and significant for both cases, as we expected. When we estimate the model by letting housing lots be a dependent variable, the coefficient of the logarithm of agricultural income is estimated to be negative and significant in both cases, as we assumed. In the meantime, the logarithm of the shipment value is estimated to be negative and significant if we let the UPA farmland ratio be a dependent variable. Here, a fraction of UPA farmland may tend to be larger in suburban parts within urban areas, where the shipment value is relatively small compared to the city

center. The results may reflect this.

From the outcomes shown in Tables 5a to 6b, our first hypothesis is validated. On the other hand, housing lots did not increase after the reforms, indicating that the reforms affected UPA farmland and housing lots differently, as suggested in the theoretical model.

Most Japanese farmers work part-time and have second jobs.[20] They earn enough income from other sources, which may induce them to preserve farmland as PGL so they can escape a higher tax burden. Yagi and Garrod (2018) demonstrated that farmers in areas with a higher population density who depend on revenue from real estate income tend to continue farming. Onishi et al. (1992) surveyed farmers in Osaka; approximately 50% of the respondents said they chose to conserve their land as PGL in order to lower their tax burden.

6. Conclusion

This paper examines how the early 1990s property tax reforms in Japan affect land use through theoretical and empirical investigation. Both the theoretical and empirical findings illustrate that the reforms reduced the proportion of UPA farmland in the designated cities within the three metropolitan areas. However, we cannot confirm whether all reduced UPA farmland was converted into housing

[20] The *Economist* (2013) shows that full-time farmers make up 28% of all farmers in Japan. For more details, please visit https://www.economist.com/asia/2013/04/13/field-work.

lots.

The policy implications drawn from our empirical findings are as follows. First, the abolishment of the long-term agricultural system was successful in reducing the amount of UPA farmland in the designated cities, which might impede urbanization in metropolitan areas. Second, the PGL Law should not have been rectified because the amendment has let landlords conserve property land as farmland. While we can verify that the amount of UPA farmland in the designated cities shrank, not all properties were not converted for residential use. Although the cause is different from some countries (for instance, like in the U.S.), urban sprawl has also been a concern in major Japanese cities; a long commute time from the fringe to the city center is a quintessential example in greater Tokyo. To solve this problem, farmland in the center of cities and inner suburbs should be converted into housing lots, which may spur urbanization and solve market failures caused by urban sprawl. In this regard, the abolishment of the long-term agricultural operation system was spot on. However, the reality is that the market failures caused by the aforementioned urban sprawl have yet to be solved. That is why not all UPA farmland could be changed into housing lots at the time of the reforms in the early 1990s. In this regard, the amendment of the PGL Act was unequivocally redundant.

This study's analysis could be fruitfully extended in two ways. First, whereas it would be difficult to specify the PGL – even if we use geographical data – it would be possible to check the conditions of the farmland on the border between the designated cities and other urban centers. When it comes to

the designated cities, a certain portion of farmland should not be developed because of the amended PGL Law, which coerces owners to keep PGL as it is for 30 years. On the other hand, farmland may have gradually been converted into other uses regarding the remaining cities. The data on the border between these two types of cities may enable us to verify land use after the reforms in more detailed way. Second, although we suggest that the PGL Law should not have been rectified, we could simulate the effects of the case by assuming that the amendment would not have been made.

Appendix. The results on farmland ratio

Tables A1 and A2 report the results that we estimate Eq. (6) by letting farmland ratio dependent variable. As shown in Table A1, while β_3 is estimated to be positive and significant in Case 1, we cannot show statistically significant result in Case 2. However, according to Table A2, we cannot show statistically significant results when we add another independent variable. Since we cannot extract the data on PGL, we may not necessarily show statistically significant results for the coefficients of β_3.

