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How Inheritance Affects the Real Estate Market in an Aging Economy: Evidence from Transaction and Registry Data*

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Abstract

The impact of population aging on real estate prices has been closely scrutinized by Mankiw and Weil (1989) and others. This paper sheds new light on the literature on asset meltdown by examining the mechanism how the death of property owners and subsequent inheritances affect the realty market. By combining the unpredictable nature of death and inheritance and the unique characteristics of the Japanese tax system, which provides an incentive to heirs to sell inherited properties shortly after inheriting them, we use the incidence of inheritance to instrument for the supply of real estate and examine the causal relationship between supply and realty prices to find the following. First, a higher incidence of inheritance results in a larger number of properties for sale. Second, a larger number of properties for sale as a result of inheritances decreases transaction prices in the real estate market. And third, there exists a substantial difference in the demand elasticity of real estate property depending on whether land use regulations were relaxed or tightened.

Keywords: Real estate market; Realty prices; Inheritance tax; Instruments
JEL classification codes: R31; R38; H24

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1. Introduction

A widely discussed issue is whether population aging dampens the real estate market. The examination of such a possible relationship between population aging and asset prices, which has been labelled "asset meltdown," is particularly relevant for a country such as Japan, whose population is increasingly greying. The seminal study by Mankiw and Weil (1989) and a number of studies that followed have scrutinized and tried to answer the question. Theoretical analyses employing an overlapping generations model with the assumption of a declining population and a constant real estate supply predict a drop in the demand for and price of real estate. On the other hand, empirical studies focusing on the age profiles of the population and the evolution of per capita housing asset holdings by age and their impact on the growth rate of realty prices have produced mixed results.[1]

One of the possible reasons for such mixed results is that previous empirical studies are not entirely clear about what they examine when looking at the coefficient on the population aging-related variable. The variable may represent declining demand or it may represent an increasing supply of properties offered for sale. Some studies examine solely a reduced-form equation for realty prices rather than presenting a structural system of supply and demand equations, meaning that the variable on population aging can be interpreted as reflecting either supply or demand.

The issue of identification between supply and demand in the realty market is important not only when we examine the impact of population aging but also when we examine other determinants of real estate prices. There exists an extensive and burgeoning literature on the determinants of real estate prices that proposes various different strategies of identifying either supply or demand by focusing on a variety of economic events such as credit market deregulation (Favara and Imbs 2015),

[1] Mankiw and Weil (1989), Takats (2012), Saita, Shimizu, and Watanabe (2016) found evidence that aging dampens the realty market, Engelhardt and Poterba (1991) and Hendershott (1991) found little demographic impact on realty prices, and Hort (1998) even found that declining population growth increases price growth.

foreclosures (Campbell, Giglio, and Pathak 2011; Brunnermeier and Julliard 2008; Mian and Sufi 2009), geographical constraints (Saiz 2010; Hilber and Vermeulen 2016), and international capital flows (Aizenman and Jinjarak 2009; Badarinza and Ramadorai 2015; Miyakawa, Shimizu, and Uesugi 2016). However, there have been few studies that focus on variables related to population aging and try to identify an exogenous increase of the supply of real estate at the disaggregated level, with an exception being the study by Campbell, Giglio, and Pathak (2011).

Against this background, the present study develops a novel and unique way of identifying the mechanism through which population aging affects the realty market. Rather than examining the impact of actual aging at the aggregated level, this study focuses on the instantaneous impact of death and inheritance, the timing of which is difficult to predict and can be regarded as exogenous at the disaggregated level. Further, the analysis exploits unique characteristics of the inheritance and capital gains tax scheme in Japan.[2] These are (1) the differential treatment of real estate assets and financial assets in terms of how their tax base values are calculated, and (2) the deduction of the inheritance tax amount from realized capital gains. Due to these characteristics, it is beneficial for families with an aged real estate property owner and young prospective heirs to sell the property shortly after the aged owner has died and the young heirs have inherited the property than to sell the property while the aged owner is still alive. By combining the unpredictable nature of death and inheritance at the disaggregated level and the unique characteristics of the Japanese tax system, our analysis is able to identify exogenous increases in the supply of real estate properties caused by realty owners' deaths and subsequent inheritances.

Using inheritances and related institutional arrangements as a source of an exogenous supply increase in the real estate market, we first examine whether properties whose owner has died and

[2] In this respect, the paper is also related to the literature on the impact of taxes on the realty market. Around the world, there are a variety of taxes related to real estate property, which have been the subject of careful study by researchers. Such taxes include transaction taxes (Best and Kleven 2015), capital gains taxes (Yamazaki 1996; Yamazaki and Idee 1997; Cunningham and Engelhardt 2008; Shan 2011), and estate and gift taxes (Bernheim, Lemke, and Scholz 2004; Poterba 2001; McGarry 2001).

which are passed on by inheritance are more likely to be sold. Second, we examine the extent to which such exogenous supply-side pressure actually decreases real estate prices. In other words, by focusing on the response of prices to an exogenous increase of supply induced by the deaths of realty owners and subsequent inheritances, we measure the slope of the demand curve or the demand elasticity of real estate properties with respect to prices. Third, as an extension, we examine if the demand elasticity of real estate properties differs across subsamples.

All of these examinations are made possible by the availability of two massive micro-level datasets that we combine for the analysis, namely, a dataset on the incidence of inheritance based on the information stored in government registries, and a dataset on real estate transactions, including asking prices and actual contract prices, collected by the largest real estate transaction information provider in Japan. The two datasets cover the entire Tokyo metropolitan area for the years 2000–2014, when Japan experienced a demographic turning point and the population started to decrease.

We obtain the following three major findings. First, a larger number of real estate inheritances results in a larger number of real estate sales offers, indicating that the death of property owners and subsequent inheritance of the properties raises the likelihood that those properties will be sold. Second, there is a significant negative relationship between real estate prices and real estate supply instrumented by the number of inheritances, while the relationship between the two variables is positive when no instruments are employed. This result indicates that an increase in the supply of real estate induced by an increase in inheritances actually decreases real estate prices, which also provides evidence for the negative demand elasticity of real estate properties with respect to prices. Third, the extent of decline in real estate prices differ across subsamples when there exists an increase in the supply of real estate. Overall, our results are consistent with the prediction of the asset meltdown hypothesis that population aging will lead to a decline in asset prices; at the same time, they also show the mechanisms how population aging affects the realty market through deaths

and inheritances.

The remainder of the study proceeds as follows. Section 2 provides an overview of the institutional background regarding the tax system related to the inheritance of real estate property. Section 3 explains our empirical approach in detail and provides a description of our data. Section 4 presents a summary of the data as well as the estimation results. Section 5 concludes.

2. Background

2.1. Inheritance tax

Inheritance tax in Japan is imposed upon persons who obtain assets by inheritance or bequest and is calculated based on the value of the assets concerned.[3] Assets subject to inheritance tax include real estate, cash, deposits, securities, jewelry, loans, patents, copyrights, and other assets that have a positive economic value. Among these various types of assets, real estate makes up the largest share by value in all inheritances in Japan.[4] The assessed value is computed for each heir by subtracting debts owed by the decedent and funeral expenses borne by heirs from the value of inherited assets. The amount of inheritance tax for each heir is calculated using these assessed values. The total sum of the assessed values for all the heirs of the decedent minus the amount of basic exemption, which is 30 million yen + 6 million yen * number of statutory heirs,[5] yields the taxable value. The taxable value is divided among the statutory heirs as designated by the civil code and the progressive inheritance tax rate is applied to the tax value for each statutory heir. The tax rate ranges between

[3] For a comparison between Japan and the US regarding the inheritance or bequest taxes, see Barthold and Ito (1991).

[4] According to a press release by the National Tax Office of Japan in December 2015, land and buildings make up 46.9% of the value of assets inherited by heirs during calendar 2014. For more details, see the following page (in Japanese): https://www.nta.go.jp/kohyo/press/press/2015/sozoku_shinkoku/index.htm.

[5] A surviving spouse of the decedent and living children of the decedent are automatically included among the statutory heirs. Grandchildren and great-grandchildren are included as statutory heirs if the children of the decedent are already dead. Further, living lineal ascendants and siblings become statutory heirs if there are no lineal descendants. Note that the actual heirs and statutory heirs may be different, since a decedent may give his assets to non-statutory heirs and statutory heirs may give up their right to inherit the decedent's assets.

