Property Tax Reform and Land Use:

Evidence from Japan♦

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Abstract

It is often said that farmland conservation in urban areas (i.e., cities and inner suburbs) is not desirable because it hinders converting farmland into residential areas, thereby deterring urbanization. If the preferential treatment of property taxes on farmland is rectified, these problems can be solved. In this paper, we study two property tax preferential treatment reforms that took place in Japan during the 1990s. We examine the effects of these reforms by theoretical and empirical investigation. The econometric results are consistent with our theoretic model's main predictions; the proportion of farmland in the major cities in the three metropolitan areas (Tokyo, Chubu, and Kansai) decreased following the reforms. However, since landlords did not replace all the farmland with housing lots, the problem of obstructed urbanization remains to be solved.

Key words: Property tax, land use in urban area, preferential treatment on farmland, urbanization
JEL Classification: H22, H71, R52, R58

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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. … economists see the farms as an extreme example of economic inefficiency. (Bruce 2000)

1. Introduction

Public finance economists have reiterated that property tax on land is neutral with respect to resource allocation. However, as a matter of practice, property tax is distortive because the tax rate differs depending on land use. Indeed, as explained later, the taxable value of farmland turns out to be lower than that of housing lots in the US and other countries.[1] Particularly, such preferential treatments are also given to farmland within cities and inner suburbs (hereafter defined as urban areas).[2] If this is the case, landlords may be reluctant to convert their farmland for other uses. Consequently, alternative uses that are valued more highly (e.g., housing lots or office buildings) may be lost as suggested by Bruce (2000). That said, it is likely that rescinding preferential treatments will urge owners to change their farmland into residential lots. However, to our knowledge, the effects of preferential property tax law reforms on land use in urban areas remains underexplored.[3]

The purpose of this study is to examine the effects of two reforms on the preferential property tax treatment in the urban area in Japan. To investigate the effect of the tax reforms, we construct a theoretical model and run difference-in-differences (DID) estimation. Japan's property tax system has interesting practical characteristics to address the effects of property tax reforms on land use in urban areas. On one hand, the government gave preferential treatment to farmland owners, even in urban areas, which led to the circumstances discussed by Bruce (2000). Indeed, local governments in the three metropolitan areas (Tokyo, Chubu, and Kansai) are eager to preserve farmland.[4] On the other hand, the Japanese government undertook fundamental reforms of preferential property tax measures so that farmland owners in urban areas are induced to transform their farmland into residential lots.

Here, let us provide details on the preferential treatment of farmland and the history of the reforms in Japan. Farmland in Japan is classified as either ordinary farmland or farmland in urban promotion

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[1] Bird and Slack (2004) raise four policies as preferential treatments with regard to farmland: (1) lower assessments, (2) exemptions for part or all of the farm property, (3) lower tax rates on farms, and (4) farm tax rebates. Among the four policies, this paper focuses on the first one.

[2] For instance, some local governments in the US give preferential treatment on urban farmland; for example, the state of California allows municipalities to lower the assessed value of property tax base even in urban area. Please see also the link: http://articles.latimes.com/2013/oct/02/local/la-me-urban-agriculture-law-20131003.

[3] Although Bruce (2000) mentioned how ineffective the protection of farmland within cities is, he did not proceed this argument with any theoretical or empirical investigations.

[4] 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 largest and most famous urban hubs of Japan, also boasts a large agricultural industry. For more details, please visit https://www.japanfs.org/en/news/archives/news_id035384.html.

areas (hereafter UPA farmland). Like many other countries, the assessment of both types of farmland is lower in Japan. Meanwhile, UPA farmland in the designated cities within the three metropolitan areas (hereafter referred to as the designated cities)[5] is taxed as housing lots. As shown in Table 1, however, the government gave preferential treatment to UPA farmland owners in the designated cites from Fiscal Year (FY) 1982. This is the long-term agricultural operation system, which let many landlords keep their farmland as it was for ten years. In a practical manner, many farmland owners in the designated cities took advantage of this system and escaped a higher tax burden by "disguising" their property as farmland, which was pointed by Ishi (1991). To solve this problem, the Japanese government undertook two fundamental reforms of the preferential property tax measure in the 1990s. One is that the long-term agricultural operation system was revoked at the end of FY 1991 (March 1992).[6] After the rescindment of this system, whereas the UPA farmland in the designated cities are taxed as housing lots, this is not applicable to the rest of the cities. Another reform is the amendment of the Production Green Land (PGL) Law in September 1991 (effective after January 1992). Under the revised PGL Law, farmland owners in the designated cities receive preferential treatment as long as they maintain the land as PGLs (a part of farmland) for 30 years.[7]

Table 2 shows the preferential treatment of UPA farmlands in the designated cities before and after the reforms in FY 1991. As can be seen from Table 2, following the reforms, farmland owners had the option to keep their farmland as UPA farmland. However, the owners face the same tax burden as housing lots. Usually, if landlords build apartments or commercial buildings and lend the buildings to others, they can reap more benefits. In this regard, farmland owners are expected to change the UPA farmland into housing lots after the reforms.

Our analysis is based on the theoretical model that contains three periods over which land prices stochastically evolve. With this model we establish two hypotheses: (1) The property tax reforms decrease the amount of farmland in urban areas (i.e., the UPA farmland). However, (2) the effect on the supply of housing lots is ambiguous.

To estimate the model using DID, following the previous arguments, we set the designated cities that were affected by the property tax reforms as the treatment group whereas all other cities that remained unaffected are in the control group. We use municipality level data for our empirical investigation. Another approach is to use micro data on individual landlords. However, in Japan, there are no household level data available that can be used to examine the behavior of landlords

[5] 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.

[6] Following the UK, the Japanese fiscal year is from April to the following March.

[7] For more information on the PGL, please visit: https://unu.edu/publications/articles/japan-s-urban-agriculture-what-does-the-future-hold.html. In the meantime, landlords can choose to preserve their land as PGL even after the reforms. However, in a practical manner, the reforms had an immediate effect because nearly all landowners who wanted to preserve their farmland designated them as PGLs at the timing of the reforms Therefore, we can assume the responses of the landlords with respect to two reforms as one-short events and apply DID estimation.

before and after the reforms.[8]

Our main findings from the empirical results substantiate these hypotheses. First, the share of the UPA farmland declined in the designated cities after the reforms of FY 1991. This is supported by DID estimation. These results remain the same even if we add other independent variables, confirming the robustness of our results. Second, when housing lots ratio is used as the dependent variable, we do not have statistically significant results for our treatment. Finally, on the other hand, our results imply that some landlords chose to preserve the land as the PGL. One important implication of these findings is that the abolishment of the long-term agricultural operation system was not as effective as expected because it shrunk UPA farmlands, which should in principle be converted into residential lots.

Our results contribute to two literatures. First, this study is related to the literature on the effects of preferential property tax treatment. A number of studies have addressed this issue: Brueckner (2001), 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 in solving deficiencies of farmland resources and the encroachment of farmland to the fringe due to urban sprawl. To our best knowledge, this is the first empirical and theoretical research that addresses the preferential treatment of farmland in urban areas.

Furthermore, our research contributes to the literature on the effects of property tax reforms that use natural or quasi-experimental approaches such as the reforms' effects on fiscal competition (Lyytikäinen 2012, Skidmore et al. 2012), the real estate market (Dachis et al. 2012), housing investments (Löffler & Siegloch 2015, Lutz 2015, Gemmell et al. 2017), and tax collection (Stine 2003, Ross & Yan 2013). However, to our knowledge, nobody has explored the reforms with respect to the preferential treatment of land use. We differentiate ourselves by utilizing a natural experiment provided by the two of FY 1991's reforms in Japan.

The rest of this paper is organized as follows. Section 2 explains the institutional background of Japan' s property tax system and preferential treatment on farmland. Here we explain this by introducing the case of the US and other countries first. 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 concludes.

[8] 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 the UPA farmland and other types; this is crucial to our analysis.