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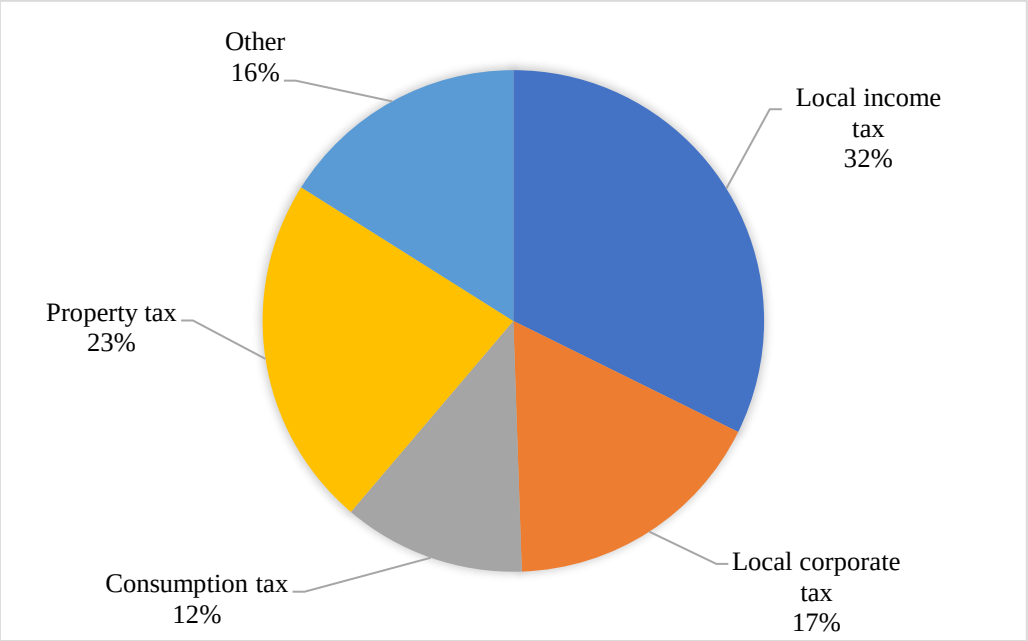
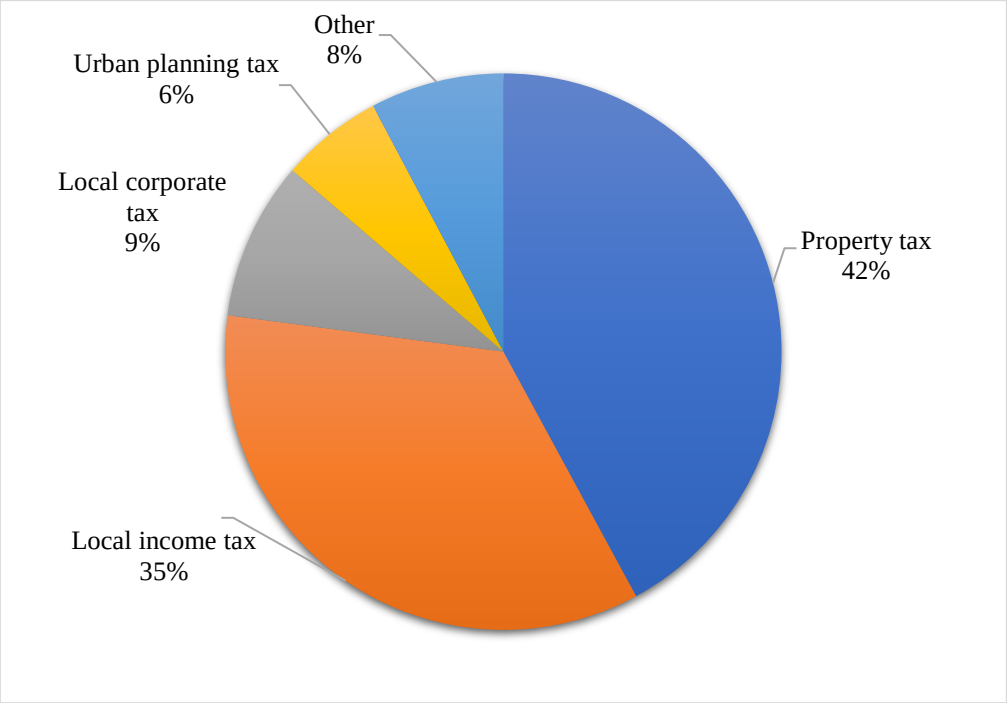
Figure 1. Share of tax revenue (prefectures and municipalities)



Source: The White Paper on Local Public Finance (issued by MIAC)

Figure 2. Share of tax revenue (municipalities)



Source: The White Paper on Local Public Finance (issued by MIAC)