10% and 55%.[6] Again, all the tax obligations of all statutory heirs are summed to obtain the total inheritance tax obligation regarding the inheritance. Finally, the actual heirs divide the total tax obligation in proportion to the amount of assets they inherit and pay the inheritance tax. An heir who has to pay inheritance tax according to the formula explained above must submit, within ten months after he knows the decedent has died, his inheritance tax return to the tax office where the decedent resided.[7]

In general, the valuation of assets for the calculation of inheritance taxes is based on the market value at the time the assets are inherited. However, in the case of real estate property, the valuation is based on the appraisal value, not on the actual transaction value. Land, one of the components of a real estate property, is assessed for inheritance tax according to a valuation map in the National Tax Bureau's office and the value in the map is known as *Rosen-ka for Inheritance Tax*. This *Rosen-ka for Inheritance Tax* is different from the public notice of land prices, which is known as *Koji Chika* and reported by the Ministry of Land, Infrastructure, Transportation, and Tourism, and *Rosen-ka for Real Estate Tax* reported by local municipal governments. Each of these three government appraisal values of property is below the market value. Prices in the *Koji Chika* are said to be generally lower than the market value, while the prices in the *Rosen-ka for Inheritance Tax* and the *Rosen-ka for Real Estate Tax* are about 80 percent and 70 percent of the prices in the *Koji Chika*, respectively. Buildings, the other component of a real estate property, are assessed for inheritance tax according to the valuation for real estate taxes, which is reported by local municipal governments. The valuation of buildings is said to be lower than the market value. As a result, the amount based on which inheritance tax is calculated is considerably smaller in the case of real estate than other assets with the same market value.

[6] The inheritance tax rate is 10% when the taxable value for the statutory heir is no more than 10 million yen and 55% when it is more than 600 million yen.
[7] There are no exceptions regarding the due date for the submission of inheritance tax returns, even when actual heirs cannot reach an agreement on how to divide the assets of the decedent.

2.2. Income tax on capital gains and its relationship with inheritance taxes

Capital gains refer to the increase in value of an asset such as a stock, bond, or real estate. Positive capital gains indicate that the sale price exceeds the purchase price. Depending on the type of asset, capital gains are subject to different types of taxes. In the case of capital gains from the sale of real estate property, such capital gains are separated from other income sources and subject to income and inhabitant taxes. If the property has been owned for more than five years on January 1 of the year in which it is sold, the income tax rate applied to capital gains is 15% and the inhabitant tax rate is 5%, while they are respectively 30% and 9% if the property has been owned for five years or less. Capital gains are calculated as the sales prices minus the sum of the acquisition price and expenses incurred for asset transactions.

There exist a few special treatments regarding the income and inhabitant taxes on capital gains from the sale of inherited real estate property. First, the tax rates of 15% (income tax) and 5% (inhabitant tax) are applied to capital gains from the sale of inherited assets if the combined period of ownership by the decedent and heirs is no less than five years. Second, the amount of inheritance tax is deducted from the capital gains from the sale of inherited assets, if assets are sold within three years after the payment of inheritance tax, thus reducing the amount of income and inhabitant tax payment.

2.3. The impact of the inheritance tax system on the timing of real estate sales

Based on the tax system in Japan described above, we posit a simple model regarding the decision of a family with two persons from different generations: an old and a young person. The old person is the owner of a real estate property and expected to die soon, while the young person is expected to inherit the assets of the old person. We assume that the family as a whole attempts to maximize the

amount of assets it holds after the old person dies. In other words, we assume that decisions by the old person are consistent with those by the young person in that both aim to maximize the total asset holdings of their family. We show that due to the two factors that are specific to Japan, namely, (1) the differential treatment of real estate and financial assets in the calculation of tax-base values, and (2) the deduction of the inheritance tax amount from the realized capital gains, it is beneficial for the family to sell the real estate property shortly after the old person dies and the young person inherits the property rather than to sell it while the old person is alive.

Suppose that the old person in the family owns one real estate property and that the family chooses between the following two options: (1) the old property owner sells the property now and transfers the proceeds in the form of financial assets to the young heir when he dies; or (2) the old owner holds the property until he dies and the young heir receives it as part of his inheritance and sells it. After the old asset owner dies, inheritance tax is levied proportional to the taxable value of the property. We denote the inheritance tax rate by a. Note that the way that the taxable value of assets is calculated in our model differs between real estate and financial assets. While the taxable value of financial assets is their full market value, real estate assets are valued at a fraction c of their market value. This means that the inheritance tax payable on real estate assets is lower than that on financial assets of the same market value. In addition, income tax on capital gains is levied when an owner sells real estate property. We denote the capital gains tax rate by b. We assume that the original purchase price that the current property owner paid in the past is zero and that the amount of capital gains from the sale of the property is equal to the sale price. Note that, depending on the interval between the payment of inheritance tax and the sale of the inherited property, the amount of inheritance tax paid by the young heir is subtracted from the amount of taxable capital gains.

First, we calculate the amount of after-tax assets the young heir receives if the old realty owner chooses the first option of selling the property before his death and bequeathing the amount in the

form of financial assets. This is expressed by

$$R_1 = (1-b)(1-a). \quad (1)$$

Next, we calculate the amount the young heir receives if the realty owner chooses the second option of holding the property until his death. We start from the case in which the amount of taxable capital gains is the same even when the young heir who sells the property has paid inheritance tax. This happens when the young heir sells inherited assets more than three years after the inheritance. We refer to this case as the "late sale" case and the formula for the amount of assets after taxes for the family is

$$R_{2\_Late\_Sale} = 1 - ac - b. \quad (2)$$

Second, we deal with the case in which the amount of inheritance tax paid for the property is subtracted from the capital gains from the sale of the property. This occurs when the heir sells inherited assets within three years of the inheritance. We call this the "early sale" case and the formula for the after-tax amount of assets is

$$R_{2\_Early\_Sale} = (1-ac)(1-b) \quad (3)$$

Subtracting R_1 from $R_{2\_Late\_Sale}$ and $R_{2\_Early\_Sale}$, we can measure the difference in the after-tax amount received by the heir between the decedent selling the real estate property before his death and the young heir selling it after inheriting it. We have

$$D_{Late\_Sale} = a(1-b-c) \quad (4)$$

for the case the property is sold long after the inheritance and no deduction of the inheritance tax amount is allowed and

$$D_{Early\_sale} = a(1-b)(1-c) \quad (5)$$

for the case the property is sold shortly after the inheritance and deduction of the inheritance tax amount from the capital gains tax base is allowed. The sign of (4) is uncertain because it depends on the size of the capital gains tax rate and of the ratio of the real estate tax-base value to its market

value, while (5) is always positive as long as $a>0$. Further, (5) is larger than (4) as long as $a>0$. Hence, our hypothetical family will strongly prefer holding the property and selling it shortly after the heir has inherited it to selling it when the old property owner is alive.

Further, differentiating D_{Early_Sale} with respect to a, b, and c, we have

$$\partial \mathrm{D}/\partial \mathrm{a} > 0, \quad \partial \mathrm{D}/\partial \mathrm{b} < 0, \quad \partial D/\partial c < 0 \qquad (6)$$

A higher inheritance tax rate increases the advantage of keeping the property until it is inherited by increasing the inheritance tax saving. A lower capital gains tax rate increases the potential inheritance tax saving by increasing the amount of assets the family keeps after capital gains tax. A lower ratio of the taxable value of real estate assets to that of financial assets increases the advantage of holding the property until it is passed on by inheritance.

To summarize the above analysis, we predict that the number of real estate sales offers will be larger in areas with a higher incidence of inheritance. The extent of this relationship depends on the effective rates of inheritance and capital gains taxes. Further, we expect that this inheritance-induced supply of real estate properties decreases the prices in the market. In the following sections, we examine these predictions using disaggregated data on inheritances and real estate transactions.