2. Institutional background

2.1. Experience with preferential treatment on farmland in the United States and other countries

Property taxes have served as major revenue sources to subnational governments around the globe. For example, property tax revenue is the primary source of tax receipt at the local level in the US. Indeed, on average, it accounts for 40% of total state and local tax revenues; some state and local governments count more heavily on property tax revenues than others.[9] What is more, although the property tax in Norway is a voluntary tax for the local governments, nearly 50% of them gained revenue from property taxation. In many countries, the property tax is applied to land. This is justifiable in terms of economic efficiency; since land is in fixed supply, a tax on land falls on landlords. Therefore, tax burden cannot be shifted onto others.

However, at the same time, many countries give various kinds of preferential treatments with regard to farmland in tax collection as summarized in Bird and Slack (2004). In fact, all 50 states in the U.S. adopt some form of use-value assessment for farmland. 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.

There are some rationales for conserving farmland through preferential treatment. For example, Lynch (2003) raises four points: 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. Furthermore, as stated in Brueckner (2011), in the circumstance that urban sprawl generates economic inefficiencies such as traffic congestion and air pollution, preferential treatment on farmland reins in the excessive urban expansion to the suburbs, which reduces inefficiency.

2.2. Japan's property tax system and preferential treatment on farmland

Table 3 outlines Japan's property tax system. Municipalities have the authority to impose property taxes, except for the 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%, and the reality is that not many local governments set the tax rate above 1.4%. When it comes to the share of the tax revenue of municipalities, as shown in Figure 1, property tax comprises 42% in FY2016, suggesting that municipalities heavily rely on property taxes.

Property tax is levied annually based on the assessment value of the aforementioned three taxable

[9] For more details, see the website: http://eyeonhousing.org/2017/10/property-taxes-by-state-2016/.

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 2 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).

Farmland in Japan is taxed much more lightly than housing lots as is done in other countries, but the UPA farmland is an exception; it is treated as housing lots when local governments make evaluations in the designated cities. The current City Planning Law (CPL), enacted in 1968, regards the UPAs as urban zones where existing farmland should, in principle, be converted to housing use from the viewpoint of urban planning in the designated cities.[10] In this regard, the UPA farmland in the designated cities can be defined as land that should 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 reflected farmers' special interests. Whereas the CPL aims to promote urbanization, the long-term agricultural operation system contradicts this objective because the system prevented landlords from converting the land for other uses.

2.3. The details with regard to the reforms in FY 1991

To solve the problems mentioned in Section 2.2, as addressed by Terai (2001) and Kabeya and Itaba (2009), in FY 1991, two reforms were simultaneously executed in the designated cities in order to not only decrease the proportion of "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). At the same time, the PGL Law was rectified in September 1991 and effective after January 1992. Under the amended PGL Law, UPA landlords whose farmland area is 500 m^2 or greater in the designated cities faced 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 FY 1991 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 can be divided into (1) bequest and (2) option. Needless to say, the inheritance tax is related to the motivation as a bequest,

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

whereas property tax affects whether landlords sell it in the future. The effects of the inheritance tax do not seem to be substantial, however, for three reasons. First, whereas the inheritance tax applies to landlords with heirs, the property tax is levied regardless of inheritors as long as landlords possess assets. Second, when it comes to the Japanese inheritance tax 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.[11] Finally, provided that life expectancy is uncertain, people do not necessarily factor in the long term. In this regard, the assumption that landlords keep the land as PGL for 30 years as a bequest is not plausible.[12]

3. Theoretical and empirical framework

3.1. 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 contains three periods over which land prices stochastically evolve[13] and 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 form rational expectation for future land prices and tax policies.

Before the property tax reforms, 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 requires 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 have to pay higher taxes according to the land value of residential use. By doing so, however, 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.

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[11] For these points, please visit: https://www.mof.go.jp/english/tax_policy/tax_system/asset/index.html#a01

[12] 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.

[13] Similarly, Anderson (1986) develops a dynamic model for the optimal timing of development (land improvement) with continuous time.

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.[14] 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 $E[P_t]$ be the expected 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 to sell their land, rather than intending to cultivate it. Figure 3 provides a timeline of their decisions. We consider that the reform is undertaken during the first period and becomes effective afterward. Accordingly, no tax is charged at t=1. As noted above, tax policy at period t=2 is uncertain before the reform. Let x_2 represent the government policy stance taking unity if agricultural land becomes subject to tax and zero otherwise. Then an effective tax is applied to farmland at period t=2, which can be written as $x_2\tau$ where x_2 is stochastic in the pre-reform era. After the reform, $x_2 = 1$ for UPAs and $x_2 = 0$ for PGL.

Designate j=*H, A* and *G* to housing, agriculture, and PGL, respectively. This corresponds to the three options farmland owners have: (1) Sell and convert the land to housing lots at period 1; (2) hold their property as farmland in UPA; or (3) maintain their land as PGL by committing not to sell the land at period t=2. There may be another option of lending land for housing use to gain rent revenue. We include this in j=*H*, interpreting P_t as the present value of rent. In the case of j=H, the payoff to the landlord equals $V_H = P_1$ which is not affected by the property tax reform. 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. Then, his payoff is given by

$$(1)\quad V_G^1 = (1+\beta)R + \beta^2 E_1[P_3]$$

where β <1 is the discount factor and the superscript 1 refers to the post-reform period. The second term is the expected price at t=3 from the first period perspective. For simplicity's sake, we assume zero property tax on the land for agricultural use. 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, i.e., either 0 or 1, the payoff from j=*A* becomes:

$$(2)\quad V_A^0 = R + \beta E_1[Max(P_2, R - \tau x_2 P_2 + \beta E_2[P_3])]$$

[14] The model is close to the optimal timing of a job search model. In this regard, the present model deviates from previous literature such as Arnott (2005), Brueckner (2001), and Brueckner and Kim (2003). Wassmer (2016) reviews theoretical findings as to how property taxes and urban sprawl interact.

where the superscript 0 denotes pre-reform and τ is the tax rate. The tax reform determines the tax rate at t=2 with certainty. The above pay-off after the reform is written as:

$$(3)\quad V_A^1 = R + \beta E_1[Max(P_2, R - \tau P_2 + \beta E_2[P_3])]$$

With j=*A*, the owner can keep the option of selling land at t=2. Such an option is not allowed 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 to sell and the tax burden at t=2. Such a tradeoff does not occur before the reform. Indeed, we have $V_A^0 > V_G^0$ 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

$$(4)\quad V_G^0 = (1+\beta)R - \beta E_1[\tau x_2 P_2] + \beta^2 E_1[P_3]$$

The difference from Eq. (1) is that 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) $V_A^0 > V_A^1$

(ii) $V_A^0 > V_G^0$

(iii) $V_G^0 < V_G^1$

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 charged on farmland in the UPA. The result is straightforward as the reform sets x_2 =1. Before the reform, j=*A* dominates commitment to holding farmland, as addressed in (ii); 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*. On the other hand, during the post-reform stage, the PGL (j=*G*) becomes more beneficial than holding farmland (j=*A*) due to the preferential tax treatment as stated in (iii).

We now turn to decision making by landowner over different options among j=*H*, *A* and *G*. In characterizing it, we adopt the setting of the random utility model that has been widely used in empirical literature on decision makings over options. To be specific, let landowner's utility from each option be given by $U_j = V_j + \varepsilon_j$ where ε_j is a random variable. It may represent transaction costs associated with land sale and non-pecuniary costs such as attachment to own land. Difference in risk aversion over land price change and thus risk premium to be paid may be incorporated in the random component as well. Then for instance landowner would like to hold land in the form of PGL if and only if

(5) $U_G = V_G + \varepsilon_G \geq U_j = V_j + \varepsilon_j \Leftrightarrow V_G - V_j \geq \varepsilon_j - \varepsilon_G$ for j=*A* and *H*.

