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Miyazaki, Tomomi

Sato, Motohiro

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Property tax and farmland use in urban areas:

Evidence from the reform in the early 1990s in Japan

Tomomi Miyazaki[a] and Motohiro Sato[b]

It is often said that farmland conservation in urban areas (i.e., cities and inner suburbs) is not desirable because it hinders the conversion of farmland into residential areas, thereby deterring urbanization. To solve such a problem, the Japanese government rectified the property tax preferential treatment of urban farmland in the 1990s. We utilize this reform as a natural experiment and examine its impact on land use. The empirical results show that the reform did not encourage the conversion of urban farmland into housing lots. This is one of the reasons concerning the shortage of housing supply in urban areas in Japan.

JEL Classification: H22, H71, R51
Key words: Property tax, land use in urban area, preferential treatment on farmland, urbanization

[a] Corresponding Author. *Graduate School of Economics, Kobe University, 2-1 Rokkodai-cho Nada-ku, Kobe, Hyogo, 657-8501, Japan*. *E-mail address*: miyazaki@econ.kobe-u.ac.jp (T. Miyazaki).
[b] *Graduate School of Economics, Hitotsubashi University, 2-1 Naka, Kunitachi, Tokyo, 186-0002, Japan*. *E-mail address*: satom@econ.hit-u.ac.jp (M. Sato).

> *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

In a standard public finance textbook, property tax on land is neutral with respect to resource allocation. However, the reality is that property tax is distortive because preferential tax treatment is provided for certain use of land.[1] Indeed, the taxable value of farmland turns out to be lower than that of housing lots in many countries.[2] Such preferential treatments are also given to farmland within cities and inner suburbs (hereafter defined as urban areas).[3] In this circumstance, landowners will be reluctant to convert their farmland for other uses. Consequently, more valuable uses (e.g., housing lots or office buildings) may be forgone as suggested by Bruce (2000), which may ultimately hinder urbanization. However, to our knowledge, the effects of preferential property tax law reforms on land use in urban areas remains underexplored.

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[1] Regarding the overview on the neutrality or non-neutrality of property tax, see Arnott (2005).
[2] 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.
[3] Some local governments in the US give preferential treatment on urban farmland via use-value assessment as indicated by Anderson and England (2014); 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.

The objective of this study is to examine the effects of the property tax reform in Japan in the 1990s, abolishing preferential tax treatment in the urban areas. In fact, Japanese local governments in the three metropolitan areas (Tokyo, Chubu, and Kansai) have been eager to preserve farmland, leading to the circumstances discussed by Bruce (2000).[4] The fundamental reform aimed to limit the preferential tax measures so as to induce landowners to transform their farmland into residential lots.

Let us touch upon the preferential treatment of farmland and the history of the reform in Japan. Farmland in Japan has been classified as either ordinary farmland or farmland in urban promotion areas (hereafter UPA farmland). UPA farmland in the designated cities within the three metropolitan areas (hereafter referred to as the designated cities) is taxed as housing lots. Note that the terminology "designated cities" follows Ishi (1991), and does not mean that the government chose these cities solely for tax purposes (see Section 2 details on the selection process).[5] Meanwhile, the data on housing lots also encompasses commercial land within the Japanese official statistics on property taxes. Although we use the word "housing lots (or residential lots)" to put it simply, bear in

[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.

[5] 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.

mind that this phrase means the land for both business and residential purposes.

However, in practice, there existed preferential property tax treatment for the UPAs in the designated cities prior to the reform. Accordingly, many farmland owners in the major cities exploited this system and escaped higher tax burdens by "disguising" their property as farmland, which was pointed out by Ishi (1991). To solve this problem, the preferential property tax measure was repealed at the end of FY 1991 (March 1992), details of which are presented in Section 2.[6] The reform, which took effect in FY 1992, aimed to induce landowners to convert their farmland into housing lots such as apartments and commercial buildings, which was expected to encourage urbanization.

We examine impacts of the tax reform using difference in difference (DID) estimation. We set the designated cities as the treatment group whereas all other comparable cities are as the control group. Municipality level data are used for our empirical investigation.[7]

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

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

[7] Another possibility would be to use micro data on individual landlords, but there are no household level data available. 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 reform 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.

this issue: Brueckner (2001), Brueckner and Kim (2003), Lynch (2003), Song and Zenou (2006, 2009), Polyakov and Zhang (2008), 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 the rationale for such treatment is addressed. In contrast, the novelty of this study is to conduct empirical analyses on the distortionary effects of the preferential treatment on land use in urban areas.[8]

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 and Siegloch 2015, Lutz 2015, Gemmell et al. 2019), and tax collection (Stine 2003, Ross and Yan 2013). However, to our best 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 reform in Japan.

[8] 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.

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. Section 3 presents our empirical framework. Section 4 explains the data and discusses the assumptions to validate our DID estimation. Section 5 reports the empirical results. Section 6 concludes.

2. Institutional background and our empirical hypotheses

2.1. Experience with preferential treatment on farmland around the world

Property taxes have served as major revenue sources to subnational governments around the globe. Also, many countries give various kinds of preferential treatments with regard to farmland in tax collection. 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.

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

The Japanese local government has two tiers: prefectures and municipalities (cities, towns, and villages). 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 tax is levied annually based on the assessment value of the three taxable assets (land, houses, buildings, and depreciable business assets (tangible assets except for land and buildings)). Tax liability is determined by ownership of 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, but as previously stated, the UPA farmland in the designated cities is an exception. The City Planning Law regards the UPAs in the designated cities as urban zones where existing farmland should, in principle, be converted to housing use from the viewpoint of urban planning.[9] In this regard, the UPA farmland in the designated cities can be defined as land expected to be changed into housing lots.

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

Meanwhile, 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. Whereas the City Planning Law aims to promote urbanization, the long-term agricultural operation system contradicts this objective because the system prevented landowners from converting the land for other uses.

2.3. Details on the reform, econometric method, and our hypotheses

To solve the problems mentioned in Section 2.2, the long-term agricultural operation system was abolished at the end of FY 1991 (March 1992). Therefore, FY 1992 is our treatment year. As can be seen from Table 1, the UPA farmland in the designated cities has been taxed as housing lots since FY 1992. The aim of this reform was to not only decrease the proportion of "disguised" farmland, but also to spur the development of housing lots.

However, the UPA landowners could maintain preferential tax treatment if they committed to preserving their farmlands as Production Green Land (PGL) for the next 30 years. The PGL Law, whose objective is to keep green space within urban promotion areas, was rectified and came into effect in January 1992.[10] Under the amended PGL

[10] For more information on the PGL, please visit: https://unu.edu/publications/articles/japan-s-urban-agriculture-what-does-the-future-hold.html.

Law, UPA landowners with farmland area of 500 m^2 or greater in the designated cities faced two options: (1) Convert farmland into housing lots; or (2) Preserve it as PGL for 30 years. When they chose the latter option, they could not convert the land for another use over 30 years. This is attributed to the institutional arrangement of the PGL, with the mandate of 30 years of cultivation; indeed, Table 2 shows that while the UPA farmland except PGL gradually decreased, PGL barely changed even after the reform.

As addressed by Terai (2001), farmland owners faced a stricter rule after the forenamed reform. In this sense, landowners were incentivized to convert their farmland into housing lots.[11]

The government chose the designated cities to promote further urbanization in the three metropolitan areas. As mentioned earlier, these cities are designated by some laws beforehand, and were not chosen for the purpose of the aforementioned reform; designation occurred independently of the reform. Since the reform was not a randomized controlled trial but a natural experiment, we use DID. The validity of DID estimation is illustrated in Section 4.

[11] The Japanese government also implemented several reforms with respect to land-related taxes in the early to mid-1990s. However, unlike the repeal of the long-term agricultural operation system, these reforms did not aim at certain groups of municipalities, but for all cities. We explain the details in Section 4.3 when we discuss the common shocks assumption.

Meanwhile, the central government decides whether or not a local community becomes a city based upon the size of its population. While all other comparable cities are included in the control group in our basic case, we also perform our DID estimation by limiting the control group to cities with populations of certain sizes as discussed in Section 4.

To perform our empirical examination using DID, we assume FY 1992 is the year of treatment because the evaluation on land use changed in April 1992 (FY 1992) following the abolishment of the long-term agricultural operation system. In addition, because some owners may have acted in anticipation of this policy change, we also address the anticipatory effects using event study approach in our estimation.

The reform then yields the following empirical hypotheses.[12]

(1) The property tax reform decreased UPA farmland in the designated cities.

(2) After the reform, the supply of housing lots increased.