3. Empirical approach

3.1. Estimation framework

This subsection provides details of the estimation framework we employ for our analysis. We examine the relationship between realty prices and the number of properties for sale to see whether a larger number of properties for sale really decreases prices in the market. Economists traditionally use hedonic models that include observable characteristics of real estate properties for the estimation of real estate prices. Following this approach, we employ the following specification:

$$\ln(PRICE_{it}) + \gamma + \eta FOR\_SALE_{it} + X_{it}\xi + \varphi_j + \varphi_t + \varepsilon_{it} \ , \qquad (7)$$

where $\ln(PRICE_{it})$ is the natural logarithm of the price of property *i* in year *t*, X_{it} is a vector of the characteristics of each property *i* in year *t*, φ_j is the location fixed effect represented by dummies for the 23 wards in the Tokyo metropolitan area, each of which is an administrative borough with its own mayor and legislature, φ_t is the time fixed effect represented by year dummies, and ε_{it} is the error term. The vector of coefficients ξ is interpreted as the purchaser's willingness to pay for each characteristic. The coefficient we mainly focus on in the analysis is η, which measures the response of prices to a shift in the supply curve and is expected to be negative. We first estimate this equation using ordinary least squares (OLS).

Note, however, that we cannot make causal inferences with regard to the estimated η, since there may be reverse causality and/or omitted unobservables that are correlated with both sales and realty prices. For example, if owners put their real estate properties up for sale in response to prices going up, there will be reverse causality and the estimated coefficient of η will be positive and biased. Alternatively, if there exists an omitted variable that is significantly correlated with supply and prices, failure to include the variable may again result in biased estimates for η.

In order to deal with the omitted variables issue, we include variables relating to age demographics in X_{it} as proxies to represent the demand for real estate. However, including these variables may not be sufficient to completely rule out potential omitted variable biases. Therefore, we need to employ suitable instruments for the variable representing properties for sale. Following the discussion in Section 2, we use two instruments that are related to inheritances: the number of properties that were passed on through inheritance within a certain spatial area and its interaction term with the average appraisal land value within the area. These instruments explain a substantial portion of the variation in properties for sale and are exogenous in that they are correlated with

prices only through their effect on properties for sale.

The next few paragraphs explain in more detail how these instruments work. Specifically, regarding the first instrument, the incidence of inheritance, we argue that at the disaggregated level it is difficult to predict a person's death and that a death necessarily results in the inheritance of assets. We then explain how families whose old asset owner dies and leaves his real estate property to his heirs tend to sell the property, increasing the number of real estate properties for sale.

Starting with the timing of a person's death, barring unusual circumstances (such as suicide or homicide), this is generally difficult to manipulate. Kopczuk and Slemrod (2003) examine if the timing of a person's death is elastic to tax incentives and find that it changes only by about a few weeks at most. Meanwhile, the death of a person always is accompanied by an inheritance unless (1) a person leaves no assets behind or (2) all heirs renounce their right to inherit. However, both cases are not quantitatively important. The first case occurs when decedents have passed on all their assets in the form of inter-vivos transfers before their death, so that no assets to be inherited remain. However, in Japan, such inter-vivos transfers are much smaller than inheritances. According to statistics reported by the National Tax Agency, inter-vivos transfers, which are categorized as gifts in the statistics, were only 15% of the size of inheritances in fiscal 2013.[8] The second case usually occurs when a decedent's liabilities are larger than the assets left behind and heirs do not benefit from accepting the inheritance. However, estimates based on government statistics suggest that such cases make up only about 5% of the total number of inheritances in Japan.[9]

As we saw in Section 2.3, families with an aged real estate property owner and young

[8] According to the 2013 Annual Statistics reported by the National Tax Agency, the value of inherited assets was about 12.55 trillion yen, while the value of inter-vivos transfers was about 1.86 trillion yen. Note, however, that the statistics only capture the amount of gifts and inheritances that are reported by those who think they may be obliged to pay gift or inheritance taxes.

[9] This figure was obtained by estimating the total number of inheritances in Japan in 2013 by multiplying the number of deaths reported in the *Population Survey* by the Ministry of Health, Labor, and Welfare, which is 1,268,436, by the number of statutory heirs per decedent reported in the *Statistics Annual* by the National Tax Office, which is 2.97. This yields a total number of inheritances of about 3.8 million for the year. On the other hand, the number of renunciations of inheritance rights in 2013 reported in the *Judicial Statistics* by the Supreme Court was 172,936, so that we arrive at a share of 5% (172,936/3.8 million=0.05).

prospective heirs have an incentive to sell the property shortly after the aged old realty owner has died and the young heirs have inherited the property. Moreover, this incentive derives from the unique characteristics of the inheritance and capital gains tax scheme in Japan, namely, (1) the differential treatment of real estate assets and financial assets in terms of how their tax base values are calculated, and (2) the deduction of the inheritance tax amount from the realized capital gains. This incentive caused by the tax scheme is always positive provided that the heirs pay inheritance taxes and there exist positive capital gains as a result of the sale of the inherited property.

Hence, by combining the exogenous nature of death and inheritance at the disaggregated level and the unique characteristics of the Japanese tax system, our analysis is able to identify an exogenous increase of supply in the real estate market caused by realty owners' death and subsequent inheritances.

The incentive for families to sell the property shortly after the aged realty owner has died and the young heirs have inherited the property, i.e., the tax savings as a result of such behavior, depends on the effective inheritance and capital gains tax rates. In order to control for this factor, we construct another instrumental variable consisting of the incidence of inheritance multiplied by the average appraisal value of land in a certain area. We expect that a larger appraisal value results in both higher inheritance and capital gains taxes. With regard to inheritance taxes, a higher property value may result in a higher effective tax rate due to the progressive nature of inheritance taxes and due to the fixed exemption for each statutory heir. With regard to capital gains taxes, a higher property value may result in a higher effective rate since more expensive properties tend to have experienced more substantial price increases and hence experienced larger capital gains than less expensive properties.

Note, however, that whether the coefficient on this interaction term will be positive or negative is an empirical issue, since a higher inheritance tax rate increases the incentive for property owners

to not sell their property and instead leave their heirs to sell the property, while a higher capital gains tax rate reduces the incentive. In our empirical analysis below, we will therefore examine whether the sign of the coefficient on the variable is positive or negative.

Based on the empirical approach detailed above relying on both OLS and instrumental variable (IV) methods for the estimation of realty prices, we empirically estimate the determinants of real estate prices in the following section. Our specific focus is on the impact of the incidence of inheritance on realty prices.

3.2. Data

The dataset used for this study comprises two distinct sources: data on changes in the status of real estate properties in public registry information and data on real estate transactions. The former data contain information on changes in the status of each piece of real estate that is recorded in public registries. The information includes transfer of ownership due to sales/purchases, inheritance, gifts, foreclosures, the establishment of new real estate properties due to land or building development, the division or merger of land pieces, and the establishment and deletion of lien on real estate. The information is accompanied by the date when the change occurred and the location of each real estate property. All of this information is hand-collected by JON, a private firm in Japan that specializes in collecting registry information from local governments. The data cover the 23 wards of Tokyo, which are located at the center of the Tokyo metropolitan area and have a population of about 9.26 million (as of January 1, 2016) and comprise an area of 626.70 km^2 (as of October 1, 2014).[10] The data are for the period from 2000 to 2014.

The latter data are collected by Recruit Co. Ltd., the largest provider of real estate transaction information in the country. Making use of its relationships with a number of real estate agencies, the

[10] The figures are based on information provided by the Tokyo metropolitan government. See: http://www.metro.tokyo.jp/PROFILE/map_to.htm.

company collects information from these agencies not only about the properties that are eventually sold but also about those that are only offered for sale by property owners. For each property, detailed information on its attributes is available. Note that the type of attributes on which information is collected differs depending on the type of property, i.e., land, detached houses, and condominiums. For land, for example, the information on attributes includes the plot area, the number of minutes it takes on foot to the nearest subway station, the number of minutes from the nearest station to Tokyo Station, the building-to-land ratio, the floor-to-land ratio, and the width of the road in front. In addition, for detached houses and condominiums, the information available also includes the building age, floor area, height of the building, number of rooms, and method of construction. The coverage of the data is the same as that of the former dataset, that is, for the 23 wards of Tokyo for the years 2000–2014.