Figure 3. The timing of the assessment and levy of property taxes in Japan

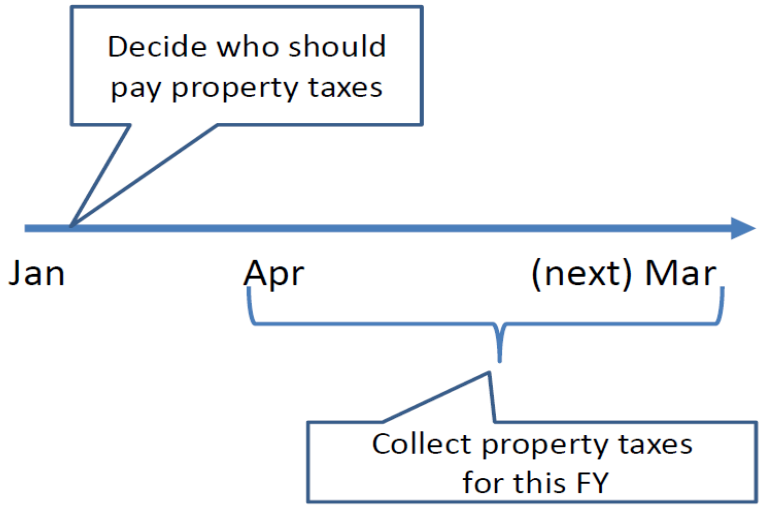
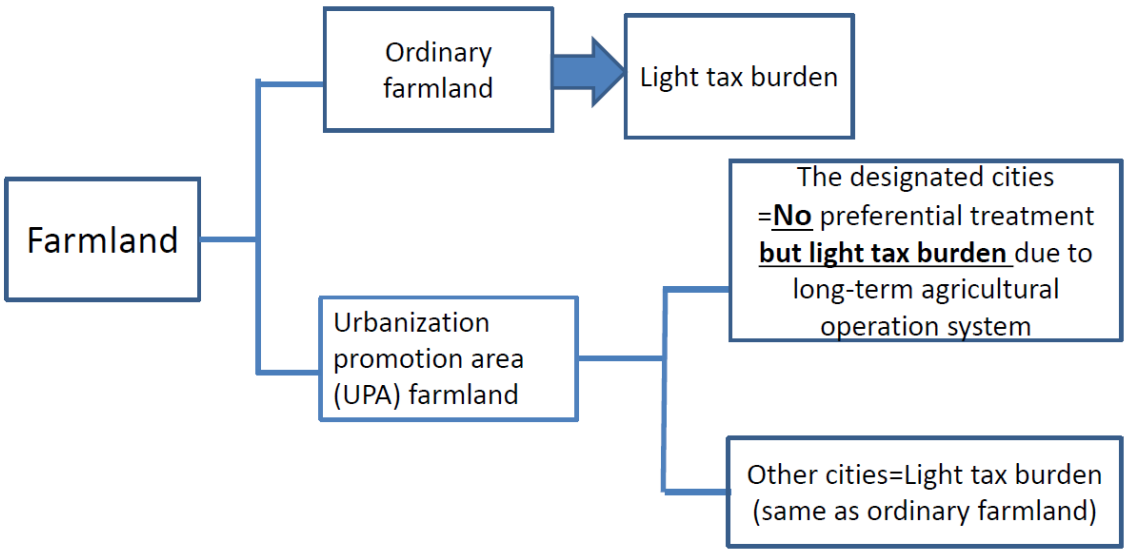


Figure 4. The classification of farmland and the property tax burden in Japan (before and after the reforms)

(**Before the reforms**)



(After the reforms)