[12] We develop the formal model to illustrate how the tax reform affects landowners' choice and establish the propositions which become a basis for our empirical hypotheses in the Appendix 1 of the working paper version of this paper, which can be downloadable from the website: https://www.economics.uci.edu/research/wp/1819/18-19-05.pdf.

3. Empirical framework

This section establishes the empirical methodology. In doing so, we give two specifications of the DID regression. The first and basic one is as follows.

$$(1) \quad L_{ipt} = \beta_0 + \beta_1 T_i + \beta_2 REFORM_t + \beta_3 D_{i,t} + \varepsilon_{ipt},$$

where L_{ipt} is the ratio of UPA farmland to the total land in city *i* within prefecture *p* in period *t* (year), and total land is the sum of UPA farmland, ordinary farmland, and housing lots.[13] This is called the UPA farmland ratio. T_i is the dummy variable that takes 1 if it is a designated city within the three metropolitan areas and zero otherwise, $REFORM_t$ is the dummy variable that takes 1 if it is FY 1992 (our treatment year) and zero otherwise, $D_{i,t} = T_i \times REFORM_t$, and ε_{ipt} is the disturbance term. Note that $D_{i,t} = 0$ if *i* is not treated in FY 1992, and $D_{i,t} = 1$ if *i* is treated in FY 1992.

Second, in addition to a simple DID estimation as given by Equation (1), we also examine the treatment effects in an event study framework as follows:

[13] If we use the area of the entire city as a denominator, woods and mountains are also included. However, these cannot be converted into housing use. Therefore, we use the sum of UPA farmland, ordinary farmland, and housing lots as a total land to capture the change of land use within habitable areas.

(2) $L_{ipt} = \alpha_{0p} + \alpha_{1p}t + \gamma_i + \lambda_t + \sum_{\tau=0}^{m} \delta_{-\tau} D_{i,t-\tau} + \sum_{\tau=1}^{q} \delta_{+\tau} D_{i,t+\tau} + X_{ipt}^{'}\eta + \varepsilon_{ipt}$,

where τ specifies the time period relative to the treatment year. We modify from $D_{i,t}$ to $D_{i,t-\tau}$ or $D_{i,t+\tau}$ to capture the post-treatment and the anticipatory effects, respectively. Both $\delta_{-\tau}$ and $\delta_{+\tau}$ are the estimated coefficients on $D_{i,t-\tau}$ or $D_{i,t+\tau}$. The right-hand side allows for m period lags of $D_{i,t-\tau}$ (we set lag length to two, δ_{-1} and δ_{-2}, and q period leads of $D_{i,t+\tau}$ (we set lead length to two, δ_{+1} and δ_{+2}). For example, if $\tau = 0$, which corresponds to the treatment year, FY 1992, δ_0 is equivalent to β_3 (the coefficient on $D_{i,t}$) of Equation (1).

We add region-specific intercepts and region-specific time trends (i.e., interaction terms between regional dummies and time trends). This follows Besley and Burgess (2004). Regional dummy variables refer to prefectural dummies. This is done to address business cycle fluctuations at the prefectural level. In Equation (2), α_{0p} is a prefecture-specific intercept and $\alpha_{1p}t$ is a prefecture-specific trend coefficient (where *t* is the time trend variable). We also include both city-specific and year fixed effects, γ_i and λ_t, respectively. The year fixed effect captures the macroeconomic movement of the entire country. X_{ipt} specifies the vector of other control variables.

As stated previously, our hypotheses are that the property tax reform (1) decreased the amount of UPA farmland, and (2) increased the amount of housing lots. Therefore, when it comes to the UPA farmland ratio, if the coefficients on $D_{i,t}$ are estimated to be negative and statistically significant, then the first hypothesis is substantiated. We also estimate Equations (1) and (2) using the ratio of housing lot per total land (housing lot ratio) as the dependent variable. We do so to check whether reduced UPA farmland was converted into housing lots to investigate our second hypothesis; if the coefficients on $D_{i,t}$ are estimated to be positive and statistically significant, the second hypothesis is substantiated. Meanwhile, landowners may keep their land as PGL rather than converting it into housing lots. To confirm this, we also use the ratio of ordinary farmland per total land (ordinary farmland ratio) as the dependent variable because the data on ordinary farmland also encompass PGL after the reform as stated in Section 4.1.

For other control variables, we add the effective tax rate of UPA farmland[14], local government tax revenue per total local government revenue, agricultural income, population density, and manufactured product shipment amount.[15] Local tax revenue

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[14] 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.

[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

share in total local government revenue and population density are added as indicators of urbanization. Manufactured product shipment amount addresses the size of manufacturing industries, and agricultural income is a proxy for rural areas. We take the logarithm of agricultural income, population density, and manufactured product shipment amount in the estimation.[16]

4. Data and graphical evidence

4.1. Data and city characteristics

The sample period is from FY 1989 to FY 1994 to focus on the duration before and after the reform.[17] Table 3 gives the description and source of the data used in estimation.

quinquennial survey in Japan. Effective tax rate on land-value tax and inheritance tax cannot be calculated because the data on the revenue of these taxes cannot be obtained at a municipality level; these can be controlled by the year effect within our framework.

[16] For a more detailed explanation, please see Appendix 2 of the working paper version. Meanwhile, we also checked the results by taking the one-period lag for all the control variables because endogeneity may be also worrying for some control variables, which also substantiated the results reported within the text. The results are available upon request.

[17] It is possible to extend the sample period by including years before FY 1988. However, due to the asset price bubble, land prices skyrocketed over the mid to late 1980s. Even if such types of macroeconomic shock contemporaneously affect all areas within a country, it would be favorable not to include the data before FY 1988 in order to exclude the influence of the irregular business cycle fluctuation during the bubble periods.

All data on square (area) measure, property value, and tax base come from the Brief Report on the Value of Properties provided by the Ministry of Internal Affairs and Communications (hereafter referred to as MIAC).[18] 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 reform, a proportion of the UPA farmland has become preserved as the PGL and has been added into ordinary 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, for example, 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 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.

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

[18] Unlike the US and some other countries, city boundaries do not change over time unless cities are merged. Since we exclude these cases, the boundary of all the municipalities remained the same throughout our sample period.

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 manufactured product shipment amount come from the Industry Statistics provided by the Ministry of Economy, Trade, and Industry.

We focus on 501 cities throughout the period from FY 1989 to FY 1994.[19] We chose these cities as follows. First, we omit cities without ordinary or UPA farmland. Second, during our sample period, some cities were not government ordinance-designated cities. Therefore, we do not include such cities.[20] 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. Thus, we omit cities that merged or disappeared from FY 1989 to FY 1994.

[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.

[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 Chiba city following the argument above.

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. Since the population of most designated cities is over 100,000, choosing these 104 cities as our control group makes both treatment and control groups more comparable. This is defined as "Case 3," and the total number of cities is 287.[21]

[21] There are some cities designated by government ordinance outside of Tokyo, Chubu, and Kansai. Since the population of these cities are as large as major cities within the three metropolitan areas, it would be an option for us to use these cities as our control group. However, throughout our sample periods, there were only four cities designated by government ordinance outside of the three metropolitan areas: Sapporo, Hiroshima, Kitakyushu, and Fukuoka (we exclude Sendai because it became a city designated by government ordinance in 1989 by merging the surrounding towns). If we choose these four cities as our control group, the number of control group is too small in comparison to the one of the treatment group cities. Thus, we do not restrict our control group to these four cities.

Figures 1a to 1c compare the cities by taking cities within Hyogo Prefecture as an example.[22] When it comes to the size of the population in the four prefectures in Tokyo urban areas (Tokyo, Chiba, Kanagawa, and Saitama), the population of most cities with UPA farmland is over 50,000; it is difficult for us to make maps to compare Cases 1, 2, and 3. We instead decided to create maps by choosing cities within Hyogo Prefecture. There are three reasons for this. First, there are some designated cities in Hyogo Prefecture (e.g., Kobe, Nishinomiya, Ashiya, etc.). Second, however, some cities with UPA farmland are not classified as the designated cities even though their population size is more than 100,000 (Akashi, Himeji, and Kakogawa). Finally, there are other cities whose population is less than 50,000, even though there are UPA farmlands (e.g., Ono, Nishiwaki, etc.).