We merge these two data sources to construct our dataset. As of 2010, there were 3,132 districts within the 23 wards of Tokyo. Districts, called “chome” in Japanese, are the smallest administrative unit in Japan whose names and borders are determined by the local legislature. Figure 2 shows the actual district boundaries in our sample of the 23 wards in Tokyo, The average population of a district is 2,959 persons, while the average area is 0.20km^2. Variables in the dataset consist of two types: property-related and district-related variables. Names and definitions of the variables are provided in Table 1. Property-related variables include the age of a building, the building-to-land ratio, the floor-to-land ratio, the land area, number of minutes to the nearest subway station, etc.

For the district-level variables, we aggregate the two datasets at the district-year level to construct the incidence of inheritance and the density of real estate for sale. For the incidence of inheritance, for each district and year, we count the number of individual real estate properties whose ownership was transferred through inheritance in the preceding three years and divide this by the

number of individual real estate properties whose registry information changed over the same period. The reason for using the previous three years is that this is the maximum interval between the sale date of an inherited property and the payment date of inheritance tax in order to benefit from the tax privilege of being able to deduct the inheritance tax amount from the capital gains from the sale of inherited real estate. We label this variable *INHERIT*.

Next, the density of properties for sale is calculated by dividing the size of properties newly offered for sale in a given district and year by the land size area of the district. The ratio, which we call *FOR_SALE1*, measures real estate properties for sale in terms of area and uses a slightly different definition for each property category. For land, the numerator is the total area of land newly placed on sale in a district and year, while the denominator is the total area of the district. For detached houses and condominiums, the numerators respectively are the total floor area of detached houses and of condominiums newly placed on sale in a district and year, while the denominator is the total floor area in the district. We also construct a similar variable, *FOR_SALE2*, in order to measure the density of real estate supply in terms of numbers.[11] Specifically, this variable is calculated as the number of properties newly offered for sale in a district and year divided by the number of individual real estate properties whose registry information changed between 2000 and 2014.

In addition, we construct three other variables at the district-year level based on publicly available data. Two are variables on the demographic age structure of residents in a district constructed from the *Population Census* published by the Ministry of Internal Affairs and Communications. The first is the aged population ratio (*AGED*), which is the population of those aged 65 or above divided by the total population in a particular district and year, while the second is the old age dependency ratio (*OLDAGE*), which is the of population of those aged 65 and above

[11] Note that the estimation results we obtain using *FOR_SALE2* are not qualitatively different from those using *FOR_SALE1*. Hence, we do not show the results in the paper.

divided by the population of those aged 15–64.[12] The final variable is the average appraised land price in each district (*APPRAISAL_AVG*) constructed from the *Koji Chika* (the public notice of land prices) reported annually by the Ministry of Land, Infrastructure, Transportation, and Tourism.

4. Results

4.1. Summary statistics

We start by describing the data we use for our analysis. Summary statistics for the three different categories of real estate property, i.e., land, detached houses, and condominiums, are provided in Tables 2(a), (b), and (c) respectively. The numbers of observations for the three categories are 25,677 for land, 77,747 for detached houses, and 52,789 for condominiums. The distributions of the number of observations across years differ to some extent across the different property categories. While observations are evenly distributed across years for land and detached houses, they are rather skewed toward the end of the observation period for condominiums.

The price per square meter of real estate properties (*PRICE*) varies substantially within each property category. In the case of land, the minimum value is only about 6,000 yen/m^2, while the maximum is about 1.7 million yen/ m^2. The mean and median values of land prices per square meter are close to each other (ca. 629,000 and 594,000 yen), indicating that the distribution is not substantially skewed to either side. The values for *FOR_SALE1* range between 0 and 0.13 for land. This means that in some of the districts no land property was for sale within a particular year, but there was also a district where 13% of the total land area was newly put on sale in a particular year. The values for *FOR_SALE1* are in a similar range for the other property categories, ranging from 0 to 0.09 for detached houses and from 0 to 0.07 for condominiums. The values for *INHERIT* range between 0 and 0.136, with the mean and median both being 0.052 in the case of land, indicating that

[12] Note that the estimation results we obtain using *OLDAGE* are not qualitatively different from those using *AGED*. Hence, we do not show the results in the paper.

the incidence of inheritance varies substantially across years and districts. While *INHERIT* represents the demographic age structure among property owners in a district, the variable *AGED* represents the demographic age structure of all residents within the district. The values for *AGED* range from 0.054 and 0.402, with a mean and median of 0.186 and 0.184 respectively in the case of land, indicating that the share of the aged population differs substantially across years and districts as well.[13]

It is important to see how the two variables *INHERIT* and *AGED* differ from each other in their geographical distributions and how each of these variables is related to *FOR_SALE1*, which measures the density of real estate properties for sale. Panels (a) and (b) of Figure 1 show the values of the two variables *AGED* and *INHERIT* across districts in the 23 wards of Tokyo. The geographical distributions differ between these two variables. In Panel (a), we see a higher density of elderly residents in the eastern (downtown) area of the 23 wards of Tokyo, while in Panel (b), we see a higher density of elderly property owners in the western (uptown) area. Panel (c) shows the values of *FOR_SALE1* across districts and its geographical distribution appears to be similar to that of *INHERIT*. This suggests that there is a positive and statistical association between the incidence of inheritance and the number of real estate properties for sale.

Next, the figures for *APPRAISAL_AVG* indicate that the district average appraisal value of land varies substantially, ranging from 147,000 yen/m^2 to 10 million yen/m^2. The standard deviation of *APPRAISAL_AVG* (358,000 yen) is somewhat larger than the standard deviation of actual transaction values, *PRICE* (247,000 yen).

Turning to the variables on the characteristics of real estate properties, let us highlight just a few. Regarding *BUILDING_AGE*, which measures the age of a building when it is sold, there is a substantial difference between detached houses and condominiums. With a mean and median age of

[13] Note that the statistics for *AGED* in the text are for land but those for other property types (detached houses and condominiums) are the same for the minimum and the maximum and similar for the means and the medians. The means and medians differ between property types due to different geographical distributions of each property type.

3.5 and 0.25 years, detached houses are substantially newer than condominiums, whose mean and median age are 21.00 and 21.42 years. These figures (together with a 75 percentile value of 0.75 years for detached houses) indicate that most detached houses are sold when they are newly built, while condominiums are also frequently bought and sold in the "second hand" market. Finally, the mean values for *DISTANCE_STATION* and *DISTANCE_TOKYO* are smaller for condominiums (7.06 and 26.65 minutes) than for land (8.64 and 30.31 minutes) and detached houses (9.51 and 31.15 minutes), indicating that condominiums are located in more convenient areas than are land and detached houses.

4.2. Estimation results using OLS

We now present the estimation results for the real estate price equations. In this subsection, we start by presenting the OLS results for each of the three property types.

The OLS results are presented in Table 3. The most important coefficient we examine is the one on *ln(FOR_SALE1)*, which measures the response of realty prices to the amount of supply in the market. For all three property categories, we obtain positive and significant coefficients. Specifically, the coefficient for land is 0.0157, that for detached houses is 0.0047, and that for condominiums is 0.0069. Since the dependent and independent variables are measured in logarithm, the numbers represent elasticities. For example, in the land equation, the coefficient indicates that a 1% increase in properties for sale results in a 0.016% increase in real estate prices. While the size of the impact in all three property categories may be small, the OLS results nevertheless suggests that an increase in supply drives up prices rather than reducing them as one might expect.

Next, looking at the *AGED* variable, which measures the share of residents aged 65+ among all residents in a district, we find that the coefficients on the variable are either significantly negative (in the case of detached houses) or positive but insignificant (in the case of land and condominiums).

In the equation for detached houses, the coefficient indicates that a 1% increase in the share of the aged population results in a -0.0007% decrease in realty prices. Although the sign is consistent with the meltdown hypothesis that population aging dampens the market and thus decreases prices, the size of the coefficient appears economically negligible.

The signs of the coefficients on the other variables are mostly unsurprising and in line with the findings of other studies. Properties fetch higher prices when the building is (relatively) new and built of reinforced concrete, when they are located close to the nearest subway station and/or the nearest station is close to Tokyo Station, one of the largest commuting hubs in the observation area, when they face a wide road in front, and/or when they are located on a higher floor. Note, however, that some of the coefficients have opposite signs for the different property categories. For example, the coefficient on *FLOOR_AREA* is negative for detached houses but positive for condominiums, while the coefficient on *FLOOR_RATIO* is positive for land but negative for detached houses. These results indicate that individuals may apply different criteria when evaluating the characteristics of different types of real estate.