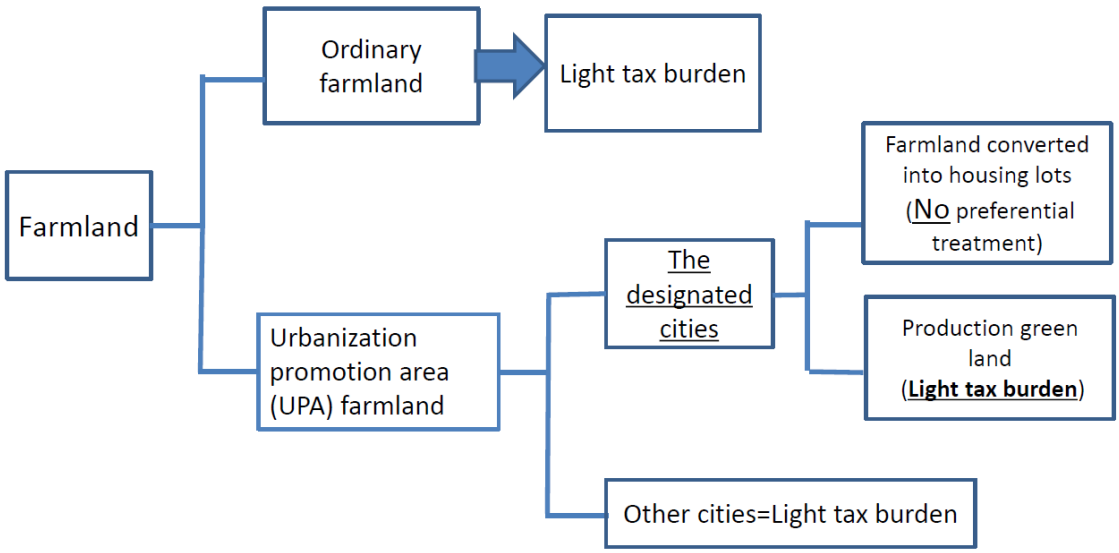
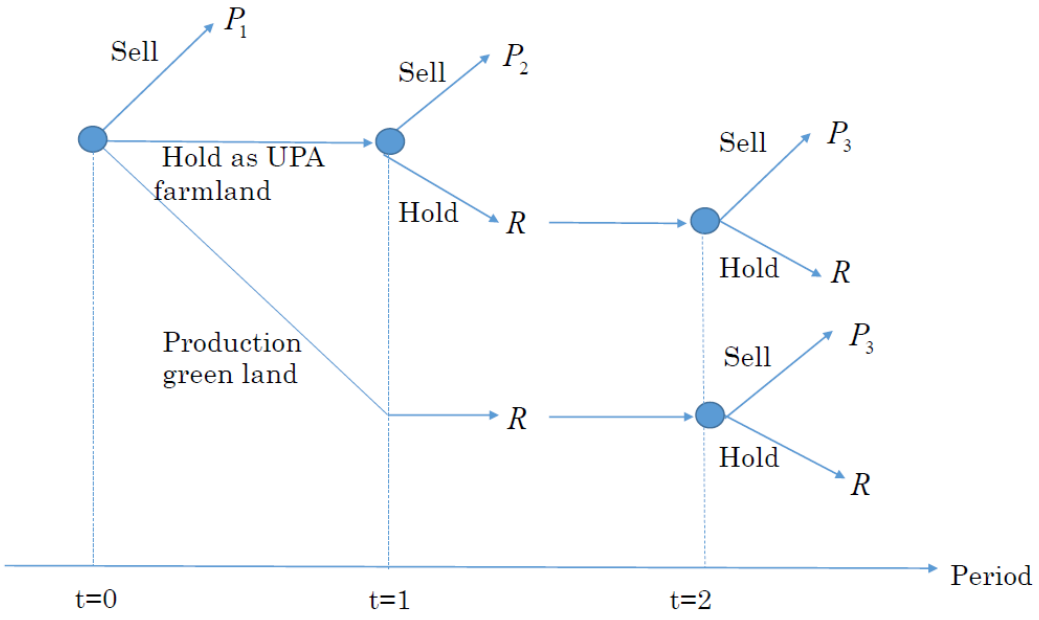


Figure 5. The timeline of the decision



Note: UPA refers to "urbanization promotion area."

Figure 6a. The average of UPA farmland ratio (Case 1, unit=%)