4.2. Summary statistics and graphical evidence

Table 4 reports the descriptive statistics of all variables used in estimation, and Table 5 presents the statistics between FY 1991 and FY1992 for the ratios of UPA farmland, housing lot, and ordinary farmland.[23] Table 5 is useful to support our simple DID estimation. Here, between FY 1991 and FY 1992, the UPA farmland ratio plunged for

[22] These figures are added following the advice of one of the reviewers.
[23] Detailed results on other variables can be obtained from the working paper version of this paper.

the treatment group, while it barely changed for the control group. In contrast, while the difference between the two periods with regard to housing lots ratio is not large, the ordinary farmland ratio increased after the reform for the treatment group. These simple comparisons before and after the reform in our treatment and control groups suggest the following. First, the decrease in the UPA farmland at the timing of the reform is consistent with our first hypothesis. Second, a large number of landowners might not convert UPA farmlands into housing lots, while retaining them as PGLs.

Figures 2a to 2c 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 the figures, in FY 1992, the year of treatment, the share of UPA farmland fell dramatically in the designated cities from the previous year; however, the ratio barely changed after the reform regarding the remaining cities. Therefore, the reform indeed served to reduce UPA farmland in the designated cities.

However, the right charts of Figures 2a to 2c suggest that decreased UPA farmland was not necessarily converted into housing lots after the reform. Had most owners converted their UPA farmland into housing lots immediately, the proportion would have increased dramatically from FY 1991 to FY 1992.

As noted earlier, PGL is included in ordinary farmland data of the Brief Report on the Value of Properties after the reform. Although it is impossible for us to extract PGL from MIAC data, Figures 2a to 2c also suggest that the farmland ratio rose from FY 1991 to FY 1992 for the designated cities, where the size of the increase is approximately equal to the size of the decrease in UPA farmland. This observation suggests that many landowners decided to keep farmland as PGL after the reform.

To test our hypotheses, we perform an econometric investigation using Equations (1) and (2).

4.3. Check of the assumptions for DID estimation

Here we would like to confirm two assumptions necessary for DID estimation. 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 imposed after FY 1992. Moreover, the government set the assessed value of land at 70–80% of the market value in FY 1994, which some landowners 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.[24]

Second, we check the common trend assumption using Figures 2a to 2c. We discuss the validity of this assumption by focusing on the UPA farmland ratio, the main outcome that we would like to address in estimating the effects of the reform. 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 reform in FY 1992. Indeed, the average of the share of UPA farmland moved almost in parallel in the designated and remaining cities between FY 1989 and FY 1990. Therefore, these graphs provide visual evidence of treatment and control cities, with a common underlying trend for pretreatment periods.

Furthermore, as reported in Section 5, the coefficients of $D_{i,t+\tau}$ are close to zero before the reform, which also support the validity of common trend assumption.

5. Empirical results

[24] Meanwhile, the inheritance tax burden is lowered if landlords preserve land as PGL in the designated cities under the revised PGL Law. However, a string of inheritance tax reforms in the 1990s, which provided tax deduction to landowners across the country, made its effect on land use less substantial. For example, the Japanese government raised the threshold on the inheritance tax from JPY 40 million to JPY 48 million in FY 1992.

Table 6 reports the estimation results for the simple DID model given by Equation (1). Overall, the estimation results are consistent with the descriptive statistics for FY 1991 and FY1992 shown in Table 5. For the case where the UPA farmland ratio is used as the dependent variable, the coefficients of $D_{i,t}$ 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. Table 6 also shows that the coefficients of $D_{i,t}$ are estimated to be positive and significant in Cases 1 and 2 with ordinary farmland ratio as the outcome, implying that after the treatment the PGL in the designated cities increased. However, we cannot confirm a statistically significant result in Case 3.

Figures 3a to 3c report the estimated coefficients on $D_{i,t-\tau}$ and $D_{i,t+\tau}$ with prefecture-specific time trends based on Equation (2).[25] Here, the upper left chart of each figure depicts the estimated coefficients of the UPA farmland ratio, the right chart reports on the housing lot ratio, and the lower left chart depicts the ordinary farmland ratio. The upper left chart of Figure 3a confirms that while the causal effects were near zero before the reform, the coefficients were down to around -0.025 after FY 1992,

[25] Detailed results on each estimation equation are available in Appendix 2 of the working paper version of this paper.

implying that UPA farmland ratio plummeted as our simple DID estimation suggested. This is also the case for the upper left charts of Figures 3b and 3c. The size of the coefficients is not substantially different before and after the reform when we use the housing lot ratio as a dependent variable according to the right charts of Figures 3a to 3c. Further, the 95% confidence intervals include zero at the time of the reform. Had most owners converted UPA farmland into housing lots then, the coefficients of housing lot ratio would have been estimated to be statistically significant. In contrast, the lower left charts of all figures indicate that the estimated coefficients became larger and statistically significant in FY 1992 with the ordinary farmland ratio as the outcome. However, the causal effects on the ordinary farmland gradually faded, and the lower left chart of Figure 3c shows that the estimated coefficient became statistically insignificant in FY 1994.

To check the robustness of the results, we conducted two further estimations. First, we eliminated insignificant regressors by applying a general-to-specific approach (Hendry, 2000) to enhance estimation efficiency. The results are reported as a "reduced model," shown in Figures 4a to 4c. Second, we estimated the standard errors with clustering by prefecture instead of municipalities. The results are illustrated in Figures 5a, 5b, and 5c. According to the upper left chart of Figures 4a to 5c, the coefficients of the UPA

farmland ratio became negative, and the 95% confidence intervals did not include zero after FY 1992. When we used the housing lot ratio as a dependent variable, the confidence intervals did not include zero in FY 1992 in the right chart of Figure 5c. Further, the right charts of Figures 5b and 5c report that the estimated coefficients of post-treatment effects were statistically significant. However, according to the right charts of Figures 4a, 4b, 5c, 5a, and 5b, the confidence intervals included zero in FY 1992. Regarding the ordinary farmland ratio, the estimates were close to zero before the reform, with sharply increasing effects at the time of the reform (FY 1992) for the lower left charts of all cases. However, the lower left chart of Figure 5c shows the estimate became statistically insignificant in FY 1993 and FY 1994.

In principle, the amended PGL Law is a sort of once and for all decision; as stated in Section 2, this is a 30-year commitment to using the land for cultivation. Thus, if land owners chose to preserve their UPA farmland as PGL, they would not be able to convert the PGL into housing lots in a couple of years; in order to change into housing lots at the time of the reform, they could not preserve the UPA farmland as PGL. If most farmland owners converted their UPA farmland into housing lots at the time of the reform, the changes on UPA farmland and housing lot would have been simultaneously confirmed. Specifically, whereas the estimated coefficients of the UPA farmland ratio

should be negative and statistically significant after the reform, those of the housing lot ratio are expected to be positive and statistically significant. Figures 4a to 6c show that the results on the UPA farmland ratio are robust. However, we cannot confirm the causal effects on housing lot ratio as robust.

Therefore, these figures strongly confirm our first hypothesis. However, the empirical results also suggest that after the reform, many landowners preserved UPA farmland as PGLs, which impugns the second hypothesis. Our results imply that PGL served as an additional option for the owners in UPA. Although it mandates 30 years of cultivation, the owners assumed PGL as a commitment by the government to sustain preferential tax treatment.

6. Conclusion

This paper examines how the property tax reform affect land use through empirical investigations by focusing on land use tax reform that took place in the 1990's in Japan. Our empirical findings strongly illustrate that the reform reduced the proportion of UPA farmland in the designated cities within the three metropolitan areas. However, whereas no robust evidence is found that reduced UPA farmland was converted into housing

lots, we show that many landlords preserved farmland as PGL from our empirical investigations as well as our graphical evidences in Section 4.

The results suggest that if the Japanese government had not amended the PGL Law at that time, more land might have been changed into housing lots; as a result, further urbanization could have been attained. On the one hand, the amended PGL Law may have a beneficial aspect if decent green space can be conserved for agricultural use. On the other hand, it has led to housing scarcity in the urban areas, which is also related to the fact that many landlords in the designated cities did not convert their land into housing lots at the time of the reform in the early 1990s. As such, the government should not have rectified the PGL Law.

Meanwhile, the reform failed to make property tax neutral for the use of lands because of a "lock-in" effect. We discuss the background. Until the 1990s, the Japanese people preferred land to financial assets in terms of portfolio choice. That is why land prices were believed to continue to rise indefinitely; this is so called the "myth of ever-rising land prices" as indicated by Okina et al. (2001). It is highly probable that many owners believed the downturn of asset prices as temporary and took for granted that the land prices would rise again. Therefore, they chose to keep farmland as PGLs when the reform took effect and planned to sell it after the land prices rose. Our conflicting

findings on ordinary farmland and housing lot ratios can be attributed to landowners' beliefs about future land prices.

