

Impacts of Property Tax Levy on Housing Price and Rent: Theoretical Models and Simulation with Insights on the Timing of China Adopting the Property Tax

Ping Zhang, Yilin Hou, Bo Li*

What will be the impact of property tax levy (RPT) on China's housing price? The conclusions from existing research are conflicting, failing to pinpoint how RPT will affect housing price and rent. More crucially, theoretical economic models are missing in clearly describing the operating mechanisms of the tax's impact. Starting with a theoretical model of RPT, housing price and rent, the paper derives the path and mechanism of RPT affecting housing price and rent, and provides insights on the choice of timing for China to adopt and levy RPT. Our simulation results show that under China's circumstances, if the effective RPT rate is 0.5% and the RPT revenue is not used to increase public services, the tax may cause a housing price decline between 8.3% and 12.5%. If the RPT revenue is used for basic public services, the housing price decline will be as small as 1.7% to 2.5%, but rent may rise by 6.7% to 20%. The reason for the sharp drop in housing price is the bubble; the premise of a rent hike is that the public services that renters can benefit from are substantially improved. Based on the impact of RPT on housing price fluctuation, the period after the market has gradually squeezed out the housing price bubble may be among the best windows for adopting RPT.

Keywords: real property tax (RPT), housing price, rent, simulation

1. Introduction

The Chinese government is more and more clear about the direction of local tax system reform, and academic research on real property tax (RPT) is increasing. In the process of RPT reform, it is an important objective to maintain the stability of the real estate market and establish a long-term mechanism for its healthy development. What will be the impact of RPT levy (RPTL) on China's housing price? What role does RPT play in the long-term mechanism of stabilizing the real estate market? The conclusions from existing research are conflicting, failing to pinpoint how the property tax will affect housing price and rent. More crucially, theoretical economic models are

* Ping Zhang (email: zhangp@fudan.edu.cn), Associate Professor, School of International Relations and Public Affairs, Fudan University; Yilin Hou (corresponding author, email: yihou@maxwell.syr.edu), Professor, Maxwell School of Citizenship and Public Affairs, Syracuse University; Bo Li, Assistant Professor, School of Economics, Peking University.

missing in clearly describing the operating mechanisms of the tax's impact. This paper weighs the applicability of relevant models, the simplicity of economic intuition, and the complexity of computation, and makes some explorative research based on the discounted value model. Starting with a theoretical model of RPT, housing price and rent, the paper derives the path and mechanism of RPT affecting housing price and rent, and provides reliable parameters for the Chinese government to make the decision on RPTL.

In order to increase the explanatory power of the model and highlight the economic intuition, we strive to keep the model simple, considering only the impact of RPT on housing price and rent, without considering other factors affecting housing price.¹ Therefore, the model in this paper focuses on the core value (fair value) of real estate. For various reasons, real estate prices fluctuate around the core value in the short and medium term, but will eventually return to its core value. We put all the short-term factors that may affect housing price, including the policy of restricting loans, the policy of restricting purchases and the rise of housing price caused by housing price bubbles, into the error item of the model. The reason is that these factors are highly volatile and easily influenced by policies and expectations, which is a consensus in theory and practice.²

The short-term impact of RPT on housing price (i.e., the degree of deviation between price and value) is transmitted through these volatile factors. Because of the high volatility of the various factors in the error term, in order to reduce the impact of RPT on housing price, RPT should be levied when the error term accounts for a low proportion of housing price. Therefore, the right time for RPTL is when the housing bubble bursts and housing price becomes relatively stable. Only in this situation is it meaningful to discuss the long-term impact of RPT on housing price and rent and the mechanism of such impact. The contribution of this paper is that it explains the impact of RPT on the real value of real estate. Due to the obstruction of the household registration (Hukou) system, public services are seriously unequal to house owners and tenants. Based on the fact of tenants and owners having different rights (TOHDR), this

¹ This paper uses a static model to study the impact of RPT on housing price and rent. The relevant dynamic model will be discussed in a special paper later.

² In this paper, various short-term factors that may affect housing price, including monetary (loan restriction) policies, various purchase restriction policies and housing price increases caused by housing price bubbles, are placed in the error term of the model. These factors are not clearly expressed in the model. The main reasons are that in recent years, these factors in China have been deeply and comprehensively affected by short-term or even immediate (central and provincial) policies, and their volatility is great. In addition, under the restriction and influence (even induction) of frequent and repeated intervention policies, the main market participants (local governments selling land and developers buying land and building houses), institutional and individual investors' expectations and game behaviors also aggravate the overall fluctuations, and cause fluctuations in some secondary aspects. The mathematical model here contains an "error term", and all irregularities for which the paper does not have proper technical terms are temporarily incorporated into the error term.

paper studies the capitalization of public services, and expands, deepens and enriches the “benefit theory” of RPT.

This paper shows that if RPT rate is 0.5% and tax revenue is not used to introduce new public services, the real value of property may decrease 8.3% ~12.5%, and that if the tax revenue is used to increase and improve basic public services, the real value of property will decrease 1.7%~2.5%, but rent may increase 6.7%~20%. The reason why the real value of property may fall sharply is that there are short-term bubbles in housing price. The premise of the huge increase in rent is that the value of public services that benefit the tenant is substantially improved.

The second part of this paper is a literature review. The third part constructs a theoretical model of the relationship between RPT, housing price and rent, and analyzes the possible impact of RPTL on housing price and rent. The fourth part carries out numerical simulation to study under what circumstances RPT will have an impact on housing price and under what circumstances it may cause housing price to rise and explain why RPT in developed countries has not eliminated the rapid rise of housing price in certain periods. The fifth part puts forward the conclusion and discusses the significance of the results of this study to China’ RPTL.