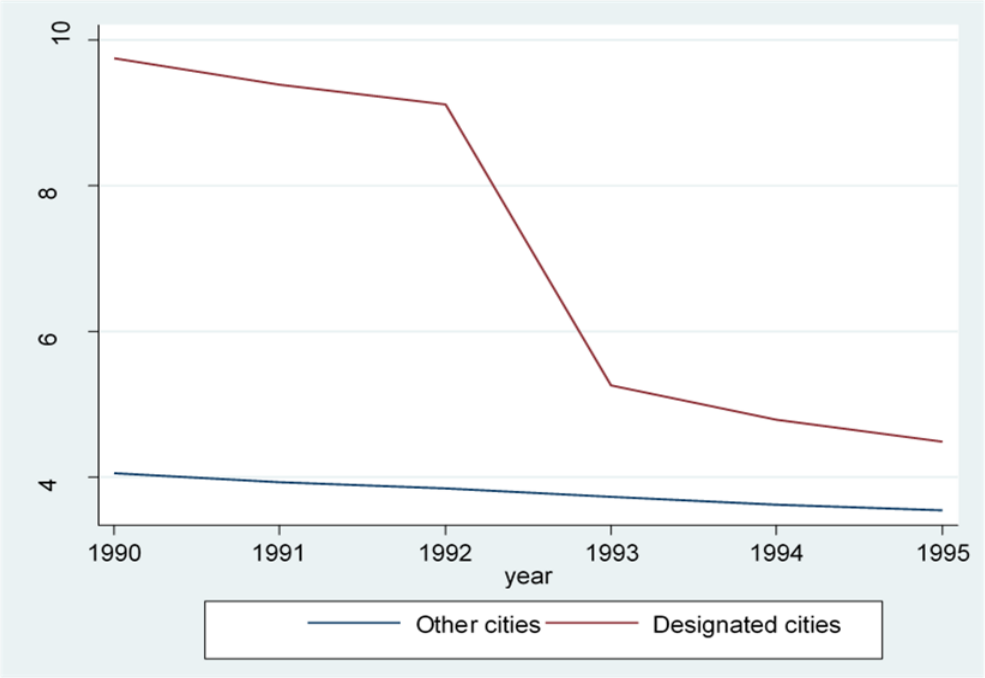


Figure 6b. The average housing lot ratio (Case 1, unit=%)

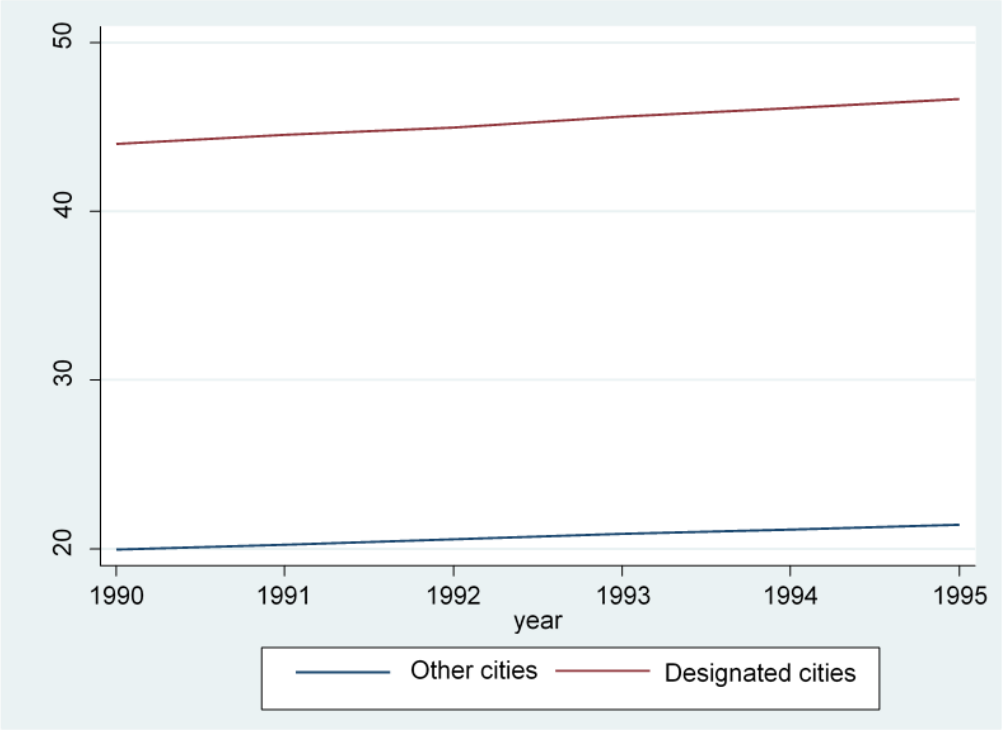


Figure 6c. The average farmland ratio (Case 1, unit=%)