The analysis presented herein could be fruitfully extended in three ways. First, the amended PGL Law expires at the end of FY 2021. It would be worthwhile to examine whether the landlords in the designated cities really convert PGL into housing lots after FY 2022. This is also needed to present a desirable policy or policy mix for farmlands in urban areas after the pandemic. Second, although we have focused on the property tax, the effects of the inheritance tax are also worth investigating using recent data because some substantial reforms on the inheritance tax system were made after the 2000s. Finally, while we concentrate on farmland use in UPA, it is also interesting to examine whether there is an impact of non-UPA (or Urban Control Areas) designation on farmland area usage.

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Table 1

The classification of the UPA farmland in the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai) before and after the reform

	Type of farmland	Preferential treatment
Before the reform (FY 1982-FY1991)	UPA farmland	Yes
After the reform (FY 1992 - FY 2021 (expected))	Production green land (PGL)	Yes (for 30 years)
	UPA farmland (except PGL)	No (taxed as residential lots)

Note: "The reform" means the abolishment of the long-term agricultural operation system. UPA farmland refers to the farmland in the urban promotion areas. UPA farmland is classified as either production green land (PGL) or non-PGL UPA farmland following the reform. Note that the Japanese fiscal year runs from April to the following March.

Table 2

The size of the UPA farmland and PGL

(Unit: 10,000ha)

	UPA farmland except PGL	PGL
1991	14.85	0.07
1992	12.81	1.52
1993	12.23	1.54
1994	11.83	1.55
1995	11.37	1.56
1996	10.92	1.56
1997	10.56	1.55
1998	10.29	1.55
1999	10.05	1.54

Note: UPA farmland refers to the farmland in the urban promotion areas and PGL means production green land.

Table 3

The description and source of the data

Description	Source
The square measure of UPA farmland, housing lots, and ordinary farmland (unit: ㎡)	The Brief Report on the Value of Properties (FY 1990 to FY1995) *
Tax base and property value of UPA farmland (unit: million JPY)	The Brief Report on the Value of Properties (FY 1990 to FY 1995) *
Population	The Basic Resident Register (FY 1989 to FY 1994)
The area of municipality (unit: ㎡)	The Area Statistics of Prefectures and Municipalities (FY 1989 to FY 1994)
Agricultural production income (unit: million JPY)	The Production Agricultural Income Statistics (FY 1989 to FY 1994)
Shipment value of manufactured goods (unit: million JPY)	The Industry Statistics (FY 1989 to FY 1994)
Local government tax revenue and total local government revenue (unit: million JPY)	The Statistics of the Final Accounts of Municipal Governments (FY 1989 to FY 1994)

* 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, for example, 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). Likewise, the data in FY 1992 are from the Brief Report in FY 1993, which indicates the evaluation in January 1993 (within FY 1992). Therefore, we use the data from the Brief Report on the Value of Properties in FY 1990-1995 instead of FY 1989-1994.

Table 4

Descriptive statistics for all sample periods (FY1989-1994) and all 501 cities

Variable	Description	NOB	Mean	Std. Dev.	Min	Max
UPA farmland ratio	UPA farmland per total land	3006	0.043	0.046	0	0.443
Housing lot ratio	Housing lots per total land	3006	0.322	0.181	0	0.871
Farmland ratio	Ordinary farmland per total land	3006	0.275	0.206	0.018	0.959
Effective tax rate	Effective tax rate of UPA farmland	3006	0.006	0.005	0	0.014
Population density	Population per the area of municipality	3006	7.412	1.226	2.303	10.347
Agricultural income	Agricultural production income	3006	12.239	1.276	7.586	15.979
Shipment	Shipment value of manufactured goods	3006	6.944	1.204	3.779	9.556
Local tax revenue ratio	Local government tax revenue per total local government revenue	3006	0.424	0.135	0.095	0.737

Note: See Table 3 for the definitions and data sources of all the variables. “Total land” within the table indicates the sum of UPA farmland, ordinary farmland, and housing lots.

Table 5

Descriptive statistics between FY 1991 and FY 1992 (between treatment and control groups)

Group	Treatment						
Variable	FY1991			FY1992			(1) Growth rate (FY1992-1991, %)
	N	mean	Std. Dev.	N	mean	Std. Dev.	
UPA farmland ratio	183	0.091	0.061	183	0.053	0.028	-42.323
Housing lot ratio	183	0.450	0.212	183	0.456	0.214	1.388
Farmland ratio	183	0.233	0.185	183	0.263	0.171	13.117

Group	Control						
Variable	FY1991			FY1992			(2) Growth rate (FY1992-1991, %)
	N	mean	Std. Dev.	N	mean	Std. Dev.	
UPA farmland ratio	318	0.028	0.033	318	0.027	0.032	-2.829
Housing lot ratio	318	0.170	0.109	318	0.173	0.111	1.557
Farmland ratio	318	0.366	0.168	318	0.364	0.167	-0.576

Dif (1)-(2),%
-39.494
-0.168
13.693

Note: See Table 3 for the definitions and data sources of all the variables. “Farmland” within the table represents ordinary farmland.

Table 6

Simple DID estimates (sample periods=FY1991-FY1992)

Dependent variable =UPA farmland ratio	Case1	Case2	Case3
$D_{i,t}$	-0.038 ***	-0.037 ***	-0.037 ***
	(0.005)	(0.006)	(0.007)
Adjusted R^2	0.29	0.22	0.18
NOB	1002	778	574
N. of treated municipalities	183	183	183
N. of control municipalities	318	206	104

Dependent variable =housing lot ratio	Case1	Case2	Case3
$D_{i,t}$	0.004	0.003	0.003
	(0.02)	(0.024)	(0.031)
Adjusted R^2	0.43	0.35	0.26
NOB	1002	778	574
N. of treated municipalities	183	183	183
N. of control municipalities	318	206	104

Dependent variable = farmland ratio	Case1	Case2	Case3
$D_{i,t}$	0.033 *	0.032 *	0.033
	(0.022)	(0.025)	(0.03)
Adjusted R^2	0.1	0.09	0.05
NOB	1002	778	574
N. of treated municipalities	183	183	183
N. of control municipalities	318	206	104

Note: Heteroskedasticity-robust standard errors are in parentheses. Asterisks indicate significance levels: * = 10% and *** = 1%. “Farmland” within the table represents ordinary farmland.

Fig. 1a. Cities of Case 1 (Hyogo Prefecture)

Note: The blue areas are the treatment group, and the gray areas are the control group of Case 1.
When it comes to the size of the population in the four prefectures in Tokyo urban areas (Tokyo, Chiba, Kanagawa, and Saitama), the population of most cities with UPA farmland is over 50,000; it is difficult for us to make maps to compare Cases 1, 2, and 3. We instead decided to create maps by choosing cities within Hyogo Prefecture. For more details, please see the text.

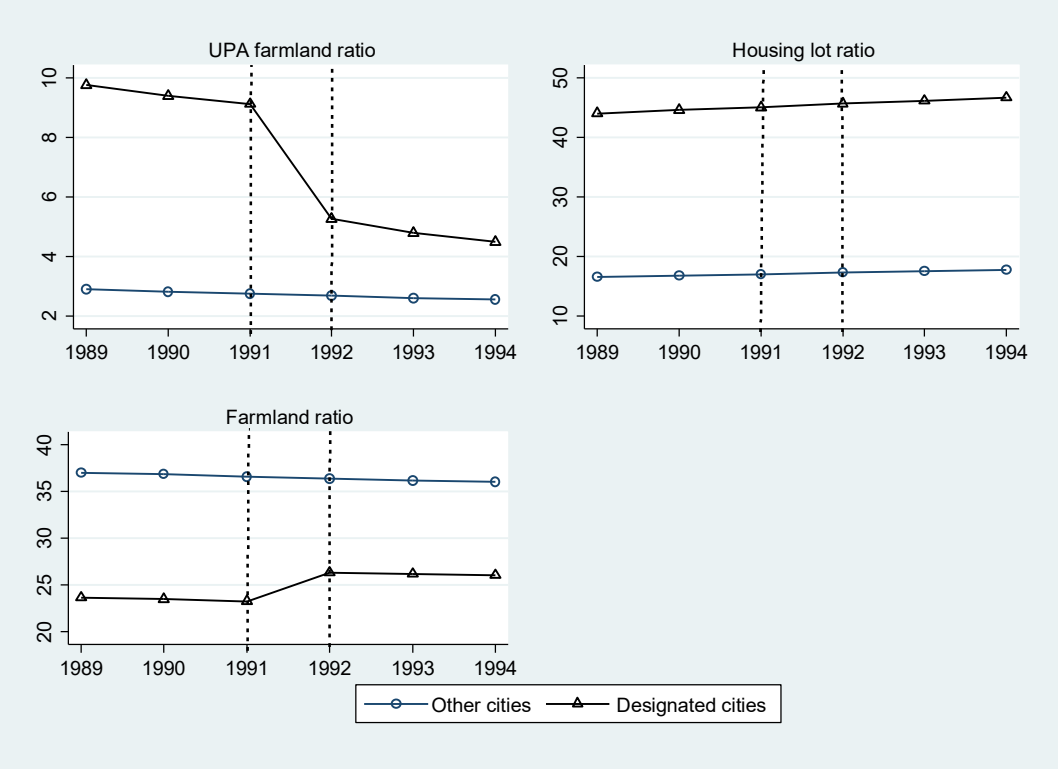
Fig. 1b. Cities of Case 2 (Hyogo Prefecture)

Note: The blue areas are the treatment group, and the gray areas are the control group of Case 2.
When it comes to the size of the population in the four prefectures in Tokyo urban areas (Tokyo, Chiba, Kanagawa, and Saitama), the population of most cities with UPA farmland is over 50,000; it is difficult for us to make maps to compare Cases 1, 2, and 3. We instead decided to create maps by choosing cities within Hyogo Prefecture. For more details, please see the text.