2. Literature Review

The relationship between RPT, property value and public service has been fully discussed in the existing literature (Oates, 1969, 1973; Pollakow, 1973; Hamilton, 1976). Capitalization theory shows that RPT can depress the property value, but the corresponding public expenditure may increase property value. Capitalization of public services reflects residents’ willingness to pay RPT, which is a consensus; what is controversial is the degree of capitalization. Most of the prior studies use the model set by Oates (1969, 1973). Haughwout (1999) compared RPT with the capitalization of infrastructure by using the data of 29 big cities in the United States, finding that urban areas are significantly different from suburban areas. He pointed out that the capitalization rate of RPT is different in different regions. Existing literature generally quantifies the value of public welfare by capitalizing public services into housing price. Where people can freely choose their place of residence, housing price reflects their willingness to pay for public goods. This conclusion has been proved by the empirical studies of many scholars (Brueckner, 1979; Roback, 1982; Haughwout, 2002). Research based on the United States emphasizes that an important factor of RPT is the capitalization of the tax, that is, the relationship between RPT, housing value and public services. From this perspective, this paper quantitatively simulates the impact of RPTL on housing price and rent at different capitalization levels, which is an aspect neglected by the existing research on RPT in China.

There are also discussions on how RPT affects housing price in Chinese literature.

The main findings are: First, RPTL may depress housing price (Kuang, 2012; Luo and Wu, 2012; Li *et al.*, 2012; Bai *et al.*, 2016; Li, 2013), and the earlier the RPTL, the better the regulation effect on housing price (Kuang, 2013). Second, RPT may raise long-term housing price in the future (Wang and Huang, 2013). Third, reducing the tax burden in the transaction link may lower housing price and benefit the buyer as a whole (Zhang *et al.*, 2016).

Relevant research also emphasizes the differences in RPT and real estate market between different regions, and points out that RPT should be suited to local conditions, not across the board (Kuang, 2012; Zhou *et al.*, 2014). Kuang (2009) used the panel data of 30 provinces in China from 1996 to 2006 to test the theoretical model, and found that RPTL can effectively restrain the rise of housing price for the eastern region and the country as a whole, but it has no obvious effect on the central and western regions. Based on the RPT pilot program in Chongqing, Bai *et al.* (2014) and Liu and Fan (2013) found that the RPT pilot program in Chongqing brings a substitution effect to the differential tax rate of different properties, and causes the price of small-sized housing to rise irrationally. However, the above studies failed to answer the question of how RPT with a wide tax base will affect housing price under different tax system elements designed. This paper answers this question. The viewpoint that RPT is a benefit tax has been established, yet it also has an element of capital tax (even if public services remain unchanged, RPT will be partially transferred to rent). Different from the scenario of tenants and owners having the same rights (TOHSR) where RPT capitalizes both housing price and rent, in China TOHDR will separate RPT's capitalization of housing price from that of rent. Because of this, there will be TOHDR premium in China's housing price, which is an academic contribution of this paper to the existing capitalization model.

3. A Theoretical Analysis of RPT and Housing Price

Tax theory holds that tax raises price, and this assertion is made mainly from the perspective of consumer goods. Since house property is a commodity, the tax levied in the transaction process will cause its price to rise. Whether the seller or the buyer pays the transaction tax, the latter must bear at least part of it. Current real estate transaction taxes include personal income tax, business tax, land value-added tax, deed tax, stamp duty, urban maintenance and construction tax, education surcharge, etc. All these taxes, to a certain extent, will be included into housing price. Most of our economic intuition about taxation comes from transaction tax, because there are few taxes during the stage of keeping real estate. The RPT discussed in this paper is not a transaction tax but a holding tax. Taxes on ordinary commodities in the process of keeping them can increase the storage cost and price of them. Different from ordinary commodities, real estate can be rented out to others and rent can be obtained, which is similar to holding

stocks and getting dividends. Because it can generate a cash flow, real estate is both a consumer product and an investment product.

How tax affects the price of investment products is related to the types of investment products and the link of taxation. Will RPTL increase or decrease housing price? This paper constructs a model and analyzes it according to the value discount theory.¹ According to the theory (dividend discount model, DDM), the intrinsic value of an asset is the present value of its future cash flow. The present value of the future cash flow of house property as an investment product is:

$$P = \frac{R}{r} \quad (1)$$

Wherein, P is housing price, R is annual rent and r is the discount rate.² Due to TOHDR in China, tenants have much less rights and interests than homebuyers (especially when it comes to children's schooling), which is termed "tenant-homebuyer difference" (THD) for short in this paper. This difference greatly reduces the rationality of China's housing price measured by "rent-to-price ratio" (RPR). TOHDR in China may separate RPT's capitalization of housing price from that of rent, and rent does not include the capitalized value of some public services. The formula for calculating the value of house property under the background of TOHDR is:

$$P = \frac{R}{r} + D \quad (1a)$$

Wherein, D stands for THD. The above formula (1a) can be transformed into:

$$\frac{D}{P} = 1 - \frac{R/P}{r} \quad (2)$$

Formula (2) shows that the ratio of THD to housing price (D/P) is directly related to rent-to-price ratio (R/P) and discount rate (r). For example, when R/P is 3% and r is 5%, THD in the value of property accounts for about 40% of its market value. Therefore, the RPR of house property in China can be comparable to that in other countries only when TOHSR is realized and THD is eliminated gradually. From a financial point of

¹ The discounted cash flow method is mainly used for enterprise valuation. Weston Model valuation method is the most representative valuation method. So far, all the studies on housing have used this model to analyze the rent-to-price ratio.

² The annual growth rate of rent is not set here. If the annual growth rate of rent is g , then $P=R/(r-g)$. Therefore, the discount rate r in this paper can be regarded as the "net" discount rate after the annual growth rate of rent is removed.

view, formula (1a) indicates that the fair value of house property is determined by fundamental factors. However, due to the influence of other factors, the actual price of the property may deviate from the fair value, as is shown below:

$$P = \frac{R}{r} + D + \varepsilon \quad (3)$$

Wherein, ε is the deviation between the price and value of real estate. The factors causing the deviation include credit policy, real estate policy, excess liquidity, and the excessive demand caused by low interest rates, which can be called “rational bubble”. The rise of house price caused by the housing price bubble is also a part of ε , which can be regarded as “irrational bubble”.