The joint distribution of the three random variables, ε_j (j=*A*, *G*, *H*) yields the probability that option j is chosen against the other alternatives:

(6) $Q_j = F_j(V_A, V_G, V_H) = \Pr(\varepsilon_j - \varepsilon_i \geq V_j - V_i, i \neq j)$

The probability is increasing in V_j and declining with $V_i (i \neq j)$. In empirical studies on discrete choice over different alternatives, Eq. (6) is often specified as the multiple logit function.[15]

(7) $\Delta Q_A = F_A(V_A^1, V_G^1, V_H) - F_A(V_A^0, V_G^0, V_H)$

(8) $\Delta Q_H = F_H(V_A^1, V_G^1, V_H) - F_H(V_A^0, V_G^0, V_H)$

Eq. (7) becomes negative given that $V_A^0 > V_A^1$ and $V_G^0 < V_G^1$. This may be obvious since the tax reform raises the tax burden on holding farmland. Thus, option j=*A* becomes less likely to be exercised. On the other hand, Eq. (8) cannot be signed. Given $V_A^0 > V_A^1$, the choice of selling land at t=1 becomes more advantageous relative to holding it as farmland, whereas the gain from the commitment to PLG is enhanced due to preferential tax treatment leading to $V_G^0 < V_G^1$. Therefore, we can establish the following Proposition, which should be empirically confirmed:

<Proposition 1:>

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

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

3.2. Empirical framework

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

(9) $$L_{it} = \beta_0 + \beta_1 T_i + \beta_2 REFORM_t + \beta_3 D_{i,t} + \beta_4 C_{it} + \varepsilon_{it},$$

where L_{it} is the ratio of UPA farmland, 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

[15] The probability function is specified as $Q_j = \dfrac{\exp[V_j]}{\exp[V_A] + \exp[V_G] + \exp[V_H]}$.

takes 1 the period when the reforms are implemented and 0 for the others, $D_{i,t}(=T_i \times REFORM_t)$, C_{it} is the vector of other control variables, and ε_{it} is the disturbance term.

When it comes to the UPA farmland ratio, if the coefficients of $D_{i,t}$ are estimated to be negative and statistically significant, we conclude that the first hypothesis is substantiated. We also estimate Eq. (9) using housing lot ratio and farmland ratio as the dependent variable. We do so to check whether reduced UPA farmland was converted into housing lots. On top of that, the farmland ratio can also be used as the dependent variable to capture the change in PGL because the data on farmland also encompass PGL after the reforms.

For other control variables, as stated in Section 4.1., we add the effective tax rate of UPA farmland, local government tax revenue per total local government revenue, agricultural income, population density, and shipments.[16]

4. Data and discussion on the validity of DID estimation

4.1. Sample period, data, and city characteristics

To be consistent with our theoretical model, we focus on the duration before and after the reforms. Therefore, the sample period is from FY 1991 to FY 1992.[17]

Table 4 gives the description and source of the data used in estimation. All data on square (area) measure, property value, and 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). Note that after the reforms, a proportion of the UPA farmland may have become preserved as the PGL and has been added into ordinal farmland in the official statistics. 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. In this regard, as shown in Table 4, our data on land use in FY 1991 (April 1991–March 1992) come from the Brief Report on the Value of Properties in FY 1992, reflecting the land use in January 1992 when

[16] 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 the treatment.

[17] It would also be possible to extend the sample periods to include before FY 1990 and after FY 1993. However, even if some methods have been proposed in several previous studies (e.g., Bertrand et al. (2004)), we cannot confidently rule out the possibility of serial correlation in the DID estimation by including the periods outside the reforms. Furthermore, the influence of asset price bubbles over the periods from the late 1980s to FY 1990 makes this problem more serious.

the long-term agricultural operation system was still in effect. Likewise, the data in FY 1992 are from the Brief Report in FY 1993, which is based on the evaluation in January 1993. Meanwhile, since the data for other independent variables reflect the change from April to the following March, we can use these data for each fiscal year.

Data on local government tax revenue and total local government revenue come from the Statistics of the Final Accounts of Municipal Governments, and population data are from the Basic Resident Register. MIAC provides these data. Regarding the area of municipality, we use the data of the Area Statistics of Prefectures and Municipalities by the Geospatial Information Authority of Japan. 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.

When it comes to additional control variables, the coefficient on the effective tax rate, with respect to the UPA farmland, is expected to be negative when we estimate the model with UPA farmland ratio as the dependent variable.[18] 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 hope to capture the path through which the reduction in UPA farmland leads to an increase in housing lots.

Local tax revenue share in total local government revenue and population density are added as indicators of urbanization. Hence, the coefficients are expected to be positive when we use UPA farmland ratio or housing lots ratio as the dependent variable; on the other hand, we expect these coefficients to be negative when using farmland ratio as the outcome. Shipment addresses the size of manufacturing industries, and agricultural income is a proxy for rural areas. The coefficient of shipment is estimated to be positive when we use UPA farmland or housing lot ratio as the left-hand side variable, and negative if farmland ratio is employed as the dependent variable. The coefficient on agricultural income is expected to be negative when UPA farmland or housing lots ratio is used as the outcome, and positive in the case that farmland ratio is used as the left-hand side variable. We take the logarithm of agricultural income, population density, and shipment in the estimation.

We focus on 501 cities throughout the period from FY 1985 to FY 1994.[19] As stated in Section 4.2, we conduct a placebo test between FY 1985 and FY 1986. Therefore, we choose FY 1985 as the

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[18] 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.

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

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

[19] 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 sample exclude the 23 wards.

initial period. We chose 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 1991. When we examine the placebo effect, the city's characteristics should be the same.[20] Therefore, we do not include such cities. Finally, 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 that merged or disappeared from 1985 to 1994.

The process above yields a sample of 501 cities. Here, the treatment group comprises 183 designated cities, and the control group has 318. There are three cases for our treatment groups. We set this as the basic case and call it "Case 1."

As our second case, we limit our sample to cities with populations over 50,000 on average. This is why though there are some exceptions, under Japan's local public finance system, the population should be over 50,000 for municipalities 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 the two groups comparable, we restrict the sample to 206 cities with population over 50,000 on average throughout our sample period. This is "Case 2," and total number of cities is 389.

Furthermore, for the third case, we chose 104 cities with populations over 100,000 as our control group. This is defined as "Case 3," and the total number of cities is 287.

4.2. The validity of DID estimation

Table 5 reports the summary statistics of all variables used in estimation. Here, the UPA farmland ratio, our main outcome variable, plunged between FY 1991 and FY 1992 for the treatment group, while it did not change between the two fiscal years for the control group. On the other hand, while the difference between the two periods with regard to housing lots ratio is not large, farmland ratio increased after the reforms for the treatment group. These simple comparison before and after the reforms for our treatment and control groups suggest the following. First, the decrease in the UPA farmland at the timing of the reforms is consistent with our first hypothesis. Second, however, as indicated by our second hypothesis, landlords might not convert all UPA farmlands into housing lots, instead keeping them as PGLs.

Figures 4a to 6b show the average of the ratio for each item with regard to land use (each item per total land, respectively) between the designated cities (the treatment group or treated cities) and the remaining cities (the control group or untreated cities) from FY 1989 to FY 1994. According to Figures 4a, 5a, and 6a, in FY 1992, when the long-term agricultural operation was repealed and the

[20] 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.

amended PGL Law came into force, the share of UPA farmland fell dramatically in the designated cities from the previous year; on the other hand, the ratio did not change after the reforms in the remaining cities. Therefore, the two concurrently implemented reforms are useful in reducing UPA farmland in the designated cities.

On the other hand, the right charts of Figures 4b, 5b, and 6b suggest that landlords did not convert all 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 1992 in comparison to FY 1991. However, these figures suggest this was not the case.

In the meantime, as noted earlier, PGL is included in farmland data of the Brief Report on the Value of Properties after the reforms. Although it is impossible for us to extract PGL from MIAC data, Figures 4b, 5b, and 6b also suggest that the farmland ratio temporarily rose between FY 1991 and FY 1992 for the designated cities. This implies that some landlords might decide to keep farmland as PGL after the reforms.

These figures imply that our hypotheses may be true. To substantiate them, we should perform an econometric investigation using Equation (9). We discuss the validity of this method by focusing on the UPA farmland ratio, the main outcome that we would like to address to examine the effects of the reforms.

First, 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. Moreover, the government set the assessed value of land at 70–80% of the market value in FY 1994, which some landlords might respond to 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.