Fig. 1c. Cities of Case 3 (Hyogo prefecture)

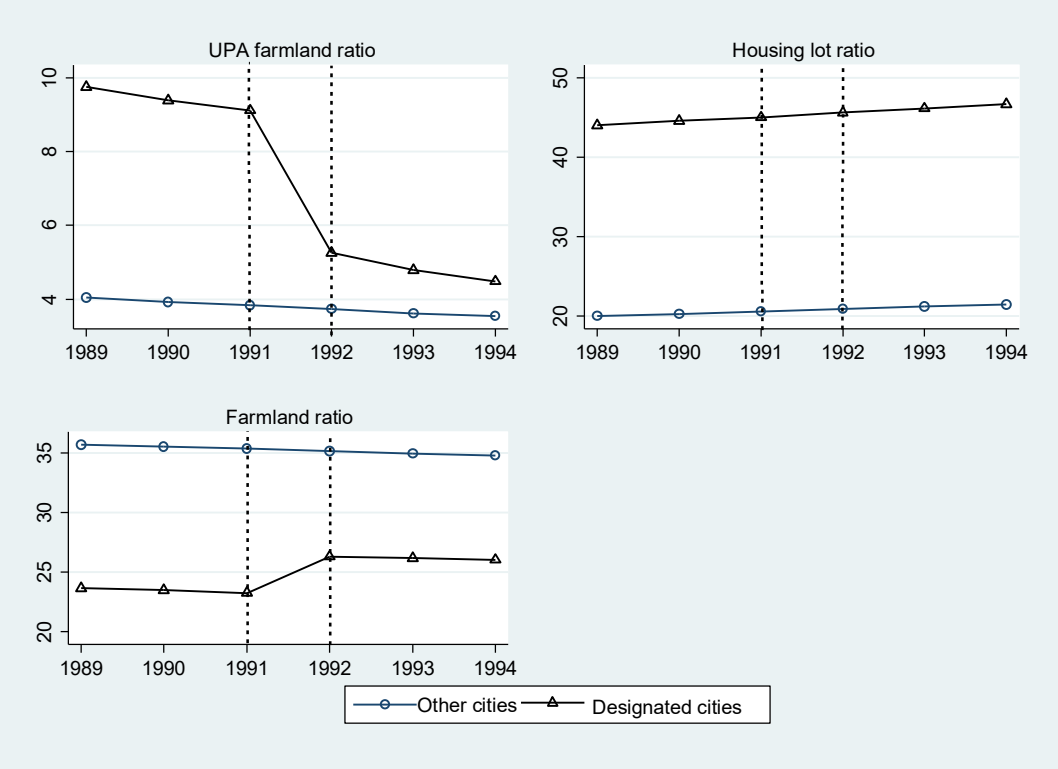
Note: The blue areas are the treatment group, and the gray areas are the control group of Case 3.
When it comes to the size of the population in the four prefectures in Tokyo urban areas (Tokyo, Chiba, Kanagawa, and Saitama), the population of most cities with UPA farmland is over 50,000; it is difficult for us to make maps to compare Cases 1, 2, and 3. We instead decided to create maps by choosing cities within Hyogo Prefecture. For more details, please see the text.

Fig. 2a. Trends in the ratio of each land use (Case 1, unit=%)



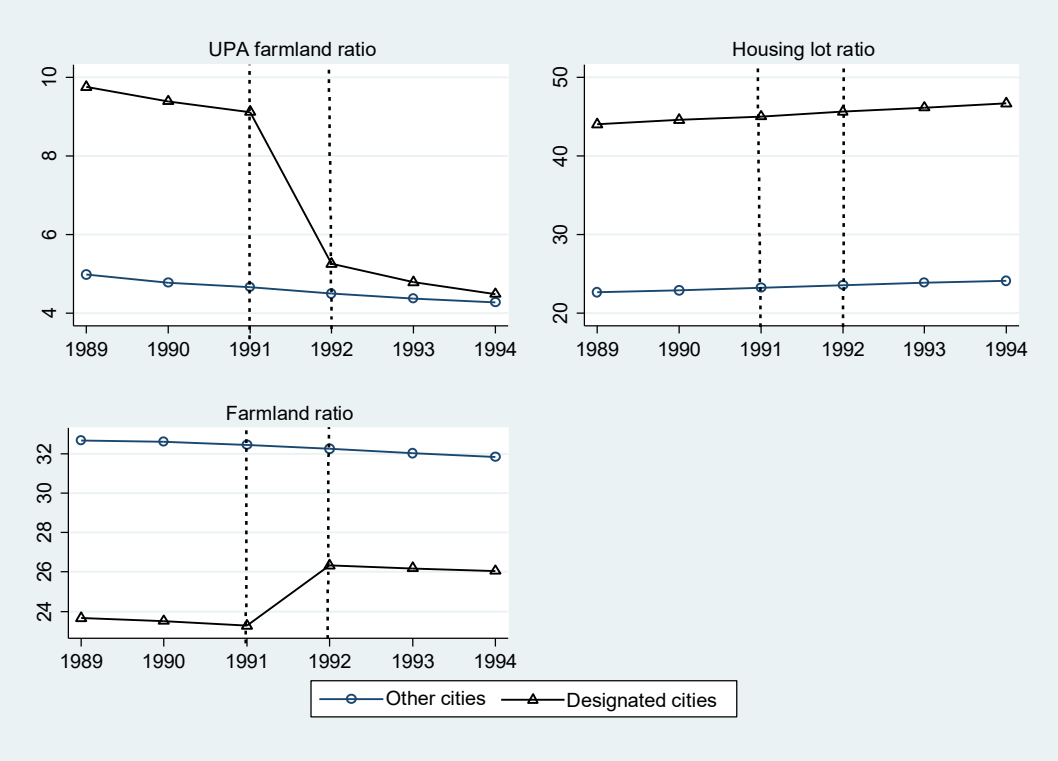
Note: Case 1 covers a sample of 501 cities; the treatment group comprises 183 designated cities, and the control group has 318 other cities. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. Each series plots the average of the share of each item per total land (=UPA farmland + housing lots + ordinary farmland) from FY 1989 to FY 1994. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991). Two dotted vertical lines indicates the years before (FY 1991) and after (FY 1992) the reform, which were presented in Table 2.