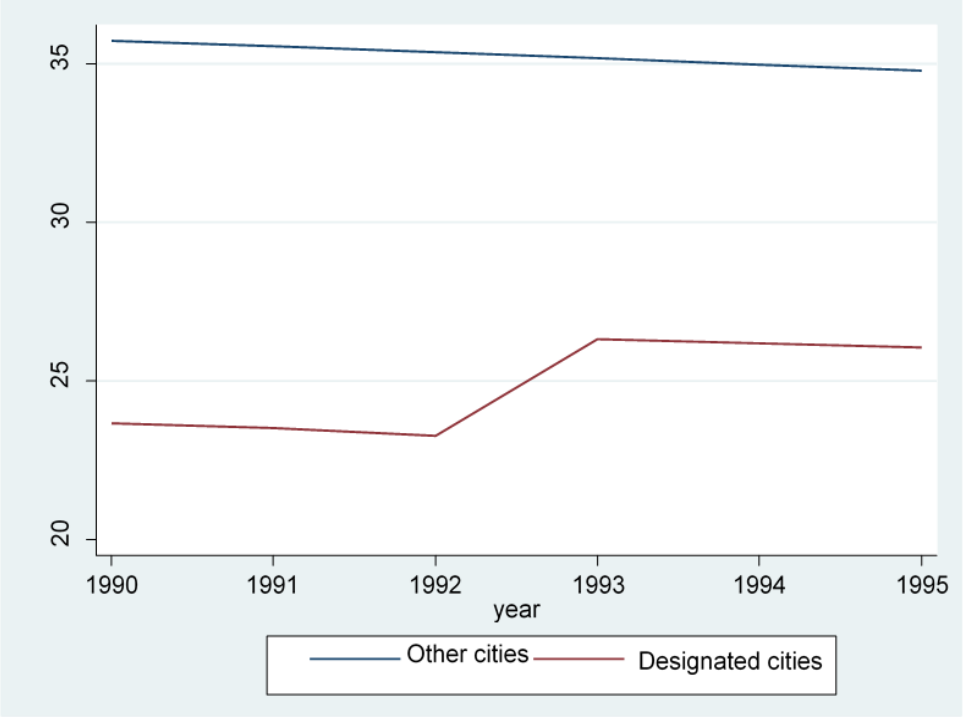


Figure 7a. The average UPA farmland ratio (Case 2, unit=%)

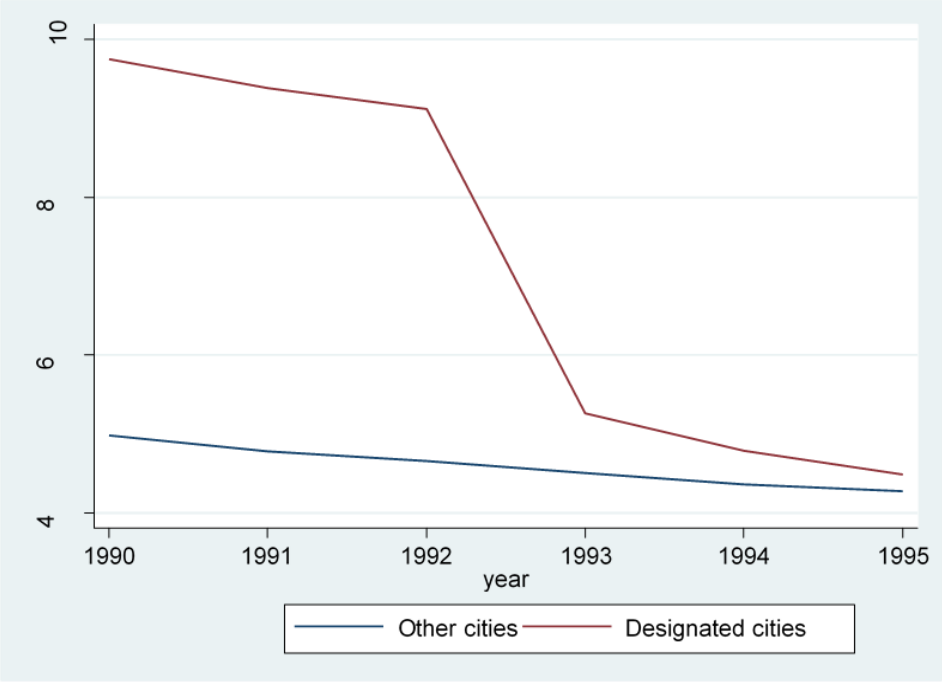


Figure 7b. The average housing lot ratio (Case 2, unit=%)

Figure 7c. The average farmland ratio (Case 2, unit=%)