4.3. Estimation results using IV estimation

Next, we introduce instruments for the properties for sale variable to examine how the results differ in the IV estimations from the OLS estimations. For each property type, we instrument *FOR_SALE1* with *INHERIT* and *INHERIT*APPRAISAL_AVG*. Then, using the instruments for *FOR_SALE1*, we implement IV estimations. The results are shown in Table 4.

Columns (1), (3), and (5) of Table 4 show the results of the first-stage estimation. The coefficients on *INHERIT* are significantly positive, while those on the interaction term between *INHERIT* and *APPRAISAL_AVG* are significantly negative. The results thus indicate that the incidence of inheritance in a district has a positive effect on the density of properties for sale in the

district. A one percentage point increase in *INHERIT* leads to 0.05% increase in the ratio of the land area for sale (*ln(FOR_SALE1)*). We observe coefficients of a similar or larger size in the case of detached houses and condominiums. Specifically, a one percentage point increase in *INHERIT* leads to a 0.10% increase in the ratio of the total floor area of detached houses for sale and a 0.06% increase in the ratio of the total floor area of condominiums for sale.

Turning to the interaction term, *INHERIT*APPRAISAL_AVG*, the negative coefficient implies that the extent to which a higher incidence of inheritance results in more properties for sale decreases with higher average appraisal land values. In Section 3.1, we highlighted that the coefficient could be either positive or negative. The fact that it is actually negative indicates that owners of expensive properties are more likely to refrain from selling their property and instead leave it for their heirs to sell because of the larger effective capital gains tax they (the owners) face than owners of less expensive properties.

Columns (2), (4), and (6) of Table 4 show the results for the realty price equation. The coefficient of greatest interest is that on *ln(FOR_SALE1)*. For all three categories of properties, we obtain significant negative coefficients; that is, the sign is the opposite of that in the OLS estimations. The size of the coefficients for land, detached houses, and condominiums are -0.246, -0.301, and -0.159, respectively. Since the dependent and independent variables are measured in logarithm, the numbers, as above, can be interpreted as elasticities. Thus, in the case of land, for example, the coefficient indicates that a 1% increase in the number of properties for sale in the real estate market results in a 0.246% decrease in real estate prices. What is more, the negative demand elasticities of real estate with respect to prices are not only statistically significant, they are also economically substantial.

Next, turning to the age-related variable, *AGED*, the coefficients on the variable differ from those obtained in the OLS estimation. They are now significantly positive in the case of land and

detached houses and negative but insignificant in case of condominiums, meaning that the signs of the coefficients on *AGED* change after controlling for the inheritance-induced supply of real estate properties. These results imply that the age-related variable at the disaggregated level may proxy for something other than the declining demand for real estate property.

Finally, looking at the results for other variables, the coefficients have mostly the same sign as in the OLS estimations. However, there are a few exceptions, including the coefficients on *DISTANCE_STATION* (in the case of detached houses), and *BUILDING_RATIO* and *FLOOR_RATIO* (in the case of land).

4.4. IV estimation taking land use regulation into account

In this subsection, we further examine the relationship between the amount of real estate for sale (instrumented by the incidence of inheritance) and transaction prices by focusing on an additional aspect: the impact of the extent of regulation on the demand elasticity of real estate property.

Given that there tends to be considerable heterogeneity in real estate markets within the 23 wards of Tokyo due to buyers' preferences and land use regulations by ward offices, there may be substantial differences in the coefficients on *ln(FOR_SALE1)* among regionally segmented markets. There may be a number of potential sources for such heterogeneity and here we focus on one of them: the extent of regulation on land use. If potential buyers think that a piece of real estate in a certain area at a certain time can be substituted by other pieces of real estate, demand for the piece of real estate will be elastic, while it will be inelastic if potential buyers regard the real estate as irreplaceable. It is likely that regulations on land use by local governments have a substantial impact on the degree of substitutability, or the demand elasticity, of real estate properties. While there are a variety of land use regulations imposed by local governments, we focus on regulations concerning the floor-to-land ratio and examine how these affect demand elasticity. We divide the entire sample

of observations into two groups based on where the property is located; namely, properties located in wards that increased the permitted floor-to-land ratio during the period 2005–2013 and wards that decreased it. Of the 23 wards, 16 increased the permitted land-to-floor ratio, while 7 decreased it.

The results of the second stage IV estimation are presented in Table 5. There are substantial differences in the results for land and detached houses and condominiums. In the case of land, the absolute value of the coefficient on *ln(FOR_SALE1)* is considerably smaller for wards that increased the permitted floor-to-land ratio than in those that decreased it. Since the demand elasticity is the inverse of the coefficient, the absolute value of demand elasticity is larger in areas that experienced a relaxation of regulations than in areas where regulations where tightened. In contrast, the opposite results are obtained in the case of detached houses and condominiums, for which the demand elasticity is smaller in areas that experienced a relaxation of regulation than in areas where regulations were tightened. These results imply that floor-to-land ratio regulations are more relevant for land, since the value of vacant land is more susceptible to land use regulations than the value of real estate which already has built structures.

5. Conclusion

Using the incidence of inheritance to instrument the supply of real estate, we examined how inheritance-induced supply affects the real estate market. In light of the potential impact of rapid population aging on economies such as Japan's, using the growing incidence of inheritance illustrated in Figure 2 and exploiting features of the Japanese tax system that provide incentives for real estate owners to pass on their properties through inheritance rather than selling them before their death, our analysis provides important insights on the impact on the realty market. Our results can be summarized as follows. First, we found that a higher incidence of inheritance is associated with an increase in properties for sale. Second, we established that such supply-side pressure actually

decreases the prices of different types of real estate properties (land, detached houses, and condominiums). The impact is not only statistically significant but also economically substantial. Third, we extended our IV estimation to examine if the demand elasticity of real estate properties differs depending on whether land use regulations were relaxed or tightened. In the case of land, we found a larger demand elasticity in wards that relaxed regulations than in wards that tightened them. In the case of detached houses and condominiums, however, we obtained the opposite result.

One of the most important takeaways from our study is that it highlights the importance of understanding the mechanisms how population aging affects the real estate market. We focus on one aspect of population aging, that is, the death of real estate owners and the subsequent inheritance of their real estate and exploit a specific institutional setup that affects the realty market, that is, Japan's tax system, which provides an incentive for real estate owners to pass on their real estate property to their heirs rather than selling it before they die. However, the study may provide a useful reference point for examining the impact of population aging on the realty market in other countries with different institutional setups. In the United States, for example, real estate property and financial assets do not appear to be treated differently in assessing their respective tax base values, but, as highlighted by Bernheim, Lemke, and Scholz (2004), there are substantial differences in the way inter-vivos gifts and estates are taxed. This difference not only affects the timing of transfers between decedents and heirs but may also affect the timing of the supply of the assets concerned in the market.

There remain a number of potential avenues for future research. First, the present study matches the incidence of inheritance and properties for sales only at the district level, but not at the transaction level. In order to identify the exogenous increase of supply caused by inheritance and to more precisely examine its impact on the prices of both inherited properties and properties in the neighborhood, it is necessary to match information on inheritances and properties for sale at the

transaction level. Second, the study may be extended to examine the impact of changes in the tax system. For example, inheritance tax rates were increased 2003 and again substantially in 2015. Examining the potential impact these changes had on the reality market would be a worthwhile exercise.