Fig. 2b. Trends in the ratio of each land use (Case 2, unit=%)



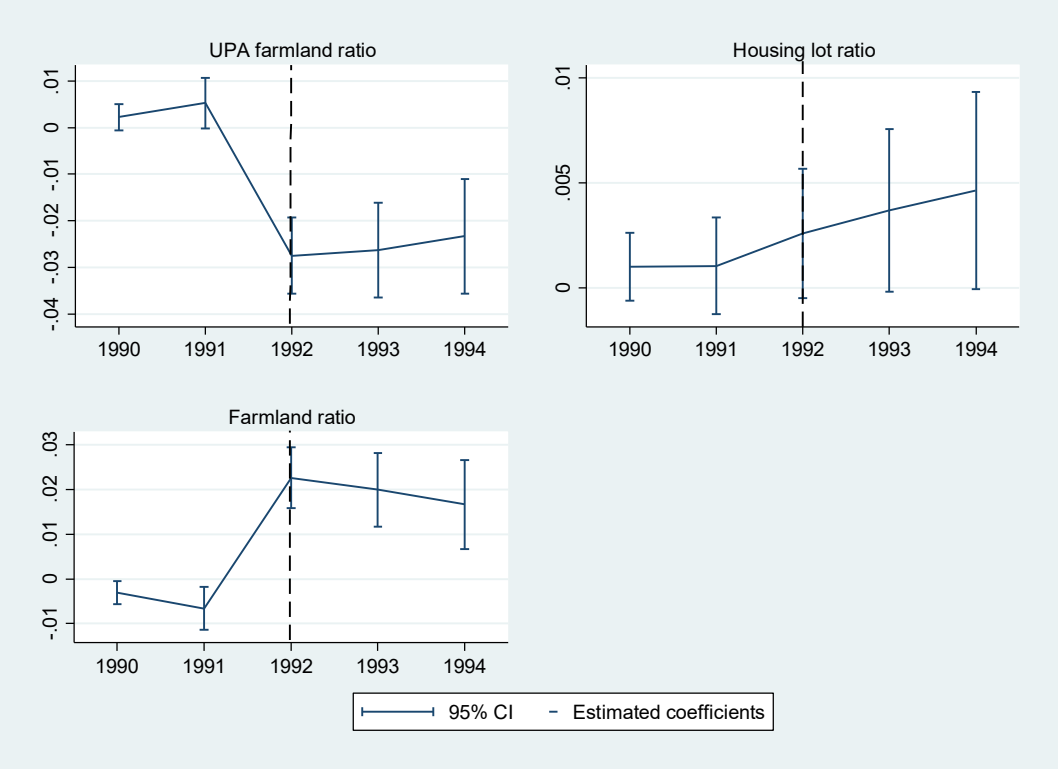
Note: Case 2 covers a sample of 389 cities; the treatment group comprises 183 designated cities, and the control group has 206 cities with populations of over 50,000 on average throughout our sample period. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. Each series plots the average of the share of each item per total land (=UPA farmland + housing lots + ordinary farmland) from FY 1989 to FY 1994. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991). Two dotted vertical lines indicates the years before (FY 1991) and after (FY 1992) the reform, which were presented in Table 2.

Fig. 2c. Trends in the ratio of each land use (Case 3, unit=%)



Note: Case 3 covers a sample of 287 cities; the treatment group comprises 183 designated cities, and the control group has 104 cities with population of over 100,000 on average throughout our sample period. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. Each series plots the average of the share of each item per total land (=UPA farmland + housing lots + ordinary farmland) from FY 1989 to FY 1994. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991). Two dotted vertical lines indicates the years before (FY 1991) and after (FY 1992) the reform, which were presented in Table 2.

Fig. 3a. The effect of the property tax reform on the land ratio (Case 1)

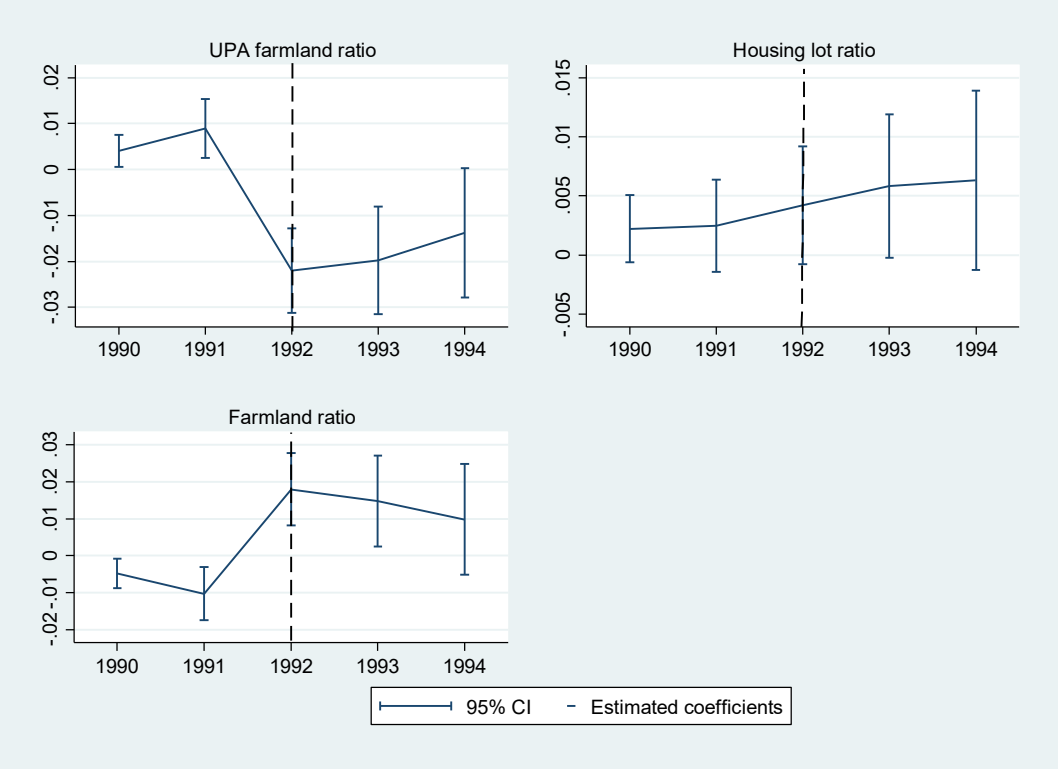


Note: Case 1 covers a sample of 501 cities; the treatment group comprises 183 designated cities, and the control group has other 318. This figure plots the estimated coefficients of $D_{i,t-\tau}$ and $D_{i,t+\tau}$ over year 1992 $\pm\tau$ in Equation (2). The dotted vertical line indicates FY 1992, when the reform came into effect. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991).

Fig. 3b. The effect of the property tax reform on the land ratio (Case 2)

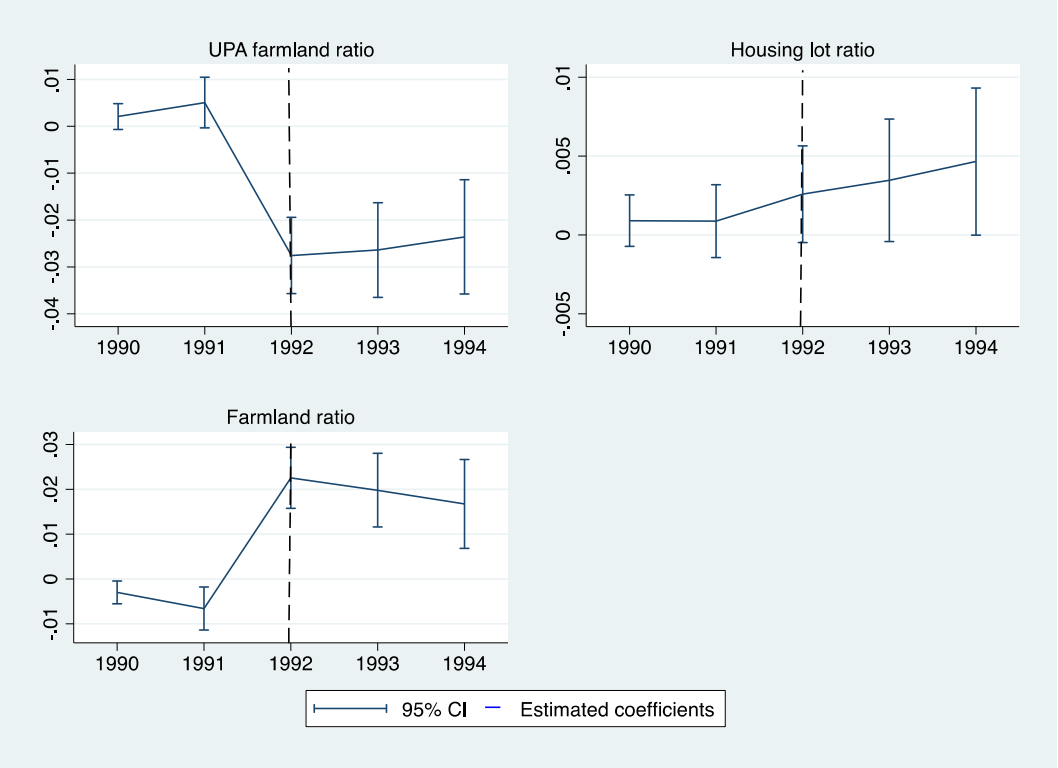
Note: Case 2 covers a sample of 389 cities; the treatment group comprises 183 designated cities, and the control group has 206 cities with population of over 50,000 on average throughout our sample period. This figure plots the estimated coefficients of $D_{i,t-\tau}$ and $D_{i,t+\tau}$ over year 1992 $\pm\tau$ in Equation (2). The dotted vertical line indicates FY 1992, when the reform came into effect. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991).