Whether housing price will rise or fall after RPTL depends on the changes of factors on the right side of formula. When there is no RPT, R is annual rent; and when there is RPT, or T , rent will be reduced by tax. The use of RPT revenue will have an impact on rent. If the revenue is used to increase or improve local basic public services, the effect will be reflected in the rent. If RPT revenue is used for public services (such as education), then THD, or D , will be expanded. Therefore, the formula for calculating property value after RPTL is:

$$P' = \frac{R'(T) - T}{r} + D' + \varepsilon' \quad (4)$$

The public services here should be considered in two different contexts: TOHSR and TOHDR. In the context of TOHSR, rent R includes capitalization of public services; in the context of TOHDR, the change in public services is reflected in difference D . Under this framework, RPT affects rent R , but only includes the change in rent brought by the capitalization of public services in the context of TOHSR. For example, the TOHDR caused by the school district is reflected in D . If the local government uses the RPT revenue to build a new park that is open to all residents, this will be a public service in the sense of TOHSR, and both the rent and the value of house property will increase. The difference in property value before and after RPTL is:

$$\Delta P = P' - P = \frac{R'(T) - R(0) - T}{r} + (D' - D) + (\varepsilon' - \varepsilon) \quad (5)$$

Based on the above formula, three scenarios are analyzed below. (1) RPT revenue is not used for public services, and a tax is suddenly included in the rent, so the value of house property will decrease. Of course, even if there is no change in public services, the property owner may still pass on part of the tax burden to the tenant by raising

rent. However, because it cannot all be passed on to the tenant, the degree of decline of property value depends on how much tax burden can be passed on.¹ (2) The situation of TOHDR remains unchanged, and RPT revenue is used for public services that are only intended for the property owner instead of the tenant. In this case, the change in rent is similar to that when RPT revenue is not used for public services, and depends on how much tax burden can be passed on to the tenant. This will increase THD, or the gap between D' and D . (3) RPT revenue is used for public services that the tenant can also enjoy. In this case, THD ($D'-D$) is reduced, the increased services are capitalized into the rent, and the rent is increased accordingly.

Therefore, as long as RPT revenue is used for local public services that benefit both tenants and property owners or just benefit the latter, these services will be capitalized into housing price directly or through rent. Within the scope of available information, in order to make the theoretical analysis feasible, the following analysis does not consider the deviation (ε) between the price and the value of house property. At this point, we can make the following conclusions:

(a) Public services do not increase after RPTL: RPT causes house prices to fall.

(b) Public services increase after RPTL: housing price may rise or fall depending on the relative strength of capitalization of newly added public services and RPT.

The rate of change in housing price is:

$$\frac{\Delta P}{P} = \frac{\frac{R'(T) - R(0)}{P} - \frac{T}{P}}{r} + \frac{D' - D}{P} \quad (6)$$

It should be noted that $R'(T) - R(0)$ in formula (6) is the capitalization of rent by newly added public services after RPTL. Rent change can be expressed as a function of RPT:²

$$R'(T) - R(0) = \delta T \quad (7)$$

¹ In the context of TOHDR in China, it can be seen from the very low RPR that the rent return is obviously lower than the market average return on capital. This shows that the current rent is basically determined by income level. Therefore, when public services do not change, the demand side in the rental market will not change, and the part of RPT that can be transferred to rent will be very limited (partly due to the impact of supply reduction).

² Here, when RPT revenue is converted into public services, the capitalization of rent only considers the amount of RPT revenue and public service expenditure, without considering the utility difference caused by the difference in residents' preference for private consumption or public consumption. See Zhang and Hou (2019) for details. If RPT is levied but public services are not increased, it is assumed that the rent will remain unchanged. In fact, homeowners can pass part of RPT on to tenants, but now China's RPR is very low, which means that rent is largely determined by the income level of tenants, so only a small part of RPT can be transferred to rent when public services are not increased. Therefore, assuming that the rent remains unchanged, the decline of housing price will be slightly overestimated.

Wherein, δ is the “conversion coefficient” for the transformation of RPT into public service, and $0 \leq \delta < 1$. In the process of transformation, besides service costs, there are also management costs. The level of management cost reflects the efficiency of government. The lower the management cost, the higher the conversion coefficient. $D'-D$ indicates the change in THD, which will lead to a change in rent at the same time. For example, as TOHSR is gradually realized, RPR will increase accordingly; however, this will only affect the present value of rent and the proportion of THD in housing price, but will not affect the impact of RPT on housing price. Therefore, if the transfer of tax burden is not considered for the time being, then whether THD changes or not, the impact of RPT on housing price is:

$$\frac{\Delta P}{P} = (\delta - 1) \frac{t}{r} \quad (8)$$

Wherein, $t = T/P$, which is the actual tax rate. The rate of rent change is directly related to THD:

$$\frac{R'(T) - R(0)}{R(T)} = \frac{\delta T}{R} = \frac{\delta t}{R/P} \quad (9)$$

From the perspective of real estate as an investment product, RPT will obviously increase the holding cost, and may cause housing price to fall. Therefore, there is a certain theoretical basis for the expectation that RPTL will lead to a decline in housing price ($\Delta P/P < 0$ in Formula 8); but this is not necessarily the case in reality, where different situations may lead to different results. The public service conversion rate here does not consider residents' preference (β). In fact, there are always some residents who have a strong preference for the quality of public services (some scholars point out that there may be over-capitalization, $\beta > 1$). For these residents, the conversion rate after considering public service preference is $\delta \times \beta$ (when $\beta > 1$, $\delta \times \beta$ may be greater than 1), and the impact of RPT on housing price is:

$$\frac{\Delta P}{P} = (\delta\beta - 1) \frac{t}{r} \quad (8a)$$

$$\frac{R'(T) - R(0)}{R(T)} = \frac{\delta\beta t}{R/P} \quad (9a)$$

In this situation, RPT may raise housing price. To simplify the model, this paper

does not consider preference difference ($\beta=1$).¹

So far, this paper has only analyzed the impact of RPT on housing price through theoretical models. According to theoretical calculation and historical experience of developed countries, RPT is not a necessary condition for controlling housing price, let alone a sufficient condition.

4. Numerical Simulation and Analysis

4.1. Numerical Simulation

If the Chinese government levies RPT, what impact will it have on housing price? The simulation here is based on Chinese data. According to the above model, the changes in housing price and rent after RPTL are expressed by formulas (8) and (9), and the numerical simulation is based on formulas (8) and (9). Since conversion rate $\delta < 1$, RPT will cause housing price to fall, and the higher the tax rate (t), the greater the decline; the higher the discount rate (r), the smaller the decline. On the premise that RPT is transformed into public services, the rent will rise. The higher the conversion rate (δ), the greater the increase in rent will be. The higher the tax rate (t), the greater the increase in rent (public services provided by tax revenue are capitalized into rent); the higher the current rent-to-price ratio (R/P), the smaller the increase in rent. That is, a high RPR means that the rent is already at a high level, so there is little room for further growth.