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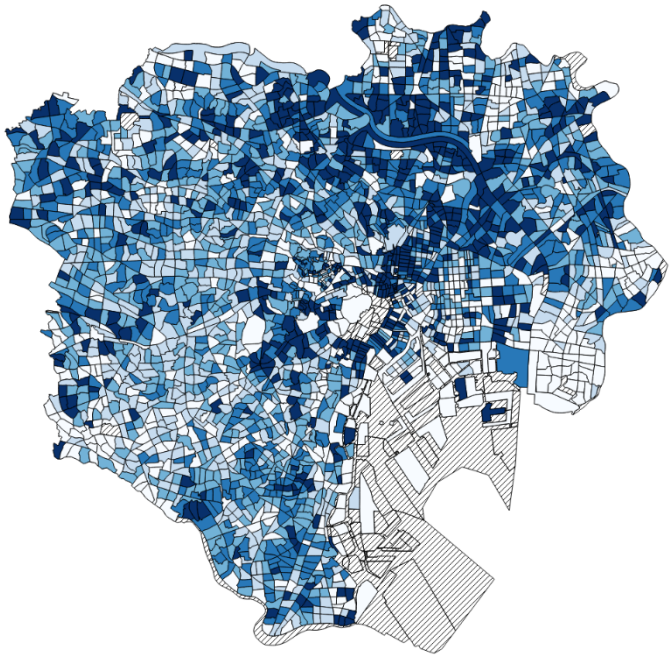
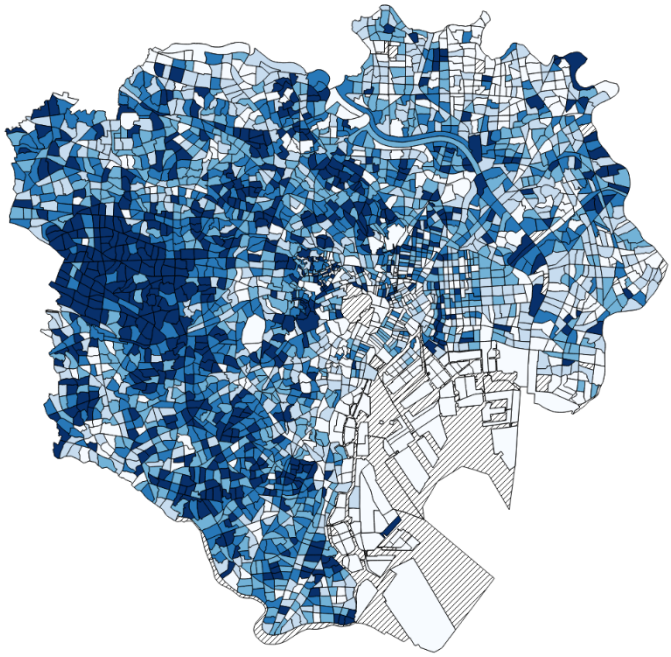
Figure 1: Aged population ratio, incidence of inheritance, and density of real estate properties for sale by district in the 23 wards of Tokyo

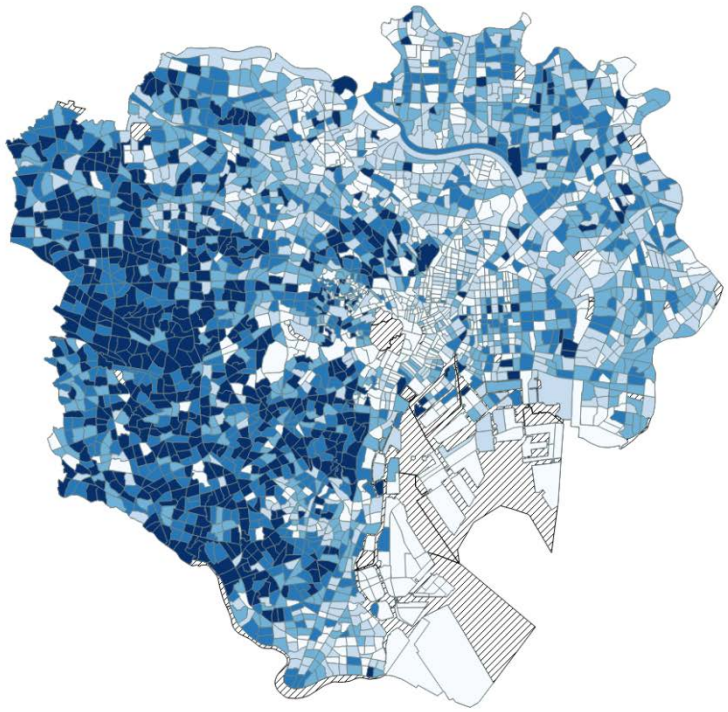
(a) Aged population ratio (*AGED*)



(b) Incidence of inheritance (*INHERIT*)



(c) Density of real estate properties for sale (*FOR_SALE1*)



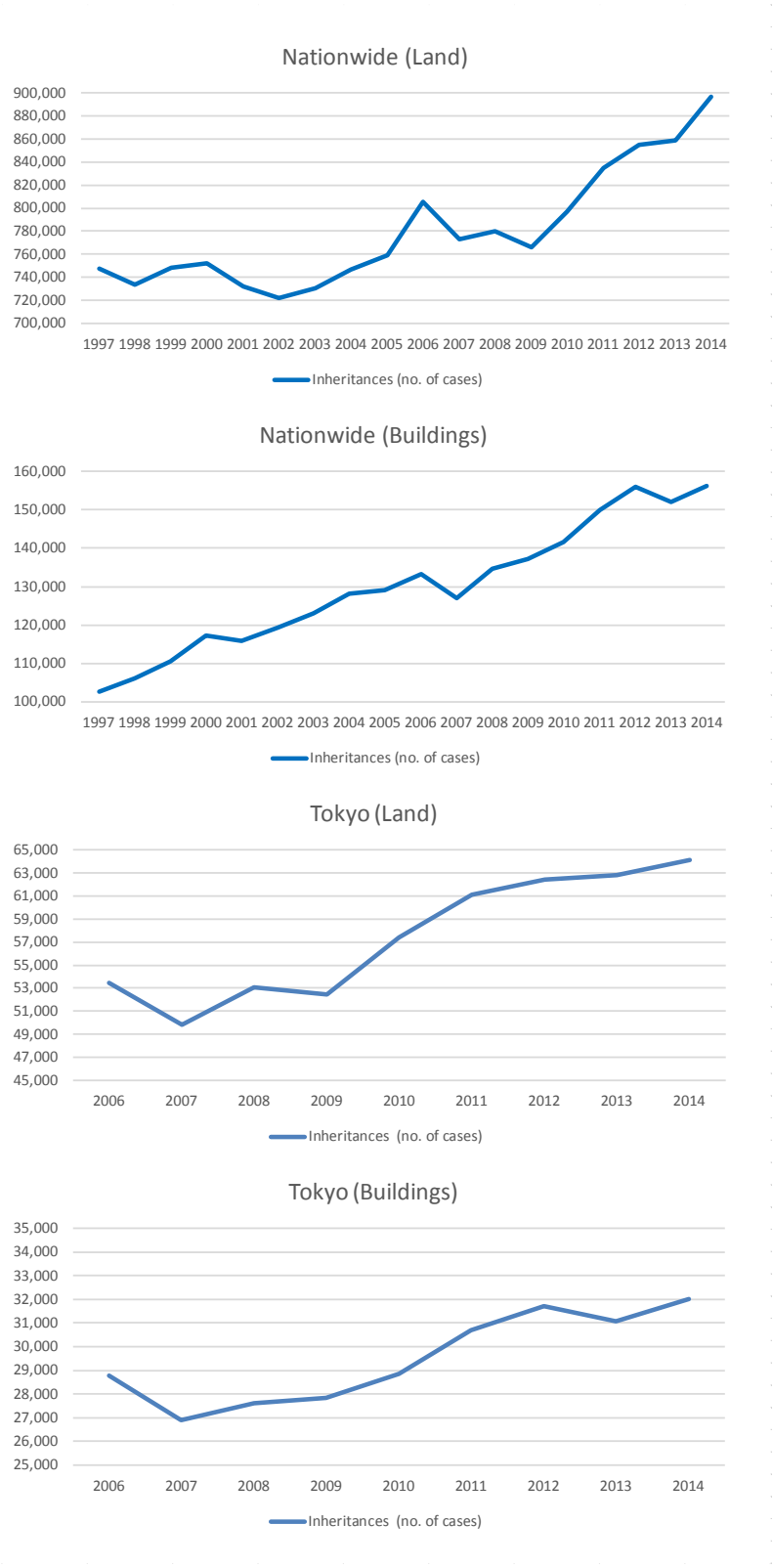
Note 1: A darker color represents a higher aged population ratio (a), a higher incidence of inheritance (b), or a higher density of real estate properties for sale (c). The table below shows the correspondence between colors and the ranges of values for each panel.