Fig. 3c. The effect of the property tax reform on the land ratio (Case 3)



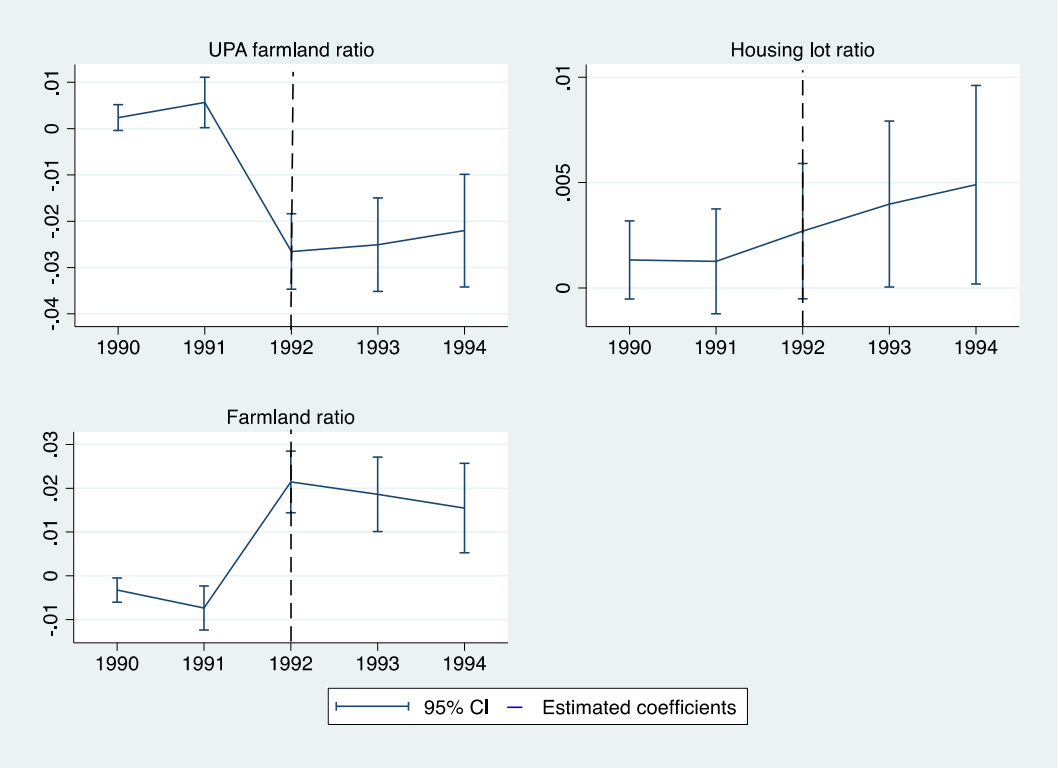
Note: Case 3 covers a sample of 287 cities; the treatment group comprises 183 designated cities, and the control group has 104 cities with population of over 100,000 on average throughout our sample period. This figure plots the estimated coefficients of $D_{i,t-\tau}$ and $D_{i,t+\tau}$ over year 1992 $\pm\tau$ in Equation (2). The dotted vertical line indicates FY 1992, when the reform came into effect. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991).

Fig. 4a. The effect of the property tax reform on the land ratio (Case 1, reduced model)



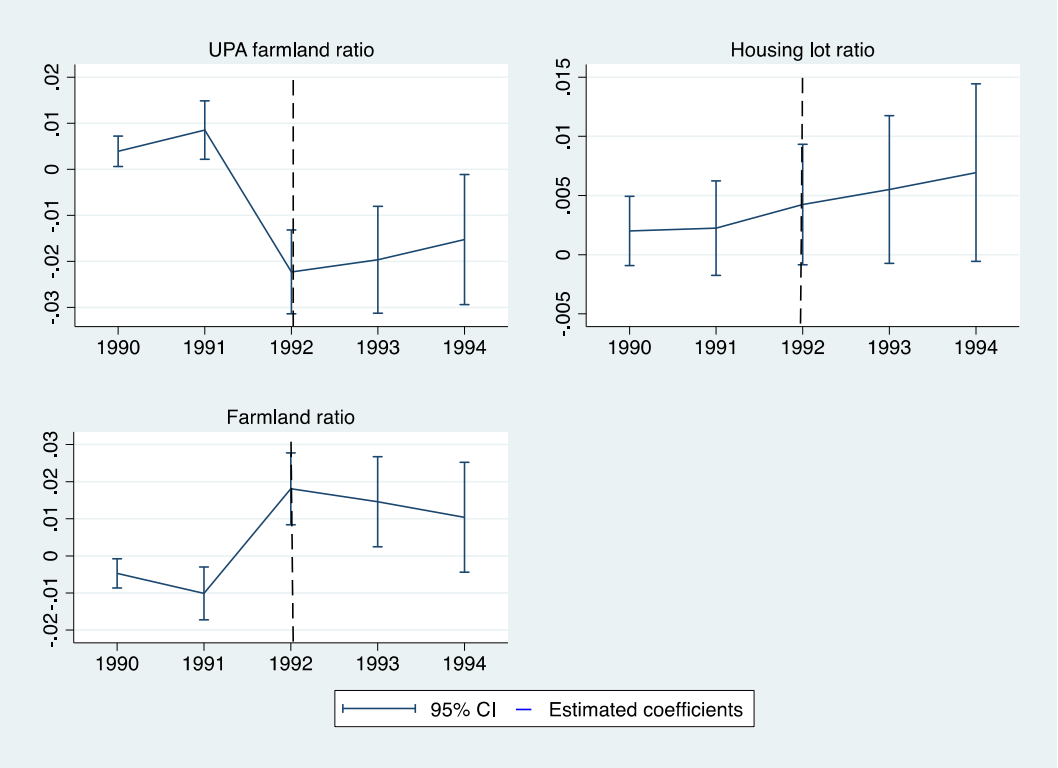
Note: "Reduced model" means the specification estimated in Equation (2) by eliminating insignificant regressors. Case 1 covers a sample of 501 cities; the treatment group comprises 183 designated cities, and the control group has other 318. This figure plots the estimated coefficients of $D_{i,t-\tau}$ and $D_{i,t+\tau}$ over year 1992 $\pm\tau$ in Equation (2). The dotted vertical line indicates FY 1992, when the reform came into effect. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991).

Fig. 4b. The effect of the property tax reform on the land ratio (Case 2, reduced model)



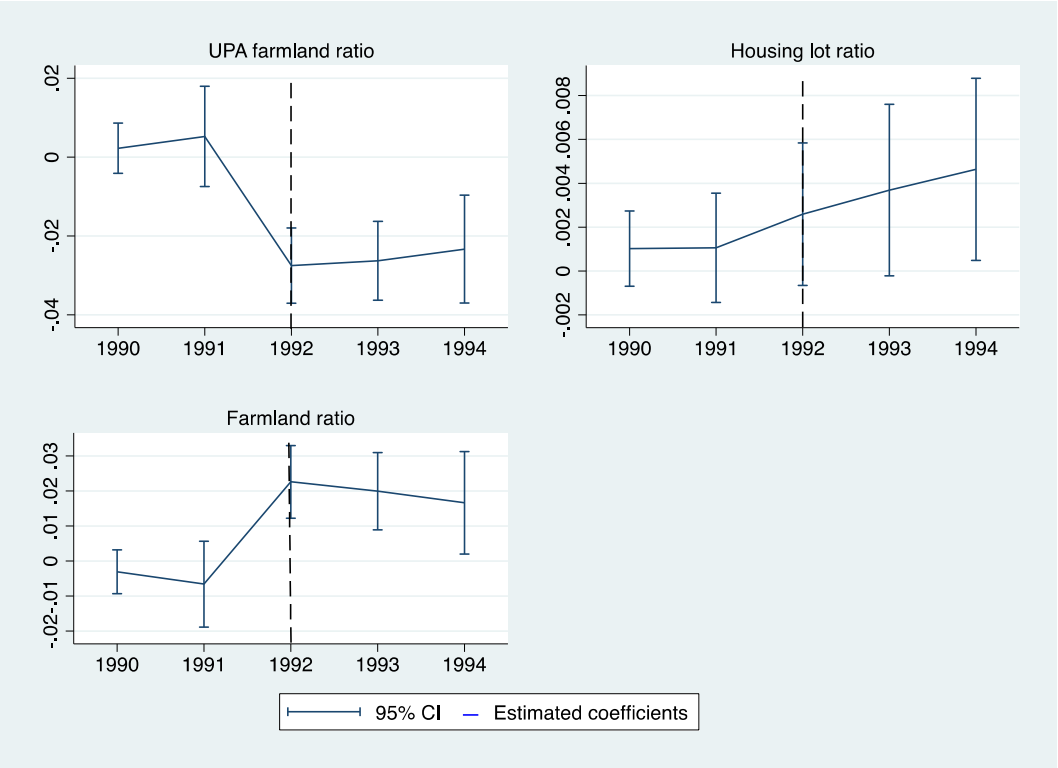
Note: "Reduced model" means the specification estimated in Equation (2) by eliminating insignificant regressors. Case 2 covers a sample of 389 cities; the treatment group comprises 183 designated cities, and the control group has 206 cities with population of over 50,000 on average throughout our sample period. This figure plots the estimated coefficients of $D_{i,t-\tau}$ and $D_{i,t+\tau}$ over year 1992 $\pm\tau$ in Equation (2). The dotted vertical line indicates FY 1992, when the reform came into effect. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991).