Second, we check the common trend assumption using Figures 4a, 5a, and 6a. The identifying assumption of our DID specification is that both the treated and untreated cities would have to follow the same time trend in the absence of the reforms in FY 1991. If this common trend assumption holds, our empirical strategy allows us to control for all unobserved differences between the two groups. The average of the share of UPA farmland moved almost in parallel in the designated and remaining cities between FY 1989 and FY 1990, with the proportion of UPA farmland declining slightly in the two groups. Therefore, these graphs provide visual evidence of treatment and control cities, with a common underlying trend for pretreatment periods.[21]

Furthermore, we present the results of the placebo test for our simple DID estimation (without any control variables) for the case where the UPA farmland ratio is used as the dependent variable. This is

[21] Meanwhile, we also implement Autor (2003)'s type Granger Causality test to check whether or not landlords change the behavior before the reforms. For both cases, null hypothesis is not rejected.

done in order to further verify the common trend assumption. Notice that, since the duration of the asset price bubble was from December 1986 to February 1991, the period between FY 1989 and FY 1990 contains the peak and collapse of the asset bubble in Japan. Even if the common shocks assumption is not violated because the business cycle fluctuation in these periods affects both groups, it would be favorable not to include the asset price bubble period in the estimation. Therefore, we conduct our placebo test for FY 1985 and FY 1986. The placebo treatment variable is equal to 1 for FY 1986. No results in Table 6 are statistically significant, and there are no differences between the treated and untreated cities before the reforms.

5. Empirical results

Table 7 reports the estimation results of simple DID estimation without control variables. For the case where the UPA farmland ratio is used as the dependent variable, the coefficients of $D_{i,t}$ (DID estimate within the table) are estimated to be negative and significant for all cases. However, once we use the housing lot ratio as the dependent variable, the coefficients are not statistically significant under any cases. The rest of the columns of Table 7 show that the coefficients of $D_{i,t}$ are estimated to be positive and significant in Cases 1 and 2, implying that after the treatment the PGL in the designated cities increased. However, we cannot confirm statistically significant results in Case 3.

We also estimate Eq. (9). Tables 8 to 10 present the results. Table 8 confirms that after the reforms, the UPA farmland ratio decreased as was suggested by our simple DID estimation for all cases. Also, the estimated coefficients are close to the simple DID estimation. Therefore, we also establish that the results regarding the UPA farmland ratio are robust. Meanwhile, Table 9 reports that the coefficients of $D_{i,t}$ are not estimated to be statistically significant when we use housing lot ratio as a dependent variable. However, as you can see from Table 10, the coefficients are estimated to be positive and significant in Cases 1 and 2 with farmland ratio as the outcome.

Tables 8 to 10 confirm our first hypothesis. The tables also imply that after the reforms some landlords preserved UPA farmland as PGLs rather than convert them into housing lots, which is consistent with the second hypothesis.

It is likely that most landlords, who often engaged in other jobs, would like to escape a higher tax burden. Indeed, most Japanese farmers work part-time and have second jobs.[22] They earn enough income from other sources, which may induce them to preserve farmland as PGL so that they can

[22] *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.

escape a higher tax payment. 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. What is more, Onishi et al. (1992) surveyed farmers in Osaka at the timing of the reforms; approximately 50% of the respondents said they chose to conserve their land as PGLs in order to lower their tax burden, supporting our interpretation above.

Among the control variables, the coefficients on the effective tax rate are estimated to be negative and significant in the case where the UPA farmland ratio is used as the dependent variable. On the other hand, these coefficients are estimated to be positive and significant when we use the housing lot ratio as the dependent variable. This suggests that while a hefty effective tax rate reduces UPA farmland, the reduced land would be converted into housing lots. For all cases, the coefficients of the logarithm of population density are estimated to be positive and significant in Tables 8 and 9, and negative in Table 10 as we expected. The coefficients of shipment is estimated to be positive for all cases and statistically significant in Tables 9 and 10. However, the coefficient of the logarithm of agricultural income is estimated to be negative and significant regardless of the dependent variables. In Japan, cropping vegetables and fruits, which require little land, have shared a substantial part of agricultural income. Therefore, there would be a negative relationship between the size of farmland and agricultural income. This may be the reason why the coefficient is estimated to be negative when we use farmland ratio as the dependent variable.

6. Conclusion

This paper examines how the property tax reforms affect land use through theoretical and empirical investigation by focusing on land use tax reforms that took place in the 1990's in Japan. On one hand, as stated in Brueckner (2011), preferential property tax treatment can solve economic inefficiencies such as traffic congestion and air pollution caused by urban sprawl. On the other hands, preferential property tax treatment on farmland in urban areas may cause another type of inefficiency indicated by Bruce (2000). 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 lots. The results also suggest that the PGL Law should not have been amended because not all the farmland was converted into housing lots, the problem of obstructed urbanization remains to be solved. Hence, obstructing the urbanization remains to be resolved.

Our findings imply that policy makers should be wary of unintended consequences when they make changes to laws concerning preferential property tax treatments. The preferential treatment to protect urban agriculture, which has been also employed in some other countries, may become

controversial; it may make housing shortage more severe in major cities.[23] Japan's experience may not be unique. If there is a loophole such as the amended PGL law, it may work against the aim of promoting urbanization. Meanwhile, there are caveats to generalizing our results. For example, the results apply only to countries where farmland owners earn larger income from another source. Our interpretation is based upon the fact that part-time farmers, whose fraction is larger in Japan than in other countries, have an incentive to keep farmland to avoid a heavier tax burden. Nevertheless, our research demonstrates that if the exception becomes a rule, the reforms with regard to preferential treatment will lead to unintended consequences, as in the case of many tax reforms.

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[23] For example, as mentioned in Nagourney and Dougherty (2017), shortages of homes and apartments has led to the exorbitant housing costs in major cities in California. For more details, please see the website: https://www.nytimes.com/2017/07/17/us/california-housing-crisis.html.

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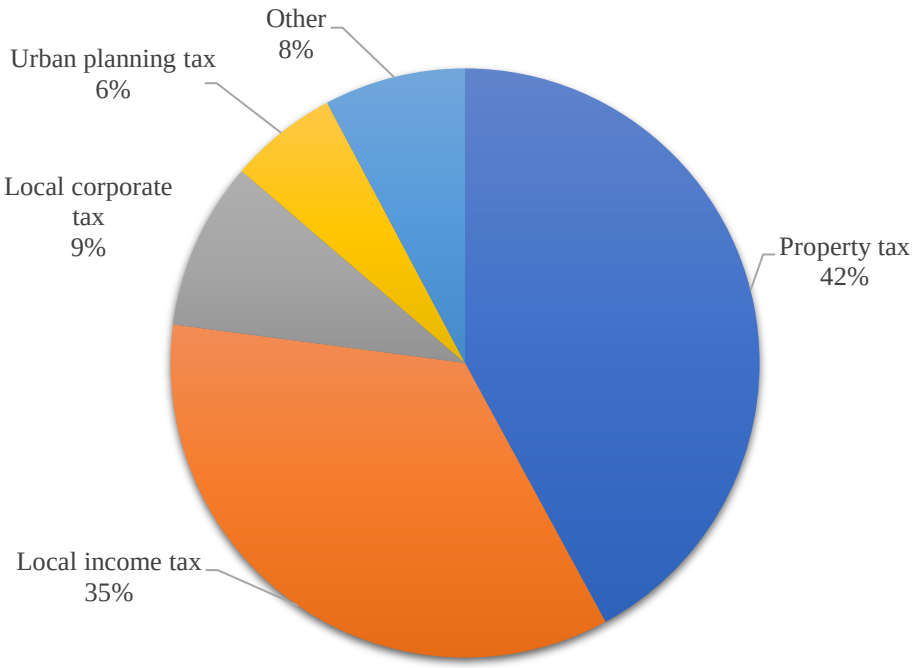
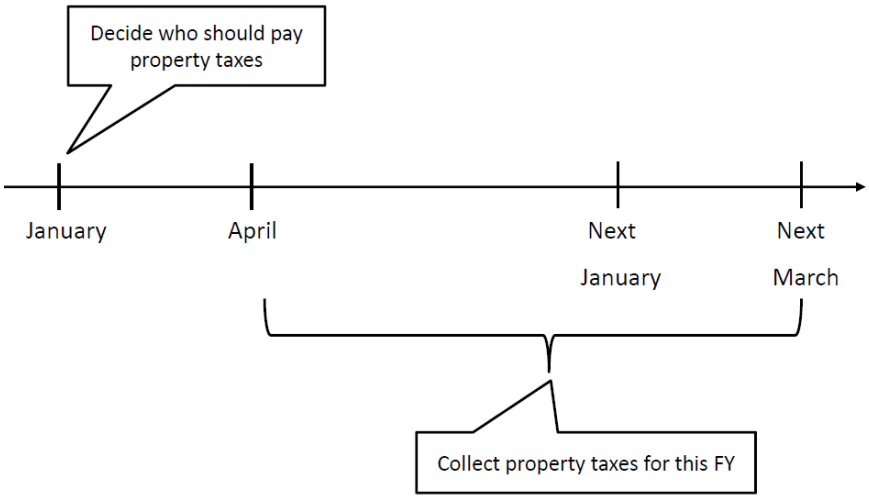
Figure 1. Share of tax revenue of municipalities in Japan (FY 2016)