		(a) AGED			(b) INHERIT			(c) FOR_SALE1		
	Quintiles	Lower bound		Upper bound	Lower bound		Upper bound	Lower bound		Upper bound
Light blue	0-20%	0.000	---	0.150	0.000	---	0.029	0.000	---	0.002
↕	20-40%	0.150	---	0.175	0.029	---	0.039	0.002	---	0.006
	40-60%	0.175	---	0.195	0.039	---	0.047	0.006	---	0.011
	60-80%	0.195	---	0.222	0.047	---	0.057	0.011	---	0.020
Dark blue	80-100%	0.222	---	0.588	0.057	---	0.222	0.020	---	0.127

Note 2: The information is for the year 2005 ((a) and (c)) and for the year 2008 (b).

Sources: *2005 Population Census*; JON; Recruit.

Figure 2: Number of inheritances in Japan



Source: *Registry Statistics*, Ministry of Justice.

Table 1: Names and definitions of variables

Variable	Definition
PRICE	Sale price of real estate property in 1,000 yen. Observations in the top and bottom percentile in each category are omitted.
FOR_SALE1	Ratio of the size of properties newly offered for sale in a district in a year to the size of the district. In the case of land, the numerator is the sum of land area for sale and the denominator is the area of the district. In the case of detached houses, the numerator is the sum of the floor area of detached houses for sale and the denominator is the total floor area in the district. In the case of condominium units, the numerator is the sum of the floor area of condominiums for sale and the denominator is the total floor area in the district. The total floor area in the district is defined as the land area of the district * average floor-to-land ratio of the district.
FOR_SALE2	Ratio of the number of properties newly offered for sale in a district in a year to the number of unique real estate pieces for which registry information changed for all the years in the observation period of 2000-2014.
INHERIT	Ratio of the number of unique real estate pieces that were passed on by inheritance during the preceding three years to the number of unique real estate pieces for which registry information changed during the same period.
APPRAISAL_AVG	Average appraised land prices in a district constructed from the *Public Notice of Land Prices* published annually by the Ministry of Land, Infrastructure, Transportation, and Tourism, in 1,000 yen.
AGED	Ratio of the population aged 65 or above in a district to the total population in the district
OLDAGE	Ratio of the population aged 65 or above in a district to the total population aged 15-64 in the district
BUILDING_AGE	Number of years since the construction of the building
FLOOR_AREA	Floor area of the real estate property in square meters
LAND_AREA	Land area in square meters
DISTANCE_STATION	Number of minutes to the nearest subway station
HEIGHT	Number of stories of the real estate property
ROOMS	Number of rooms in the real estate property
DISTANCE_TOKYO	Number of minutes to the Tokyo terminal station
CONCRETE	Dummy for properties that are reinforced concrete structures
BUILDING_RATIO	Ratio of building site area to land size
FLOOR_RATIO	Ratio of floor area to land size
ROAD_WIDTH	Width of the road the property faces in meters
SOUTH	Dummy for properties facing south (condominiums only)
FLOOR_UNIT	Floor on which the property is located (condominiums only)

Table 2: Summary statistics

(a) Land

	n	Mean	S.D.	Min.	25%	Median	75%	Max.
Year	25677	2007	3.389	2002	2005	2007	2011	2013
PRICE	25677	628.5	247.3	6.132	455.6	593.8	751.5	1741
lnPRICE	25677	6.370	0.388	1.814	6.122	6.386	6.622	7.462
FOR_SALE1	25677	0.017	0.014	0	0.007	0.013	0.022	0.128
ln(FOR_SALE1)	25677	-4.443	0.918	-9.022	-4.942	-4.321	-3.811	-2.052
INHERIT	25677	0.052	0.017	0	0.042	0.052	0.061	0.136
AGED	25677	0.186	0.032	0.054	0.166	0.184	0.202	0.402
APPRAISAL_AVG	25677	560.7	358.2	147	426	515	607	10000
G_APPRAISAL_AVG	25677	-0.004	0.038	-0.166	-0.024	-0.01	0.01	0.517
LAND_AREA	25677	116.9	84.37	1	73	99.22	133.9	6164
DISTANCE_STATION	25677	8.642	4.407	0	5	8	11	36
DISTANCE_TOKYO	25677	30.31	7.259	5	26	31	35	126
BUILDING_RATIO	25677	0.547	0.135	0	0.5	0.6	0.6	1
FLOOR_RATIO	25677	1.61	0.834	0	1	1.5	2	9
ROAD_WIDTH	25677	4.887	3.541	0	3.8	4	5.7	72

(b) Detached houses

	n	Mean	S.D.	Min.	25%	Median	75%	Max.
Year	77747	2007	3.57	2002	2004	2007	2011	2013
PRICE	77747	585	150	0.538	479.5	579.3	677.8	1081
lnPRICE	77747	6.337	0.27	-0.62	6.173	6.362	6.519	6.985
FOR_SALE1	77747	0.012	0.01	0	0.005	0.009	0.015	0.087
ln(FOR_SALE1)	77747	-4.832	0.945	-10.24	-5.402	-4.722	-4.18	-2.441
INHERIT	77747	0.050	0.016	0	0.039	0.049	0.059	0.136
AGED	77747	0.187	0.034	0.054	0.167	0.186	0.205	0.402
APPRAISAL_AVG	77747	468.5	193.9	138	353	446	538	4100
G_APPRAISAL_AVG	77747	-0.008	0.031	-0.167	-0.025	-0.014	0.003	0.448
BUILDING_AGE	77747	3.508	7.864	0	0.083	0.25	0.75	87.92
FLOOR_AREA	77747	102.1	46.76	21.06	84.64	94.77	106.9	7535
LAND_AREA	77747	87.47	50.27	2	62.25	80.36	100.2	8060
DISTANCE_STATION	77747	9.51	4.913	0	6	9	13	63
HEIGHT	77747	2.351	0.704	0	2	2	3	25
ROOMS	77747	3.447	0.88	0	3	3	4	45
DISTANCE_TOKYO	77747	31.15	7.695	4	26	31	37	48
CONCRETE	77747	0.023	0.151	0	0	0	0	1
BUILDING_RATIO	77747	0.546	0.145	0	0.5	0.6	0.6	2.64
FLOOR_RATIO	77747	1.628	0.782	0	1	1.5	2	8.4
ROAD_WIDTH	77747	4.533	2.427	0	4	4	5.4	99.9

(c) Condominiums

	n	Mean	S.D.	Min.	25%	Median	75%	Max.
Year	52789	2009	3.599	2002	2006	2010	2012	2013
PRICE	52789	529.6	173	3.516	409.5	503.2	625.5	1198
lnPRICE	52789	6.220	0.327	1.257	6.015	6.221	6.439	7.088
FOR_SALE1	52789	0.007	0.007	0	0.002	0.005	0.009	0.071
ln(FOR_SALE1)	52789	-5.44	0.993	-10.12	-6.065	-5.361	-4.756	-2.645
INHERIT	52789	0.045	0.015	0	0.035	0.045	0.055	0.136
AGED	52789	0.176	0.036	0.054	0.155	0.176	0.196	0.402
APPRAISAL_AVG	52789	647.2	463.6	166	385	520	728.2	10000
G_APPRAISAL_AVG	52789	-0.008	0.043	-0.213	-0.033	-0.017	0.013	0.517
BUILDING_AGE	52789	21.00	12.15	0	9.75	21.42	31.33	68.33
FLOOR_AREA	52789	60.96	22.48	12.01	48.07	59.08	70.37	877.8
DISTANCE_STATION	52789	7.055	4.25	0	4	6	10	96
HEIGHT	52789	9.058	4.931	0	6	8	11	143
ROOMS	52789	2.211	0.887	0	2	2	3	51
DISTANCE_TOKYO	52789	26.65	8.136	1	20	26	33	48
CONCRETE	52789	0.595	0.491	0	0	1	1	1
SOUTH	52789	0.343	0.475	0	0	0	1	1
FLOOR_UNIT	52789	6.832	3.544	0	4	6	8	80