Numerical simulation needs to assign values to corresponding parameters. According to the actual situation in China, the assignment of values is shown in Table 1, where the discount rate is set to 4%, 5% and 6%,² the RPR is between 2% and 6% for different cities,³ the tax

¹ It can be seen from formula (8a) that when RPT is used for new public services, and $\delta\beta=1$, no matter how the RPT system is designed, the actual value of real estate is not affected by RPT. Based on sensitivity analysis, $\delta\beta$ as a whole measuring the impact of RPT on the changes in housing price and assuming undifferentiated public service preference, bring no essential change to the results of this paper.

² Discount rate is an important parameter affecting people's purchase behavior, and is also an important factor affecting RPR in this paper. As one of the important assets of residents, according to the principle of no arbitrage in the capital market under the framework of DMM, the discount rate in the housing market is no different from that in other asset markets. In this paper, the choice of discount rate (4%~6%) in numerical simulation is mainly based on the situation of Chinese market and other references. Zhang (2015) set the discount rate to 3%~6%; Chen and Wen (2017) set the discount rate to 4%. In addition, there is a link between discount rate and interest rate. Existing literature holds that the discount rate is the reciprocal of the interest rate or the sum is approximately equal to 1 (Aiyagari, 1994; Iacoviello and Pavan, 2013). China's interest rate (Libor) fluctuates around the level of 5% most of the time, so the discount rate is set to 4%~6% in this paper.

³ According to the housing market data, bubble level and reasonable RPR published by Zhou and Guo (2020), we calculated the actual RPR of 35 cities in 2014 according to the formula in their paper "bubble level of housing market = actual RPR/reasonable RPR". Our calculation shows that Harbin has the highest RPR (5.46%) and Xiamen has the lowest RPR (1.97%). Therefore, the RPR in our paper is set to 2%~6%, which is used to evaluate the impact of RPTL under different RPR conditions.

rate is set to 0.1%, 0.5% and 1%,¹ and the conversion rate is set to 0, 0.5 and 0.8. A conversion rate of 0 means that RPTL has nothing to do with the quantity and quality of public services received by residents. The higher the conversion rate, the closer the connection between RPT and local public services. For example, a conversion rate of 0.8 means that 80% of the RPT paid by residents is returned to them in the form of public services, showing that the RPT is a benefit tax. Whether the tenant has the right to benefit from these public services directly determines the degree of change in rent, which is similar to the degree at which RPT is passed on to the tenant.

Table 1. Assignment of Different Parameters in Numerical Simulation

Parameter	Assignment
Discount rate (r)	4%, 5%, 6%
Rent-to-price ratio (R/P)	2%, 3%, 4%, 5%, 6%
Tax rate (t)	0.1%, 0.5%, 1%
Public service conversion rate (δ)	0, 0.5, 0.8

Note: In a real and complete market economy, RPR will not be much higher than discount rate because otherwise, too many people will go to the market to buy house property for rent and arbitrage. In practice, RPR may be slightly higher than discount rate due to the existence of real estate maintenance costs and budget constraints. However, China's current RPR is relatively low.

For the convenience of discussion, we first consider the case of TOHSR. In this case, tenants and property owners have the same rights to the public services provided by RPT revenue, and the change in rent is the result of TOHSR. In the case of TOHDR, however, the change in rent is smaller than that in the case of TOHSR. It should be noted that here we do not consider the migration of residents between different cities due to different tax rates. According to parameter assignment, the simulation results are shown in Table 2.

¹ Referring to the existing domestic estimates and by comparison with the RPT burden in some countries, Zhang and Hou (2016a, 2016b) held that an effective tax rate of 0.5% is appropriate in China. There are other studies in this regard: Zhang *et al.* (2005) worked out a reasonable tax rate of 0.8% according to the fact that the land transfer fee and other fees and taxes receivable by the government account for 40% of housing price. Wang (2006) estimated the tax rate to be 0.6% based on the data of Zhejiang Province. The Development Research Center of the State Council (2006) set the tax rate to 0.3%~0.8%, considering the tax burden on residents at the initial stage of RPTL. Yu (2007) set the tax burden at 2%~4% of residents' income, and worked out a tax rate of 0.29%~0.59%. Qu and Yan (2008) derived a tax rate of 0.45%~0.91% based on the disposable income of middle-income families in Beijing. Hou *et al.* (2014) used the per capita disposable income minus the basic living expenses as the net disposable income, and then based on China's land tax habits since ancient times, multiplied by 10% to get a tax rate of 1%. He (2013) concluded a tax rate of 0.22%~0.43% based on the assumption that a middle-income family in Beijing owns 90 square meters of house on average.

Table 2. The Impact of RPT on Housing Price and Rent (Numerical Simulation)

Parameter combination	Tax rate	Tax-to-service conversion rate	Change in housing price ($\Delta P/P$)	Change in rent ($\Delta R/R$)
(1)	1%	0	$[-25\%, -16.7\%]$	0
(2)	1%	0.5	$[-12.5\%, -8.3\%]$	$[8.3\%, 25\%]$
(3)	1%	0.8	$[-5\%, -3.3\%]$	$[13.3\%, 40\%]$
(4)	0.5%	0	$[-12.5\%, -8.3\%]$	0
(5)	0.5%	0.5	$[-4.2\%, -6.3\%]$	$[4.2\%, 12.5\%]$
(6)	0.5%	0.8	$[-2.5\%, -1.7\%]$	$[6.7\%, 20\%]$
(7)	0.1%	0	$[-2.5\%, -1.7\%]$	0
(8)	0.1%	0.5	$[-1.3\%, -0.8\%]$	$[0.8\%, 2.5\%]$
(9)	0.1%	0.8	$[-0.5\%, -0.3\%]$	$[1.3\%, 4.0\%]$

Table 2 and Figure 1 show the changes in housing price and rent caused by RPT in different scenarios. According to simulation, RPTL will not have a destructive effect on the real value of house property if the housing bubble and other factors are not considered. In this scenario, if the tax rate is 1% and the tax revenue is not used to increase public services, RPT can reduce housing price by 25%; if the tax rate is 0.5%, the largest drop in housing price will be 12.5%; if the tax rate is 0.1%, the largest drop will be 2.5% only. Even if when the tax rate is 1% but the conversion rate is 0.8, or when the tax rate is 0.5% but the conversion rate is also 0.5, the drop in housing price will be about 5% only, showing that RPT's impact on housing price is quite limited. Then, why is the whole society concerned that RPTL will make housing price fall precipitously? The main cause of concern is RPT's impact on housing bubble (ε). As mentioned earlier, in the investment market, the expected changes will cause the price to fluctuate drastically, but this fluctuation is a short-term trend. In the long run, however, the impact of RPTL on the real value of house property will be limited within a socially acceptable range, according to the parameter assignment widely used and agreed upon in the exiting literature.