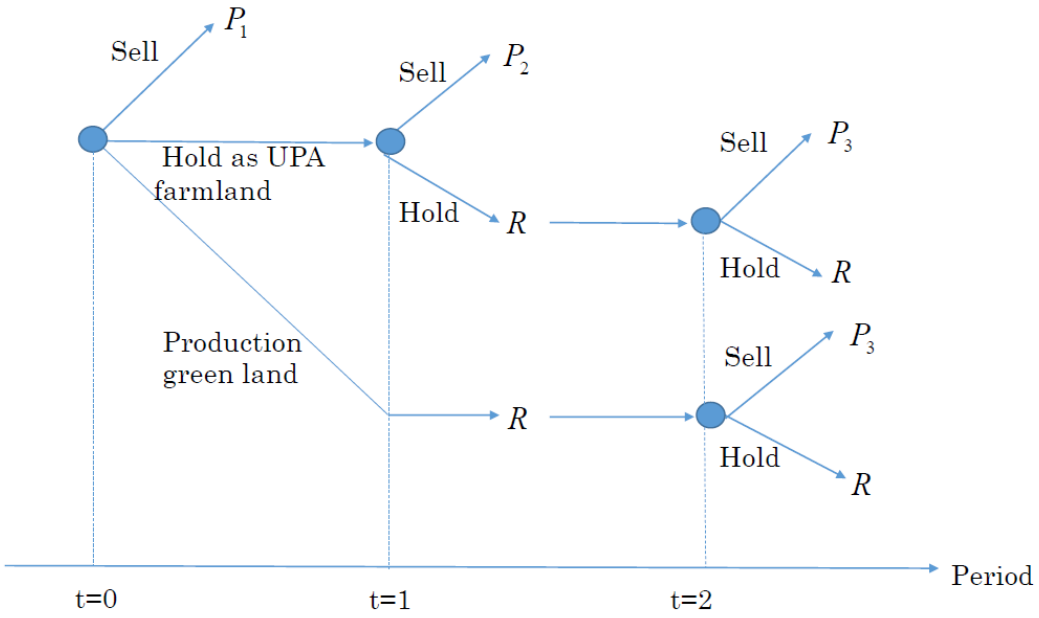
Source: The White Paper on Local Public Finance (issued by MIAC)

Figure 2. The timing of the assessment and levy of property taxes in Japan



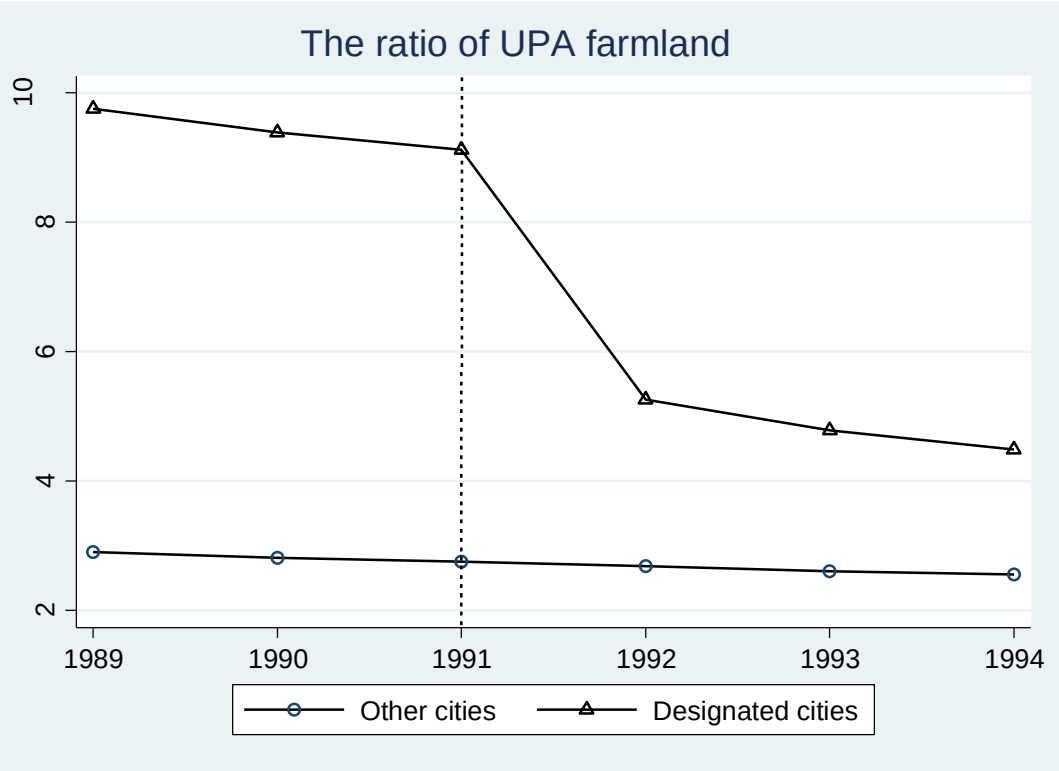
Notes: The Japanese fiscal year runs from April to the following March. Under the Japanese property tax administration system, tax liability is determined by ownership of assets, based on the value as of January. Municipalities collect property taxes over the next fiscal year in reference to this record.

Figure 3. The timeline of the decision



Notes: UPA farmland refers to the farmland in the urban promotion areas.

Figure 4a. Trends in UPA farmland ratio (Case 1, unit=%)



Notes: UPA farmland stands for the farmland in the urban promotion areas. Each series plots the average of the share of UPA farmland per total land (=UPA farmland + housing lots + ordinary farmland) from FY 1989 to FY 1994. The definition of "designated cities" in this paper is the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai). The dotted vertical line indicates the year (FY 1991) that the two reforms were conducted, which were presented in Tables 1 and 2.