Table 3: OLS estimation results

	Dependent variable: ln(PRICE)		
	(1)	(2)	(3)
	Land	Detached	Condos
Variable	OLS	OLS	OLS
ln(FOR_SALE1)	0.0157***	0.00474***	0.00694***
	(0.00184)	(0.000754)	(0.000883)
AGED	0.0584	-0.0741***	0.0177
	(0.0502)	(0.0189)	(0.0216)
BUILDING_AGE		-0.00733***	-0.0147***
		(8.03e-05)	(6.86e-05)
FLOOR_AREA		-0.000827***	0.000457***
		(1.60e-05)	(4.04e-05)
LAND_AREA	-0.000470***	0.000887***	
	(1.82e-05)	(1.47e-05)	
DISTANCE_STATION	-0.00946***	-0.00262***	-0.00755***
	(0.000354)	(0.000128)	(0.000185)
HEIGHT		-0.0490***	0.00337***
		(0.00125)	(0.000206)
ROOMS		-0.0105***	0.00411***
		(0.000761)	(0.00106)
DISTANCE_TOKYO	-0.0109***	-0.00395***	-0.00753***
	(0.000315)	(0.000120)	(0.000157)
CONCRETE		0.0819***	0.0130***
		(0.00430)	(0.00172)
BUILDING_RATIO	0.00537	0.176***	
	(0.0173)	(0.00780)	
FLOOR_RATIO	0.0153***	-0.0532***	
	(0.00315)	(0.00141)	
ROAD_WIDTH	0.00773***	0.00514***	
	(0.000443)	(0.000271)	
SOUTH			0.00127
			(0.00152)
FLOOR_UNIT			0.00735***
			(0.000260)
Constant	7.434***	7.222***	6.811***
	(0.0337)	(0.0383)	(0.0126)
Number of observations	25,677	77,747	52,789
R-squared	0.633	0.619	0.751
Year dummies	YES	YES	YES
Ward dummies	YES	YES	YES

Table 4: IV estimation results

	(1)	(2)	(3)	(4)	(5)	(6)
	Land	Land	Detached	Detached	Condos	Condos
Variable	First stage	IV	First stage	IV	First stage	IV
ln(FOR_SALE1)		-0.246***		-0.301***		-0.159***
		(0.0316)		(0.00862)		(0.00615)
INHERIT	4.541***		9.843***		6.189***	
	(0.377)		(0.290)		(0.310)	
INHERIT*APPRAISAL_AVG	-0.00295***		-0.0194***		-0.0104***	
	(0.000341)		(0.000447)		(0.000241)	
AGED	2.773***	0.867***	0.831***	0.234***	-0.331***	-0.0133
	(0.173)	(0.118)	(0.0914)	(0.0345)	(0.109)	(0.0279)
BUILDING_AGE			-0.0109***	-0.0109***	0.00592***	-0.0138***
			(0.000376)	(0.000173)	(0.000333)	(9.48e-05)
FLOOR_AREA			0.00108***	-0.000546***	0.00477***	0.00121***
			(7.52e-05)	(2.93e-05)	(0.000195)	(5.90e-05)
LAND_AREA	0.000749***	-0.000274***	0.000550***	0.00107***		
	(6.11e-05)	(3.38e-05)	(6.92e-05)	(2.65e-05)		
DISTANCE_STATION	0.0283***	-0.00213**	0.0208***	0.00464***	0.0337***	-0.00138***
	(0.00119)	(0.000999)	(0.000602)	(0.000303)	(0.000892)	(0.000328)
HEIGHT			-0.0771***	-0.0726***	0.00330***	0.00355***
			(0.00588)	(0.00230)	(0.00100)	(0.000266)
ROOMS			0.0199***	-0.00457***	0.000126	0.00577***
			(0.00358)	(0.00135)	(0.00515)	(0.00137)
DISTANCE_TOKYO	0.00740***	-0.00888***	0.00332***	-0.00159***	0.0213***	-0.00349***
	(0.00107)	(0.000483)	(0.000575)	(0.000222)	(0.000755)	(0.000250)
CONCRETE			0.0412**	0.0924***	0.0685***	0.0264***
			(0.0202)	(0.00759)	(0.00834)	(0.00228)
BUILDING_RATIO	0.437***	0.124***	0.772***	0.406***		
	(0.0582)	(0.0271)	(0.0366)	(0.0152)		
FLOOR_RATIO	-0.245***	-0.0498***	-0.269***	-0.135***		
	(0.0105)	(0.00888)	(0.00657)	(0.00337)		
ROAD_WIDTH	-0.00802***	0.00542***	0.0154***	0.00985***		
	(0.00150)	(0.000654)	(0.00127)	(0.000497)		
SOUTH					0.00230	0.00191
					(0.00738)	(0.00197)
FLOOR_UNIT					-0.00276**	0.00702***
					(0.00126)	(0.000337)
Constant	-5.204***	6.023***	-5.006***	5.389***	-7.086***	5.527***
	(0.111)	(0.175)	(0.180)	(0.0847)	(0.0537)	(0.0494)
Number of observations	25,677	25,677	77,747	77,747	52,789	52,789
R-squared	0.251	0.344	0.313	-0.188	0.365	0.585
Year dummies	YES	YES	YES	YES	YES	YES
Ward dummies	YES	YES	YES	YES	YES	YES

Table 5: IV estimation results taking land use regulation into account

	Wards that increased permitted floor-to-land ratio			Wards that decreased permitted floor-to-land ratio		
	(1)	(2)	(3)	(4)	(5)	(6)
	IV	IV	IV	IV	IV	IV
Variables	Land	Detached	Condos	Land	Detached	Condos
ln(FOR_SALE1)	-0.143***	-0.389***	-0.194***	-0.572***	-0.160***	-0.129***
	(0.0319)	(0.0115)	(0.00794)	(0.0975)	(0.0111)	(0.00772)
AGED	0.576***	0.332***	-0.0642*	1.947***	0.109	0.215***
	(0.118)	(0.0434)	(0.0357)	(0.454)	(0.0868)	(0.0501)
BUILDING_AGE		-0.0123***	-0.0139***		-0.00749***	-0.0138***
		(0.000224)	(0.000122)		(0.000341)	(0.000162)
FLOOR_AREA		-0.000501***	0.000828***		-0.00161***	0.00203***
		(3.64e-05)	(7.89e-05)		(9.68e-05)	(8.96e-05)
LAND_AREA	-0.000423***	0.00103***		0.000953***	0.00308***	
	(2.93e-05)	(3.22e-05)		(0.000206)	(0.000119)	
DISTANCE_STATION	-0.00526***	0.00638***	0.000110	0.0121***	0.00255***	-0.00157***
	(0.00100)	(0.000382)	(0.000431)	(0.00409)	(0.000781)	(0.000547)
HEIGHT		-0.0804***	0.00460***		-0.0221***	0.00238***
		(0.00295)	(0.000378)		(0.00483)	(0.000393)
ROOMS		-0.000936	0.0127***		-0.0200***	-0.00874***
		(0.00174)	(0.00186)		(0.00271)	(0.00215)
DISTANCE_TOKYO	-0.00939***	-0.00171***	-0.00348***	0.00634	0.000309	-0.000701
	(0.000393)	(0.000271)	(0.000304)	(0.00448)	(0.000731)	(0.000477)
CONCRETE		0.104***	0.0257***		0.0636***	0.0324***
		(0.0104)	(0.00302)		(0.0116)	(0.00370)
BUILDING_RATIO	0.0180	0.551***		0.0936	0.119***	
	(0.0263)	(0.0207)		(0.105)	(0.0278)	
FLOOR_RATIO	-0.000806	-0.187***		-0.165***	-0.0384***	
	(0.00910)	(0.00495)		(0.0257)	(0.00377)	
ROAD_WIDTH	0.00473***	0.0120***		0.0256***	0.00393***	
	(0.000592)	(0.000626)		(0.00389)	(0.00128)	
SOUTH			0.00832***			-0.00838**
			(0.00253)			(0.00353)
FLOOR_UNIT			0.00749***			0.00572***
			(0.000455)			(0.000530)
Constant	5.464***	4.324***	5.000***	3.940***	5.862***	5.614***
	(0.183)	(0.0668)	(0.0606)	(0.585)	(0.0942)	(0.0620)
Number of observations	22,136	69,954	38,021	3,541	7,793	14,768
R-squared	0.466	-0.698	0.466	-1.077	0.280	0.630
Year dummies	YES	YES	YES	YES	YES	YES
Ward dummies	YES	YES	YES	YES	YES	YES