Changes in rent are directly related to the rate of conversion from tax revenue to public services (Table 2 and Figure 1). When the tax rate is 1% and the conversion rate is 0.8, the rent increase can reach 40%. As long as the tenant has the right to enjoy the public services provided by tax revenue, the rent will increase to a certain extent. It can be seen that after RPTL, there will be a certain downward pressure on housing price (but within the controllable range), while rent will rise to a certain extent according to THD. Therefore, as mentioned in Section 3(2), RPT will gradually push the housing price and rent to the middle point, and make RPR reach an equilibrium level. Rent is mainly supported by income, and RPR equilibrium is a process in which the ratio of housing price to income declines and tends to balance. In this way, RPT becomes the pricing mechanism of public services. "House property is easy to buy but difficult to hold," quite a lot of people say, but the cost of holding it includes the cost of public services that residents can enjoy.

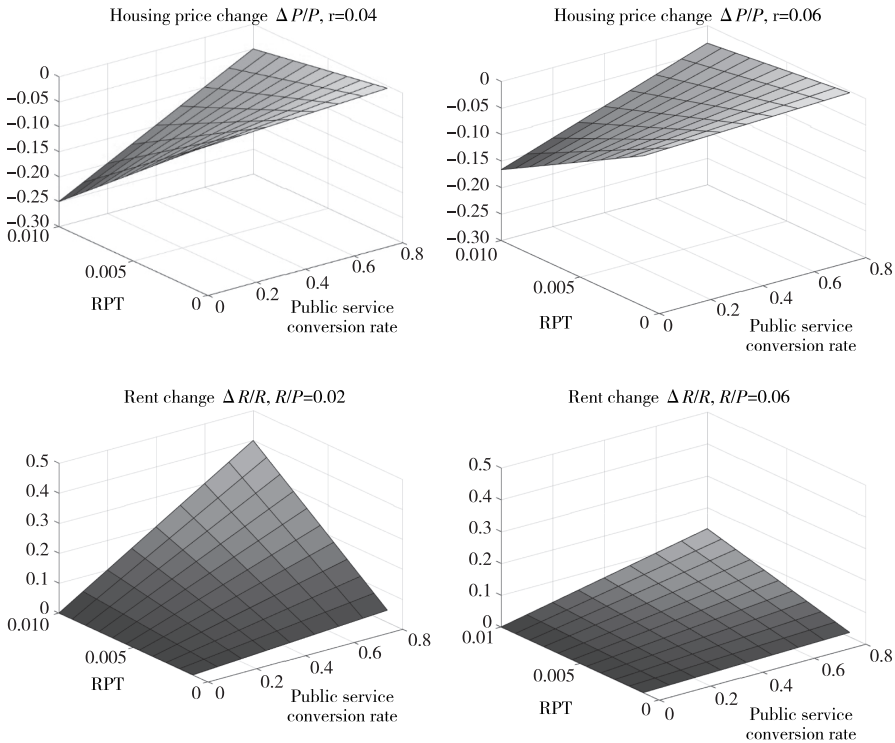


Figure 1. RPT's Impact on Housing Price and Rent under Different Parameter Assignments

4.2. The Relationship between RPT and Housing Price

Exorbitant housing price will bring adverse effects to the economy. First, it can cause the misallocation of resources and the excessive flow of capital to the real estate market; second, it is likely to give rise to systemic financial risks. Since most real estate loans are provided by banks, a sudden sharp drop in housing price may have a huge impact on the banking system. Whatever the impact on housing price, the cost of holding a property will increase after RPTL, but the gap between housing price and income will gradually narrow. Therefore, RPT can become a stabilizer of the ratio of housing price to income, and play an important role in restraining housing price.

Returning to the previous question, why do countries that have levied RPT still see rapid housing price increases, bubbles and even bursting of bubbles? In essence, the real estate bubble is a financial phenomenon not necessarily related to RPT. If there is a connection, part of the reason is that during the period of rapid price increase, if the RPT burden rises by the same proportion, it will exceed the affordability of residents. As a result, the government tends to lower the tax rate during the period of rapid housing price increase, leaving the tax burden only slightly higher. During the period of rapid

housing price increase in Japan, for example, the Japanese government lowered the RPT rate so that the tax burden only increased by 5% to 10% (Wan, 2018). California's Act 13 of 1978 reduced the effective RPT rate by 57%.¹ Even so, the smoothing effect of RPT on the real estate market still exists. In the United States, for example, people tend to settle in the states with lower RPT rates. As a result, housing price in low-tax states rose much faster than in high-tax states. From 2013 to 2018, housing price rose by an average of 45% in the United States, but in New Jersey where RPT rate was the highest, the figure was only 5%; in Colorado and Arizona where RPT rates were low, the figure was as high as 59% and 83%, respectively. Denver, the capital of Colorado in the United States, also became one of the cities with the fastest rise in housing price in this period.²

As an investment product, real estate also has a residential function and has the most developed second-hand market among all commodities. This allows its supply and demand to switch to each other quickly. That is, if RPTL changes people's expectations for the rise in housing price, then holders of multiple houses may be willing to sell their surplus property, supply increases rapidly, but demand decreases because the sales proceeds may not enter the real estate market, all of which can have an impact on housing price. Of course, such a circumstance can only occur where a significant proportion of families own surplus property as investment rather than residence and they are willing to sell it. This change is reflected in the error term ε , and may rapidly narrow the gap between the price and real value of house property, even making the price lower than the value in short-term irrational selling. This possible situation can have a great impact on the economy and society, which is one of the reasons the government has been very cautious about RPTL to avoid sharp fluctuations in housing price. The greater the gap (bubble) between price and value, the greater the risk of such an outcome will be. Therefore, considering the overall situation and controlling further irrational rise in housing price will be a national policy for the government to implement in the years to come. Resolving this risk requires "trading time for space", i.e. with the increase in household income, the bubble in the real estate market may gradually decrease until it returns to a safe level when housing price rises at a lower rate than income does.