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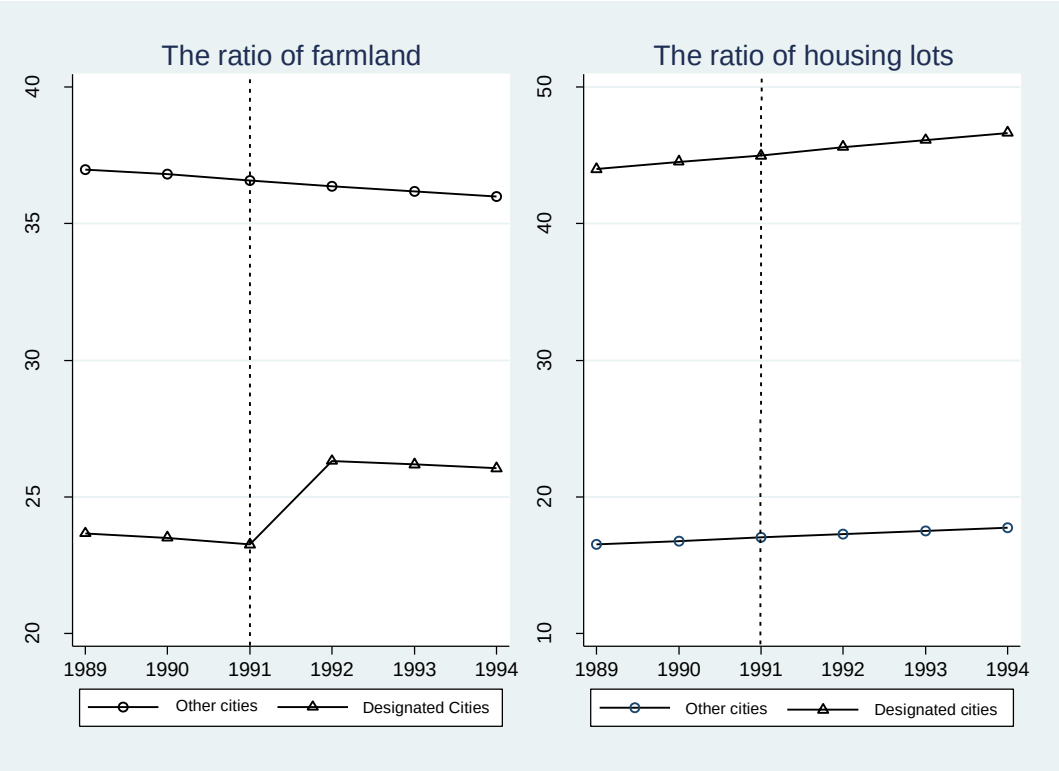
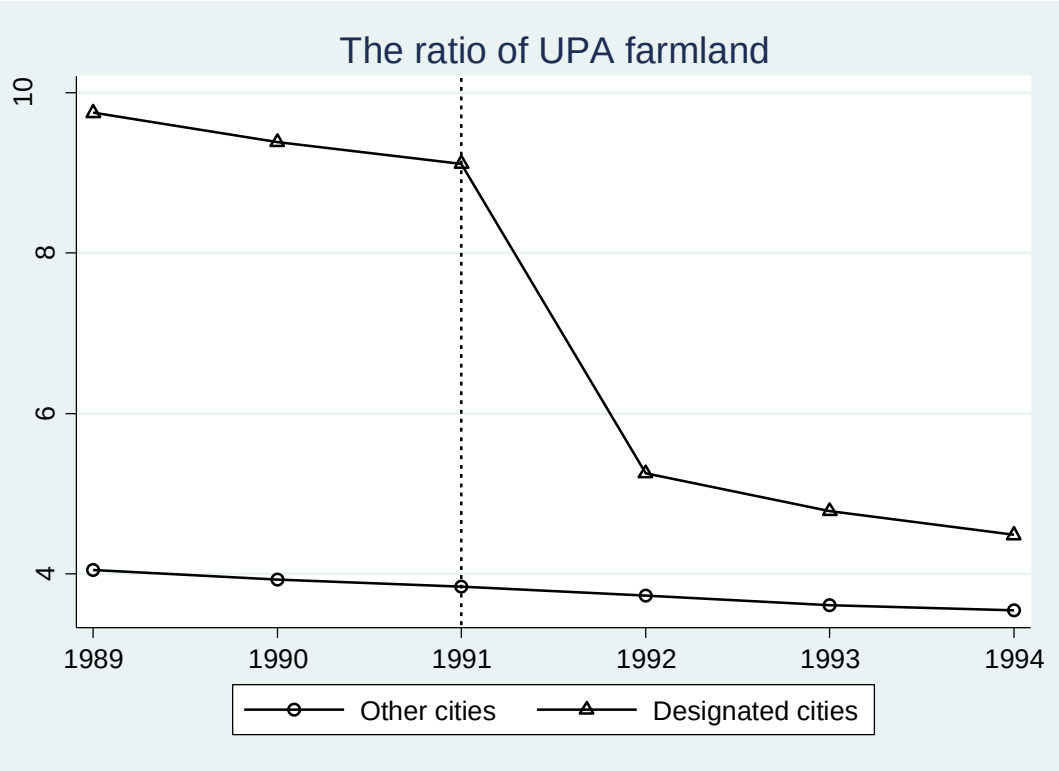
Figure 4b. Trends in ordinary farmland and housing lots ratio (Case 1, unit=%)



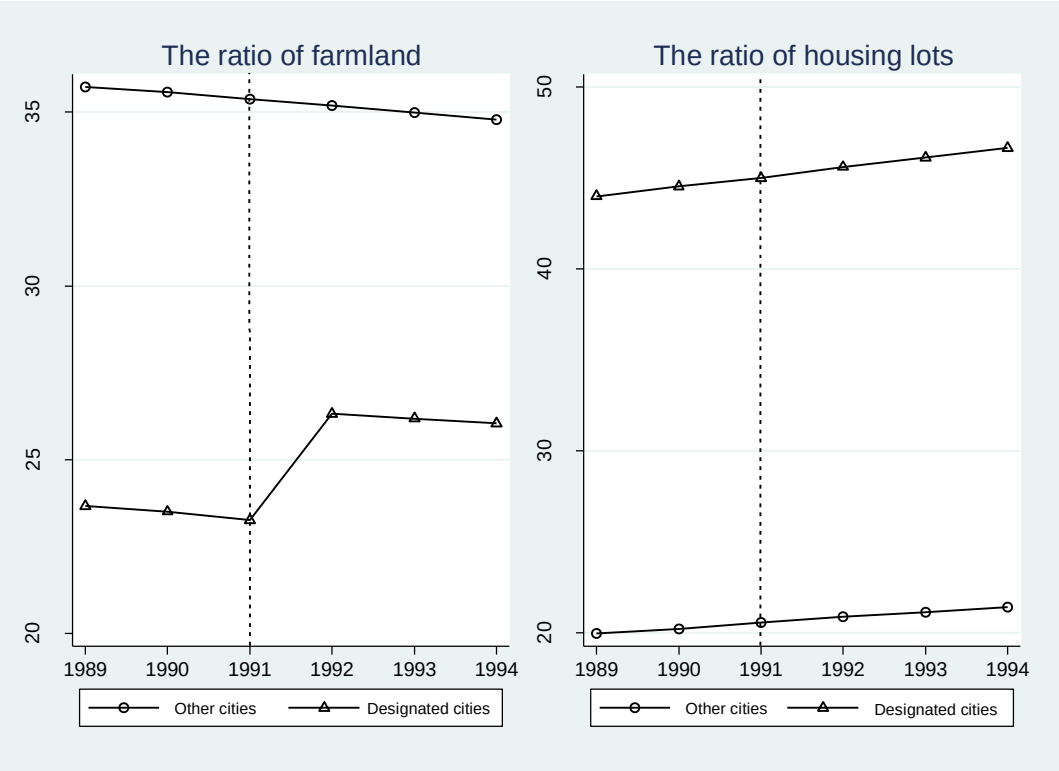
Notes: "Farmland" within the figure stands for ordinary farmland. Each series plots the average of the share of ordinary farmland or housing lots per total land (=UPA farmland + housing lots + ordinary farmland) from FY 1989 to FY 1994. The definition of "designated cities" in this paper is the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai). A dotted vertical line within the graph indicates the year (FY 1991) that the two reforms were conducted, which were presented in Tables 1 and 2.

Figure 5a. Trends in UPA farmland ratio (Case 2, unit=%)



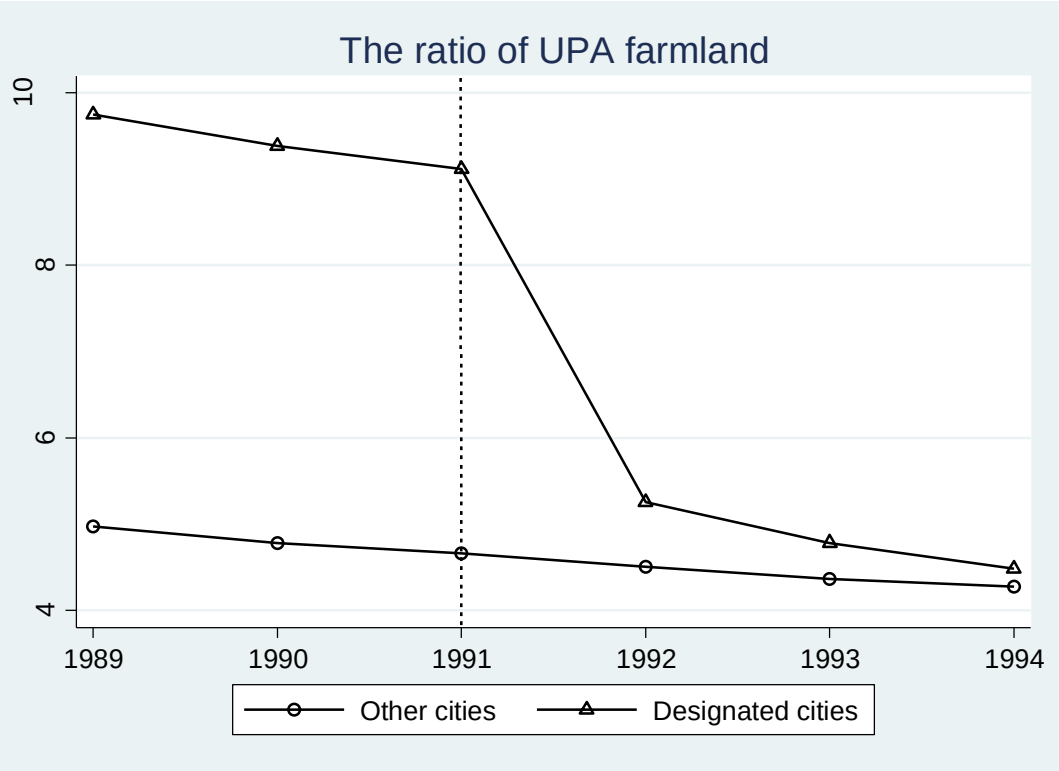
Notes: UPA farmland stands for the farmland in the urban promotion areas. Each series plots the average of the share of UPA farmland per total land (=UPA farmland + housing lots + ordinary farmland) from FY 1989 to FY 1994. The definition of "designated cities" in this paper is the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai). A dotted vertical line within the graph indicates the year (FY 1991) that the two reforms were conducted, which were presented in Tables 1 and 2.