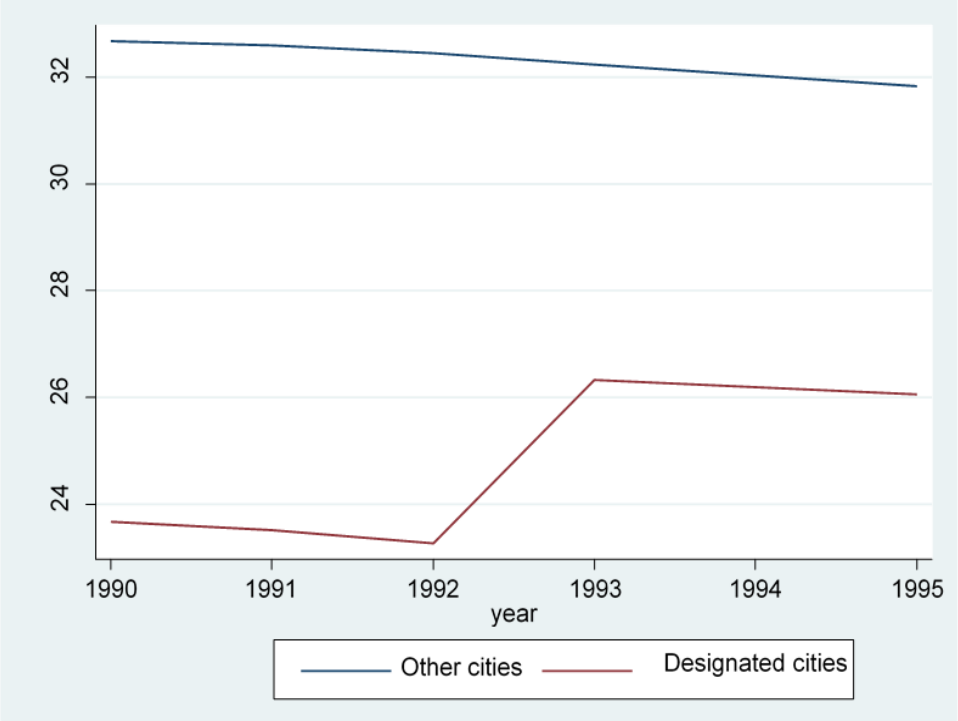


Table 1. An outline of Japan's property tax system

Tax authority	Municipalities (cities, towns, and villages) assess, levy, and collected taxes*
Taxable assets	1. Land
	2. Houses and buildings
	3. Depreciable business assets
Taxpayer	Owners of each taxable asset
The evaluation of the tax base	Value (fair market value) as of January 1
Tax rate	Statuatory tax rate: 1.4 %
	(Maximum tax rate): 2.1 %

＊Regarding Tokyo's special wards, the Tokyo metropolitan government is in charge of tax administration.

Table 2. Pay-offs before and after the reforms

After the reforms / Before the reforms	$V_H \leq \hat{V}_A$		$V_H > \hat{V}_A$	
	$Max[V_H, V_G] \leq \hat{V}_A$	$\hat{V}_A < V_G$	$V_H > Max[\hat{V}_A, V_G]$	$V_H < V_G$
$V_H \leq V_A$	From j=A to j=A	From j=A to j=G	From j=A to j=H	From j=A to j=G
$V_H > V_A$			From j=H to j=H	From j=H to j=G

Table 3. The movement of farmland and PGL (unit: 10,000 ha)

	UPA farmland except PGL	PGL
1992	14.85	0.07
1993	12.81	1.52
1994	12.23	1.54
1995	11.83	1.55
1996	11.37	1.56
1997	10.92	1.56
1998	10.56	1.55
1999	10.29	1.55
2000	10.05	1.54

Table 4. Placebo test for the UPA farmland ratio. Sample periods=FY 1990–FY 1991

	Case 1	Case 2
DID esimate	-0.002	-0.002
(T*Reform)	(0.007)	(0.010)
R2	0.23	0.15
NOB	778	574
N. of treated municipalities	183	183
N. of control municipalities	206	104

Note: The placebo treatment variable is equal to 1 for FY 1991. Robust standard errors are in parentheses.

Table 5a. Simple DID results (Case 1). Sample periods=1992-1993, NOB=778

Dependent variable	ufarm (ratio)	house (ratio)
DID esimate	-0.037 ***	0.003
(T*Reform)	(0.006)	(0.024)
R2	0.22	0.35
N. of treated municipalities	183	183
N. of control municipalities	206	206

Note: “Ufarm” stands for UPA farmland, while “house” indicates housing lots. Robust standard errors are in parentheses. Asterisks indicate significance levels: * = 10%, and *** = 1%.