The relationship between RPT, housing price and housing rent derived in this paper is based on the conclusion about fair value, and the bubble factors in the error term ε magnify the impact of RPT on housing price. The impact of RPTL on housing bubble is complex. Apart from increasing the holding cost as part of the housing price, the bubble component significantly changes the market expectation, reduces the

¹ Source: <https://www.californiaaxdata.com/pdf/Prop13.pdf>.

² Source: https://www.washingtonpost.com/realestate/is-there-a-link-between-property-tax-rates-and-the-rate-at-which-your-home-appreciates-in-value/2018/04/17/1a56806a-418d-11e8-8569-26fda6b404c7_story.html?noredirect=on&utm_term=.3db1d16edef2.

investment demand, and even changes the supply-demand relationship of the whole market. The specific range of impact cannot be calculated using the theoretical model in this paper, but it is determined that RPT can effectively squeeze the bubbles and rapidly reduce the bubble component in housing price.

Therefore, levying RPT when the housing bubble is big may increase the risk of violent fluctuations in housing price. When the bubble is small, RPTL has less impact on housing price, and price fluctuations can be around the fair value. When housing prices in major first-and second-tier cities have actually squeezed out most of the bubbles, then it is the right time for RPTL.

4.3. Sensitivity Analysis

Sensitivity analysis is carried out in this section (Figure 2). As far as the impact of RPT on housing price is concerned (Figure 2, upper two columns), if residents have low preference for public services ($\beta < 1$), RPTL may lead to a decline in housing price, and the higher the tax rate, the greater the decline, which is consistent with the simulation results of the benchmark model. If residents' preference for public services

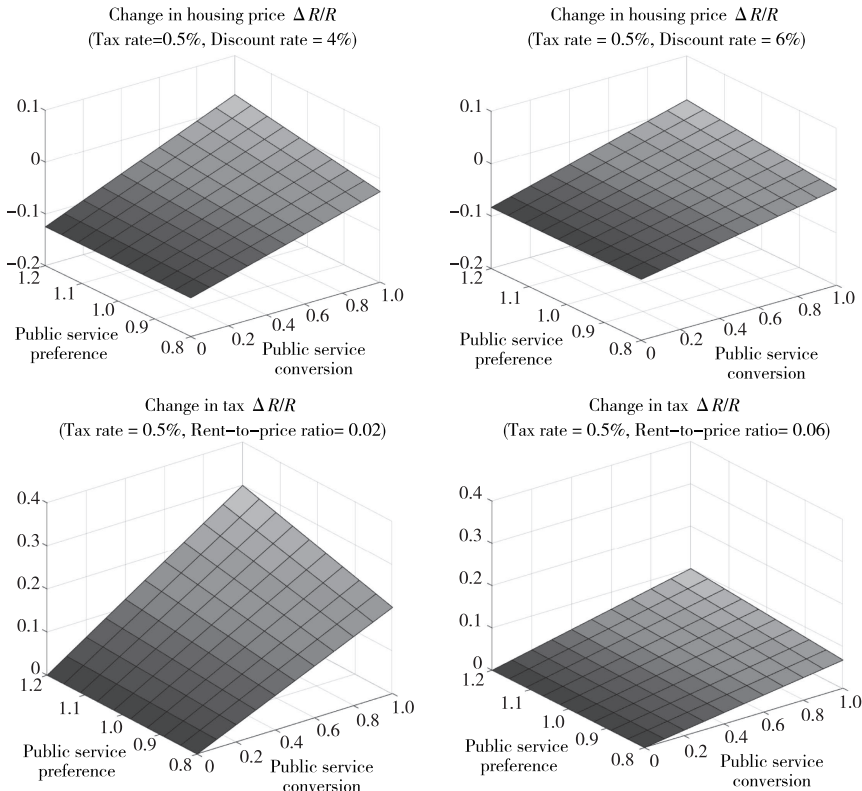


Figure 2. The Impact of RPT on Housing Price and Rent (Sensitivity Analysis)

is high ($\beta > 1$), “over-capitalization” may occur, and RPTL may lead to an increase in housing price when the tax-to-service conversion rate (δ) is also high (Figure 2, upper right column), but in reality, “over-capitalization” is rarely seen.

In terms of the impact of RPT on rent (Figure 2, lower two columns), RPTL may lead to a rent increase at different tax-to-service conversion rates regardless of residents’ low preference for public services ($\beta < 1$) or high preference ($\beta > 1$). In the sensitivity analysis of the impact of public service preference on housing price and rent, the simulation result is similar to the benchmark numerical simulation result, i.e., after RPTL, rent may increase; the higher the tax rate, the greater the rent increase; the higher the tax-to-service conversion rate, the greater the rent increase.

To sum up, the residents’ public service preference and the government’s public service conversion rate of RPT revenue do not affect the core results of this paper, but the higher the public service preference and tax-to-service conversion rate, the smaller the impact of RPT on housing price but the greater the impact on rent.

5. Conclusion and Discussion

Through theoretical analysis and numerical simulation, this paper demonstrates the possible impact of RPTL on housing price and rent in China. One of the reasons why the Chinese government has been hesitant to promote RPT reform for many years is the fear of causing drastic fluctuations in housing price. From the technical level of basic research, this paper gives the parameter interval of RPTL’s impact on the real value of real estate without considering the bubble factor. The analysis and results of the paper can serve as part of the basis or reference for China’s RPT reform, decision-making and policy evaluation. At the same time, TOHDR in China’s current situation enriches the action scenario of the viewpoint that “RPT is a benefit tax”. Local governments use RPT revenue to provide public services, but there are two circumstances here: one is TOHSR and the other is TOHDR. In the circumstance of TOHSR, both the tenant and the property owner can benefit from the public services, so the result of capitalization is that both rent and housing price will increase. In the circumstance of TOHDR, only property owners can enjoy the public services, not tenants. Therefore, capitalization of such public services will cause an increase in housing price but not (necessarily) in rent.