Figure 5b. Trends in ordinary farmland and housing lots ratio (Case2, unit=%)



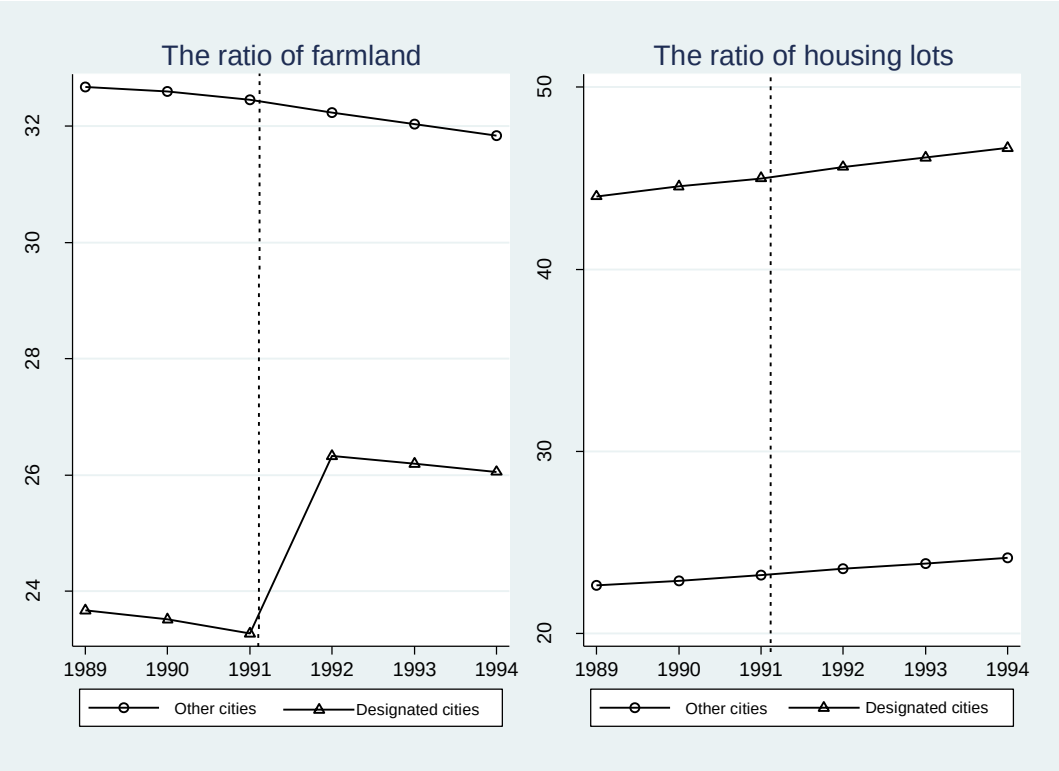
Notes: "Farmland" within the figure stands for ordinary farmland. Each series plots the average of the share of ordinary farmland or housing lots per total land (=UPA farmland + housing lots + ordinary farmland) from FY 1989 to FY 1994. The definition of "designated cities" in this paper is the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai). A dotted vertical line within the graph indicates the year (FY 1991) that the two reforms were conducted, which were presented in Tables 1 and 2.

Figure 6a. Trends in UPA farmland ratio (Case 3, unit=%)



Notes: UPA farmland stands for the farmland in the urban promotion areas. Each series plots the average of the share of UPA farmland per total land (=UPA farmland + housing lots + ordinary farmland) from FY 1989 to FY 1994. The definition of "designated cities" in this paper is the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai). A dotted vertical line within the graph indicates the fiscal year (FY 1991) that the two reforms were conducted, which were presented in Tables 1 and 2.

Figure 6b. Trends in ordinary farmland and housing lots ratio (Case 3, unit=%)



Notes: "Farmland" within the figure stands for ordinary farmland. Each series plots the average of the share of ordinary farmland or housing lots per total land (=UPA farmland + housing lots + ordinary farmland) from FY 1989 to FY 1994. The definition of "designated cities" in this paper is the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai). A dotted vertical line within the graph indicates the year (FY 1991) that the two reforms were conducted, which were presented in Tables 1 and 2.

Table 1. History of the preferential treatment for the UPA farmland in the designated cites within the three metropolitan areas.

Year	Month	
1982	April	The enactment of the long-term agricultural operation system
1991	September	The amendment of the Production Green Land (PGL) Law
1992	January	The Production Green Land (PGL) Law has comes into effect (until March 2023)
	March	The repeal of the long-term agricultural operation system

Notes: UPA farmland refers to the farmland in the urban promotion areas.

Table 2. The classification of the UPA farmland in the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai) before and after the reforms in FY 1991

	Type of farmland	Preferential treatment
Before the reforms (FY 1982-FY1992)	UPA farmland	Yes
After the reforms (FY 1992 - FY 2022 (expected))	Production Green Land (PGL)	Yes (for 30 years)
	UPA farmland (except PGL)	No (taxed as residential lots)

Notes: UPA farmland refers to the farmland in the urban promotion areas. The Japanese fiscal year runs from April to the following March. UPA farmland is classified as either production green land (PGL) or non-PGL UPA farmland following the reforms.

Table 3. An outline of Japan's property tax system

Tax authority	Municipalities (cities, towns, and villages) assess, levy, and collect 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	Statutory tax rate: 1.4 %**

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

** The upper limit is 2.1%

Table 4. The description and source of the data

Description	Source
The square measure of UPA farmland, housing lots, and farmland (unit: ㎡)	The Brief Report on the Value of Properties (FY 1992 and FY1993) *
Tax base and property value of UPA farmland (unit: million JPY)	The Brief Report on the Value of Properties (FY 1992 and FY 1993) *
Population	The Basic Resident Register (FY 1991 and FY 1992)
The area of municipality (unit: ㎡)	The Area Statistics of Prefectures and Municipalities (FY 1991 and FY 1992)
Agricultural production income (unit: million JPY)	The Production Agricultural Income Statistics (FY 1991 and FY 1992)
Shipment value of manufactured goods (unit: million JPY)	The Industry Statistics (FY 1991 and FY 1992)
Local government tax revenue and total local government revenue (unit: million JPY)	The Statistics of the Final Accounts of Municipal Governments (FY 1991 and FY 1992)

* 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, as indicated in Figure 2. In this regard, our data with regard to land use in FY 1991 (April 1991–March 1992) come from the Brief Report on the Value of Properties in FY 1992, reflecting the land use in January 1992 (still within FY 1991) when the long-term agricultural operation system was still in effect. Likewise, the data in FY 1992 are from the Brief Report in FY 1993, which indicates the evaluation in January 1993 (within FY 1992).