Fig. 4c. The effect of the property tax reform on the land ratio (Case 3, reduced model)



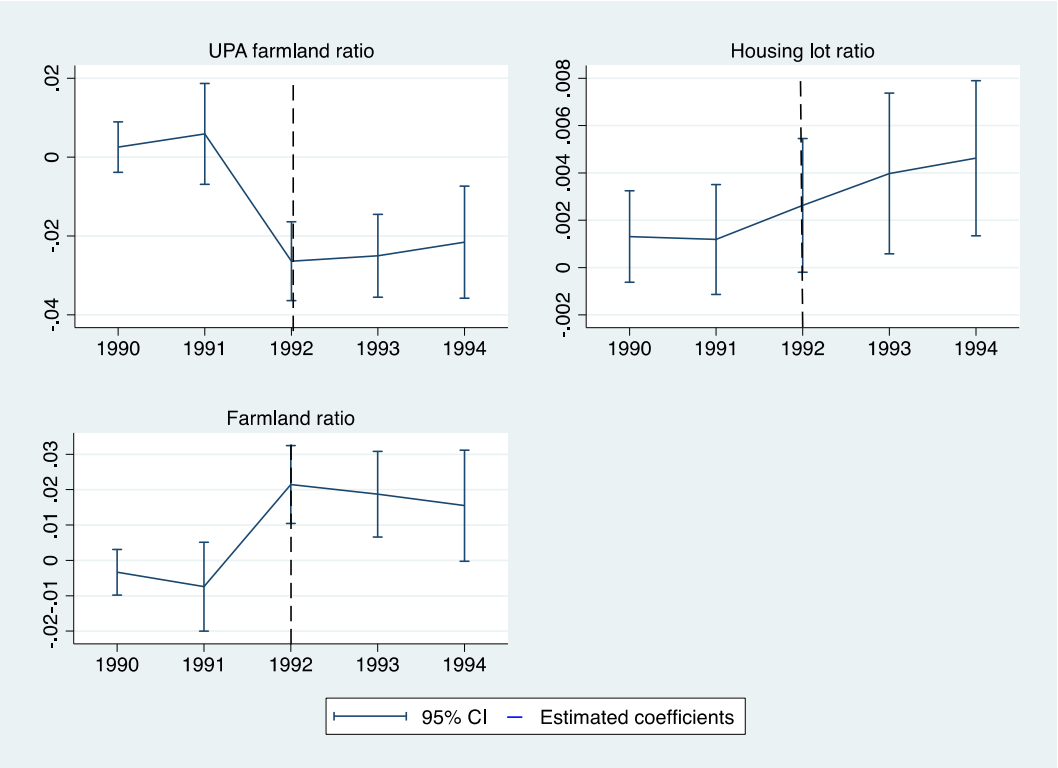
Note: "Reduced model" means the specification estimated in Equation (2) by eliminating insignificant regressors. Case 3 covers a sample of 287 cities; the treatment group comprises 183 designated cities, and the control group has 104 cities with population of over 100,000 on average throughout our sample period. This figure plots the estimated coefficients of $D_{i,t-\tau}$ and $D_{i,t+\tau}$ over year 1992 $\pm\tau$ in Equation (2). The dotted vertical line indicates FY 1992, when the reform came into effect. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991).

Fig. 5a. The effect of the property tax reform on the land ratio (Case 1, The case that standard errors are estimated with clustering by prefecture)



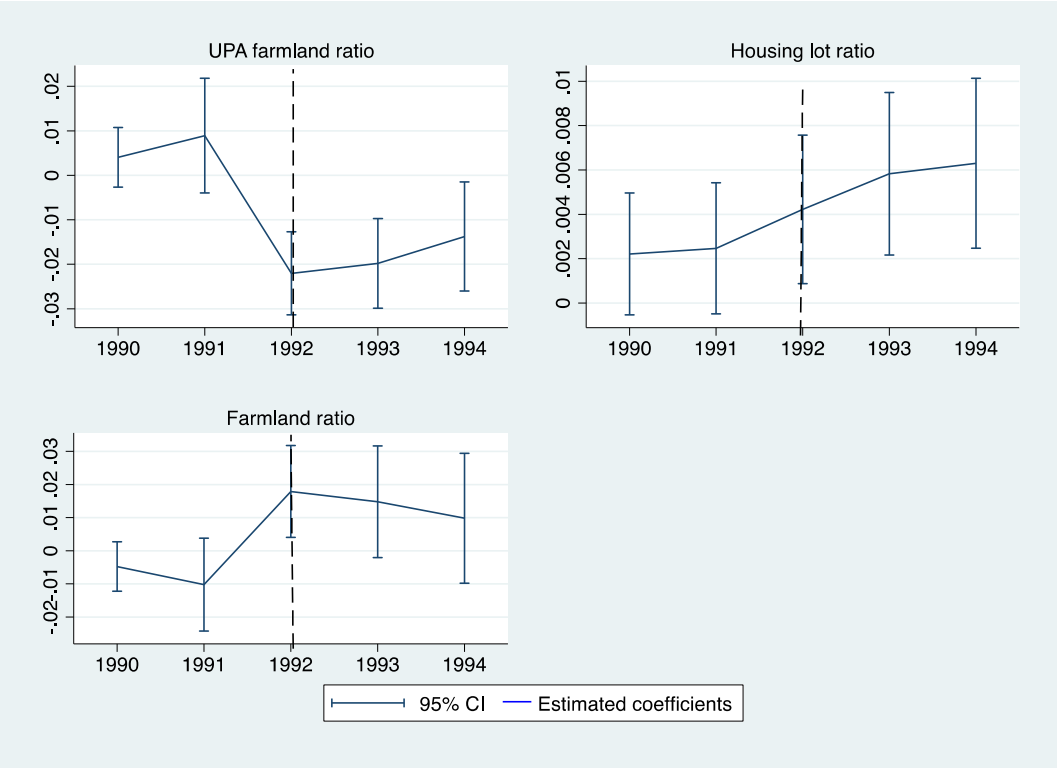
Note: Case 1 covers a sample of 501 cities; the treatment group comprises 183 designated cities, and the control group has other 318. This figure plots the estimated coefficients of $D_{i,t-\tau}$ and $D_{i,t+\tau}$ over year 1992 $\pm\tau$ in Equation (2). The dotted vertical line indicates FY 1992, when the reform came into effect. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991).

Fig. 5b. The effect of the property tax reform on the land ratio (Case 2, The case that standard errors are estimated with clustering by prefecture)



Note: Case 2 covers a sample of 389 cities; the treatment group comprises 183 designated cities, and the control group has 206 cities with population of over 50,000 on average throughout our sample period. This figure plots the estimated coefficients of $D_{i,t-\tau}$ and $D_{i,t+\tau}$ over year 1992 $\pm\tau$ in Equation (2). The dotted vertical line indicates FY 1992, when the reform came into effect. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991).

Fig. 5c. The effect of the property tax reform on the land ratio (Case 3, The case that standard errors are estimated with clustering by prefecture)



Note: Case 3 covers a sample of 287 cities; the treatment group comprises 183 designated cities, and the control group has 104 cities with population of over 100,000 on average throughout our sample period. This figure plots the estimated coefficients of $D_{i,t-\tau}$ and $D_{i,t+\tau}$ over year 1992 $\pm\tau$ in Equation (2). The dotted vertical line indicates FY 1992, when the reform came into effect. UPA farmland stands for the farmland in the urban promotion areas, and "farmland" within the figure represents ordinary farmland. Meanwhile, housing lots also encompass commercial land following the classification of the Brief Report on the Value of Properties. "Designated cities" refer to the designated cities within the three metropolitan areas (Tokyo, Chubu, and Kansai), which follows the wording by Ishi (1991).