5.1. The Impact of RPT on Housing price and Rent

The relationship between supply and demand determines the price of general consumer goods, for which an increase in tax may lead to an increase in price, and how much of the tax burden is shared by the seller and buyer is determined by the elasticity of supply and demand. Similarly, the real estate transaction tax may increase the transaction price of real estate. Since real estate has the attributes of both consumer

goods and investment goods, RPTL could reduce the rental value of real estate, thus reducing the price of house property. However, because the public services supported by RPT may cause housing price to rise, the final impact of RPT on housing price depends on residents' preference for public services, and the relative strength of two capitalization effects of levying new taxes and improving public services. To study this process, the paper constructs a theoretical model and makes calculations based on it, finding that RPTL can cause housing price to fall slightly and rent to rise in different degrees. The higher the RPT rate, the greater the decline in housing price and the greater the possibility of rent increase (tax burden transfer); the higher the conversion rate of public services, the smaller the decline in housing price and the greater the increase in rent (capitalization of public services). However, the impact of RPT on the real value of real estate is relatively limited. If RPT rate is 1% and the tax revenue is not used to increase public services, RPT can reduce housing price by as much as 25% and increase rent by as much as 40%, but the premise of rent increase is the increase of the value of public services that the tenant can enjoy.

5.2. Significance of the Results of This Study to China's RPTL

According to the theoretical model and numerical simulation results, the impact of RPTL on housing price and rent in China will be in a controllable range. The short-term housing price fluctuation caused by RPTL (from scratch) will not have a drastic impact on the real estate market. Even if the tax rate is 1% and RPT revenue is not used to increase public services, the real value of real estate will not fall by more than 25% theoretically. Referring to the existing domestic estimates and by comparison with the RPT burden in some countries as mentioned earlier, we believe that a maximum effective tax rate of 0.5% is more appropriate in China at present. In this way, the real value of house property should fall less than 12.5%. From a long-term perspective, RPT will become a hub connecting housing price, rent and household income after forming a stable equilibrium, making RPR and the "ratio of housing price to income" gradually reasonable, and serving an important long-term mechanism for stabilizing the real estate market.

It should be noted that limited by the feasibility of the analysis, the theoretical results of this paper only show the impact of RPT on the real value of house property, without considering the error term (ϵ) that includes bubble factors. If bubbles account for a large part of housing price, RPT may have a strong squeezing effect on bubbles. That is to say, if there is a big bubble in the current housing price, RPTL may lead to a large decline in housing price in a short period. After the latest round of housing price increase, the government immediately implemented a series of restrictive policies to prevent further increase, considering that excessive housing price bubble could not only lead to systemic financial risks, but also be detrimental to the implementation of RPT policy. If it can be confirmed that the recent slow decline in housing price in some cities

is the result of correct implementation of financial policies against housing bubbles, then it will be a candidate opportunity for these cities to levy RPT after a large part of the bubble is squeezed out and the local real estate market becomes stable. The reason is that by this time, supply has been fully released, housing price has fallen to a reasonable level, and demand has increased, which is conducive to supporting the housing market.

In a word, the impact of RPT on housing price could mainly be reflected in the change in fair value, and the range of this change is relatively controllable. Needless to say, it will be a great psychological challenge to the majority of property owners to levy RPT after housing price has experienced a corrective decline. Therefore, the difficulty for the government to persuade property owners and win their support will increase sharply, and the social risk of levying new taxes will also increase. However, from the perspective of social welfare and overall economic efficiency, systematic financial risks and hidden social troubles caused by violent fluctuations in housing price are the primary object of prevention. Moreover, from the theoretical analysis of this paper and the long-term practice of many countries, the public tends to approve of and accept fair, just, transparent and predictable taxation. This is the embedded and self-consistent logic of RPT as a long-term mechanism to stabilize the real estate market.

At the same time, we should stay alert to another circumstance, that is, the psychological impact of falling property prices on investors, which may trigger panic selling to cause real estate price to fall below the fair value. When levying RPT, therefore, governments at all levels must carefully track and grasp abnormal dynamics of the real estate market, promptly use appropriate policy tools and mobilize various resources to take over surplus property for short-term leasing so that the market price does not deviate too much from the fair value. When housing price returns to a reasonable and relatively stable level, these assets can return to the market.¹

In first-and second-tier cities where the absolute value of real estate is much higher than that in third-and fourth-tier cities, the same proportion of price decline may have a greater impact on property owners, and the possibility of financial risks is greater as well. As time goes by, however, RPR and the ratio of housing price to income in first-and second-tier cities will gradually return to a reasonable level, and the risk of RPT driving property price to decline will be defused in the end.

References

Aiyagari, S. R. (1994). Uninsured Idiosyncratic Risk and Aggregate Saving. *The*

¹ Hou *et al.* (2016) put forward this mechanism as one of the preventive measures against social risks in *Design Outline of China's Real Estate Tax System Elements*.