Table 5. Summary statistics

Group		Treatment							Control						
Variable	Description	FY1991			FY1992			(1) Growth rate (FY1992-1991, %)	FY1991			FY1992			(2) Growth rate (FY1992-1991, %)	Dif (1)-(2),%
		N	mean	Std. Dev.	N	mean	Std. Dev.		N	mean	Std. Dev.	N	mean	Std. Dev.		
UPA farmland ratio	The ratio of UPA farmland per total land	183	0.0912	0.0612	183	0.0526	0.0282	-42.323	318	0.0276	0.0326	318	0.0268	0.0316	-2.829	-39.494
Housing lots ratio	The ratio of housing lots per total land	183	0.4499	0.2118	183	0.4562	0.2136	1.388	318	0.1704	0.1094	318	0.1730	0.1105	1.557	-0.168
Farmland ratio	The ratio of farmland per total land	183	0.2327	0.1854	183	0.2632	0.1706	13.117	318	0.3659	0.1676	318	0.3638	0.1671	-0.576	13.693
Effective tax rate	Effective tax rate of UPA farmland	183	0.0057	0.00112	183	0.0063	0.0011	11.300	318	0.0058	0.0055	318	0.0067	0.0057	15.340	-4.040
Population density	Population per the area of municipality	183	4233.6	3013.3	183	4261.4	3017.91	0.656	318	783.2	725.919	318	786.28	731.88	0.394	0.263
Agricultural income	Agricultural production income	183	1684.9	1775.33	183	1540.9	1654.74	-8.546	318	3638.9	3259.74	318	3636.7	3108.7	-0.061	-8.485
Shipment	Shipment value of manufactured goods	183	713710	1272310	183	683154	1216806	-4.281	318	342281	447711	318	332138	432097	-2.963	-1.318
Local tax revenue ratio	Local government tax revenue per total local government revenue	183	0.5318	0.09712	183	0.5284	0.09912	-0.638	318	0.3693	0.11793	318	0.362	0.1159	-1.981	1.344

Notes: See Table 4 for the definitions and data sources of all the variables.

Table 6. Results from a series of placebo tests for the simple DID estimation (without control variables, FY 1985-1986). Dependent variable: UPA farmland ratio

	Case1	Case2	Case3
DID estimate	-0.001	-0.001	-0.0001
	(0.007)	(0.008)	(0.011)
R_2	0.34	0.25	0.16
N. of treated municipalities	183	183	183
N. of control municipalities	318	206	104

Note: The placebo treatment variable ($REFORM_t$) is equal to 1 for FY 1986. Heteroskedasticity-robust standard errors are in parentheses. DID estimate indicates $D_{s,t}(=T_i \times REFORM_t)$ of Equation (9).

Table 7. Simple DID estimates (without control variables). Sample periods=FY1991-FY1992

Dependent variable	Ufarm			Housing			Farm		
	Case1	Case2	Case3	Case1	Case2	Case3	Case1	Case2	Case3
DID esimate	-0.038 ***	-0.037 ***	-0.037 ***	0.004	0.003	0.003	0.033 *	0.032 *	0.033
	(0.005)	(0.006)	(0.007)	(0.02)	(0.024)	(0.031)	(0.022)	(0.025)	(0.03)
R_2	0.29	0.22	0.18	0.43	0.35	0.26	0.1	0.09	0.05
N. of treated municipalities	183	183	183	183	183	183	183	183	183
N. of control municipalities	318	206	104	318	206	104	318	206	104

Notes: “Ufarm” means the share of urbanization promotion area farmland in total land (=UPA farmland + housing lots + ordinary farmland), “Housing” is the share of housing lots in total land, and “Farm” indicates ordinary farmland ratio per total land. Heteroskedasticity-robust standard errors are in parentheses. “DID estimate” indicates $D_{s,t}(=T_i \times REFORM_t)$ of Equation (9). Asterisks indicate significance levels: * = 10%, and *** = 1%.

Table 8. DID estimates with control variables. Dependent variable= the share of urbanization promotion area farmland per total land. Sample periods=FY1991-FY1992

	Case1	Case2	Case3
DID estimate	-0.038 ***	-0.038 ***	-0.037 ***
	(0.005)	(0.005)	(0.005)
T_i	0.018 ***	0.011 ***	0.007 *
	(0.002)	(0.004)	(0.005)
$REFORM_t$	0.001	0.001	0.001
	(0.002)	(0.002)	(0.003)
Effective tax rate	-1.643 ***	-2.117 ***	-2.743 ***
	(0.17)	(0.228)	(0.495)
Local tax revenue	0.014	0.025 **	0.022
ratio	(0.012)	(0.014)	(0.018)
Agricultural income	-0.008 ***	-0.012 ***	-0.014 ***
	(0.002)	(0.002)	(0.003)
Population density	0.028 ***	0.033 ***	0.036 ***
	(0.002)	(0.002)	(0.002)
Shipment	0.001	0.002	0.002
	(0.002)	(0.002)	(0.002)
const	-0.063 ***	-0.067 ***	-0.057 ***
	(0.015)	(0.018)	(0.022)
R_2	0.593	0.546	0.478
N. of treated municipalities	183	183	183
N. of control municipalities	318	206	104

Notes: We take the logarithm regarding agricultural income, population density, and shipment in our estimation.

"DID estimate" indicates $D_{s,t}(=T_i \times REFORM_t)$ of Equation (9). Asterisks indicate significance levels: * = 10%, **=5%, and *** = 1%.

Table 9. DID estimates with control variables. Dependent variable= the share of housing lots per total land. Sample periods=FY1991-FY1992

	Case1	Case2	Case3
DID estimate	0.003	0.002	0.0005
	(0.013)	(0.012)	(0.013)
T_i	0.006	-0.022 **	-0.037 ***
	(0.01)	(0.01)	(0.012)
$REFORM_t$	0.0004	0.002	0.003
	(0.005)	(0.012)	(0.008)
Effective tax rate	3.834 ***	4.317 ***	4.994 ***
	(0.597)	(0.769)	(1.254)
Local tax revenue	-0.095 ***	0.004	0.003
ratio	(0.033)	(0.043)	(0.048)
Agricultural income	-0.017 ***	-0.022 ***	-0.024 ***
	(0.005)	(0.006)	(0.007)
Population density	0.166 ***	0.189 ***	0.208 ***
	(0.005)	(0.005)	(0.006)
Shipment	0.007 *	0.013 **	0.016 ***
	(0.004)	(0.005)	(0.006)
const	-0.771 ***	-0.97 ***	-1.117 ***
	(0.054)	(0.059)	(0.069)
R_2	0.834	0.836	0.829
N. of treated municipalities	183	183	183
N. of control municipalities	318	206	104

Notes: We take the logarithm of agricultural income, population density, and shipment in our estimation. "DID estimate" indicates $D_{s,t}(=T_i \times REFORM_t)$ of Equation (9). Asterisks indicate significance levels: * = 10%, **=5%, and *** = 1%.

Table 10. DID estimates with control variables. Dependent variable= the share of ordinary farmland per total land. Sample periods=FY1991-FY1992

	Case1	Case2	Case3
DID estimate	0.032 *	0.032 *	0.031
	(0.021)	(0.022)	(0.027)
T_i	-0.043 **	-0.014	-0.023
	(0.019)	(0.02)	(0.023)
$REFORM_t$	0.006	0.006	0.004
	(0.013)	(0.017)	(0.022)
Effective tax rate	-2.591 ***	-2.047	2.182
	(1.323)	(1.732)	(2.746)
Local tax revenue	-0.058	-0.006	0.125 **
ratio	(0.059)	(0.063)	(0.068)
Agricultural income	-0.061 ***	-0.063 ***	-0.058 ***
	(0.009)	(0.009)	(0.01)
Population density	-0.025 ***	-0.057 ***	-0.08 **
	(0.008)	(0.008)	(0.01)
Shipment	0.026 ***	0.025 ***	0.016 **
	(0.006)	(0.007)	(0.007)
const	0.933 ***	1.174 ***	1.335 ***
	(0.073)	(0.081)	(0.09)
R_2	0.19	0.25	0.278
N. of treated municipalities	183	183	183
N. of control municipalities	318	206	104

Notes: We take the logarithm of agricultural income, population density, and shipment in our estimation. "DID estimate" indicates $D_{s,t}(=T_i \times REFORM_t)$ of Equation (9). Asterisks indicate significance levels: * = 10%, **=5%, and *** = 1%.