Table 5b. Simple DID results (Case 2). Sample periods=1992-1993, NOB=574

Dependent variable	ufarm (ratio)	house (ratio)
DID esimate	-0.037 ***	0.003
(T*Reform)	(0.007)	(0.031)
R2	0.18	0.26
N. of treated municipalities	183	183
N. of control municipalities	104	104

Note: “Ufarm” stands for “UPA farmland,” and “house” refers to housing lots; “farm” indicates farmland. Robust standard errors are in parentheses. Asterisks indicate significance levels: *** = 1%.

Table 6a. Robustness check for Case 1. Sample periods=1992-1993, NOB=778.

Dependent variable	ufarm (ratio)	house (ratio)
T*Reform	-0.037 ***	0.008
	(0.005)	(0.011)
Treatment	0.013 ***	-0.032
	(0.004)	(0.092)
Reform	-0.001	0.0003
	(0.002)	(0.006)
taxrate	-1.959 ***	3.940 ***
	(0.219)	(0.700)
ltaxratio	0.022 *	-0.043
	(0.015)	(0.033)
ln(agri income)	0.001	-0.046 ***
	(0.001)	(0.003)
ln (pop density)	0.029 ***	0.152 ***
	(0.002)	(0.004)
ln (ship value)	-0.004 *	0.026 ***
	(0.002)	(0.004)
const	-0.124 ***	-0.765 ***
	(0.020)	(0.047)
R2	0.53	0.88
N. of treated municipalities	183	183
N. of control municipalities	206	206

Note: "Ufarm" stands for "UPA farmland," and "house" means housing lots; "farm" indicates farmland. Robust standard errors are in parentheses. Asterisks indicate significance levels: * = 10%, and *** = 1%.

Table 6b. Robustness check for Case 2. Sample periods=1992-1993, NOB=574.

Dependent variable	ufarm (ratio)	house (ratio)
T*Reform	-0.037 ***	0.006
	(0.005)	(0.012)
Treatment	0.014 ***	-0.052 ***
	(0.005)	(0.011)
Reform	-0.0008	0.002
	(0.003)	(0.008)
taxrate	-2.355 ***	5.192 ***
	(0.450)	(1.202)
ltaxratio	0.023	-0.023
	(0.019)	(0.038)
ln(agri income)	0.003 *	-0.049 ***
	(0.002)	(0.004)
ln (pop density)	0.033 ***	0.165 ***
	(0.003)	(0.005)
ln (ship value)	-0.004 **	0.027 ***
	(0.002)	(0.004)
const	-0.146 ***	-0.867 ***
	(0.025)	(0.057)
R2	0.45	0.87
N. of treated municipalities	183	183
N. of control municipalities	104	104

Note: “Ufarm” stands for “UPA farmland,” and “house” refers to housing lots; “farm” indicates farmland. Robust standard errors are in parentheses. Asterisks indicate significance levels: * = 10%, and *** = 1%.

Table A1. Simple DID results. Dependent variable=farmland ratio, sample period=FY 1992-FY 1993.

	Case1	Case2
DID esimate	0.032 *	0.033
(T*Reform)	(0.025)	(0.03)
R2	0.09	0.05
NOB	778	574
N. of treated municipalities	183	183
N. of control municipalities	206	104

Robust standard errors are in parenthesis. Asterisks indicate significance levels: * = 10%.

Table A2. The case that other independent variables are added. Dependent variable=farmland ratio, sample period=FY 1992-FY 1993.

	Case1	Case2
T*Reform	0.018	0.019
	(0.019)	(0.021)
Treatment	0.022	0.049 ***
	(0.018)	(0.02)
Reform	0.0001	-0.002
	(0.013)	(0.016)
taxrate	-0.317	3.918 ***
	(1.389)	(2.005)
ltaxratio	0.021	0.093 *
	(0.052)	(0.058)
ln(agri income)	0.102 ***	0.098 ***
	(0.004)	(0.005)
ln (pop density)	-0.011 *	-0.029 ***
	(0.007)	(0.008)
ln (ship value)	-0.048 ***	-0.045 ***
	(0.005)	(0.005)
const	0.207 ***	0.252 ***
	(0.074)	(0.085)
R2	0.49	0.52
NOB	778	574
N. of treated municipalities	183	183
N. of control municipalities	206	104

Note: Robust standard errors are in parenthesis. Asterisks indicate significance levels: * = 10%, and *** = 1%.