- Quarterly Journal of Economics*, 109(3), 659–684.
- Bai, C. E., Li, Q., & Ouyang, M. (2014). Property Taxes and Home Prices: A Tale of Two Cities. *Journal of Econometrics*, 180(1), 1–15.
- Bai, W., Liu, Y., & Lu, X. (2016). Effects of Real Estate Tax Reform in Shanghai and Chongqin on Housing Price: An Empirical Study on the Analysis of Counterfactuals. *Finance and Trade Research (Caimao Yanjiu)*, 1, 70–79.
- Bowman, J. H. (2006). Big Ideas—the Morning after || Property Tax Policy Responses to Rapidly Rising Home Values: District of Columbia, Maryland, and Virginia. *National Tax Journal*, 59(3), 717–733.
- Brueckner, J. K. (1979). Property-Values, Local Public-Expenditure and Economic-Efficiency. *Journal of Public Economics*, 11(2), 223–245.
- Case, K. E., & Grant, J. H. (1991). Property Tax Incidence in a Multijurisdictional Neoclassical Model. *Public Finance Review*, 19(4), 379–392.
- Cebula, R. J. (2009). Are Property Taxes Capitalized into Housing Prices in Savannah, Georgia? An Investigation of the Market Mechanism. *Journal of Housing Research*, 18(1), 63–75.
- Chen, K., & Wen, Y. (2017). The Great Housing Boom of China. *American Economic Journal: Macroeconomics*, 9(2), 73–114.
- Fischel, W. A. (1992). Property Taxation and the Tiebout Model: Evidence for the Benefit View from Zoning and Voting. *Journal of Economic Literature*, 30(1), 171–177.
- Fischel, W. A. (2001). Homevoters, Municipal Corporate Governance, and the Benefit View of the Property Tax. *National Tax Journal*, 54(1), 157–174.
- Hamilton, B. W. (1975). Zoning and Property Taxation in a System of Local Governments. *Urban Studies*, 12(2), 205–211.
- Hamilton, B. W. (1976). Effects of Property Taxes and Local Public Spending on Property Values: A Theoretical Comment. *Journal of Political Economy*, 84(3), 647–650.
- Haughwout, A. F. (1999). Regional Fiscal Cooperation in Metropolitan Areas: An Exploration. *Journal of Policy Analysis and Management*, 18(4), 579–600.
- Haughwout, A. F. (2002). Public Infrastructure Investments, Productivity and Welfare in Fixed Geographic Areas. *Journal of Public Economics*, 83(3), 405–428.
- He, Q. (2013). Research on China's Residential Real Estate Tax. Doctoral Dissertation of Dongbei University of Finance and Economics.
- Hou, Y., Ren, Q., & Zhang, P. (2014). *Real Estate Tax in China: History, Pilot and Exploration*. Beijing: Science Press. (in Chinese)
- Hou, Y., Ren Q., & Ma H. (2016). Design Outline of China's Real Estate Tax System Elements. Beijing: *Economic Science Press*. (in Chinese)
- Iacoviello, M., & Pavan, M. (2013). Housing and Debt over the Life Cycle and over the Business Cycle. *Journal of Monetary Economics*, 60(2), 221–238.

- Kuang, W. (2009). Housing Characteristics, Property Tax and Housing Price. *Economic Research Journal (Jingji Yanjiu)*, 4, 151–160.
- Kuang, W. (2012). Property Tax, Land Price and Housing Price. *China Soft Science (Zhongguo Ruanxue)*, 4, 25–37.
- Kuang, W. (2013). The Impact of Property Tax on Expected Housing Price: Evidence from a Questionnaire in Beijing. *The Journal of World Economy(Shijie Jingji)*, 6, 145–160.
- Kuang, W., & Ma, Y. (2010). Property Tax, Elasticity of Supply and Demand, and Housing Price. *China Soft Science(Zhongguo Ruanxue)*, 12, 27–35.
- Li, X., Gao, B., & Li, Y. (2012). Real Estate Tax, Public Services Supply and Housing Price: An Analysis Based on Provincial Panel Data. *Finance and Trade Research(Caimao Yanjiu)*, 3, 67–75.
- Li, Y. (2013). The Reform of Real Estate Tax Price Effects and Household Welfare Changes in China. *Academic Monthly(Xueshu Yuekan)*, (10), 90–101.
- Liu, J., & Fan, Z. (2013). Effect Evaluation of China's Real Estate Tax Pilot: Research Based on Synthetic Control Method. *The Journal of World Economy(Shijie Jingji)*, 11, 117–135.
- Luo, Y., & Wu, W. (2012). Macroeconomic Effects of House Property Tax Reform and Housing Price Movement: A Simulation Analysis Based on DSGE Model. *Journal of Financial Research (Jinrong Yanjiu)*, 5, 1–14.
- Mieszkowski, P. (1972). The Property Tax: An Excise Tax or a Profits Tax? *Journal of Public Economics*, 1(1), 73–96.
- Netzer, D. (1966). *Economics of the Property Tax*. Washington: The Brookings Institution.
- Oates, W. E. (1969). The Effects of Property Taxes and Local Public Spending on Property Values: An Empirical Study of Tax Capitalization and the Tiebout Hypothesis. *Journal of Political Economy*, 77(6), 957–971.
- Oates, W. E. (1973). Effects of Property Taxes and Local Public Spending on Property Values: Reply and Yet Further Results. *Journal of Political Economy*, 81(4), 1004–1008.
- Pollakow, H. O. (1973). Effects of Property Taxes and Local Public Spending on Property Values: Comment and Further Results. *Journal of Political Economy*, 81(4), 994–1003.
- Qu, W., & Yan, Y. (2018). Study on the Connotation of Property Tax and Tax Measurement Analysis—Taking Beijing as an Example. *Journal of Huazhong Normal University (Humanities and Social Sciences)(Huazhong Shifan Daxue Xuebao)(Renwen Shehui Kexueban)*, 6, 48–56.
- Roback, J. (1982). Wages, Rents, and the Quality of Life. *The Journal of Political Economy*, 90(6), 1257–1278.
- Simon, H. A. (1943). The Incidence of a Tax on Urban Real Property. *Quarterly*

- Journal of Economics*, 57(3), 398–420.
- Wan, J. (2018). Prevention and Landing of Bubble. *International Review of Economics & Finance*, 56(7), 190–204.
- Wang, C. (2006). Analysis of the Rate of Real Estate Tax of Our Country—An Example of Zhejiang Province. *Journal of Zhejiang Wanli University (Zhejiang Wanli Xueyuan Xuebao)*, 3, 92–95.
- Wang, M., & Huang, Y. (2013). The Impact of Purchase Restrictions and Property Tax on Housing Price: An Analysis based on Long-Term Dynamic Equilibrium. *The Journal of World Economy (Shijie Jingji)*, 1, 141–159.
- Wei, Z., & Yi, G. (2006). Reform of Property Tax and Local Public Finance. *Economic Research Journal (Jingji Yanjiu)*, 3, 15–24.
- Yu, Y. (2007). An Empirical Study on the Setting of Real Estate Tax Rate. Doctoral Dissertation of Zhejiang University.
- Zhang, F. (2015). Inequality and Housing Price. University of Michigan, Working Paper.
- Zhang, M., Chen, J., & Shi, W. (2016). How Do Tax Policy Differentiation on Trading Links Affect Housing Price—New Findings from Empirical Research of Second-Hand Houses in Shanghai. *Public Finance Research (Caizheng Yanjiu)*, 2, 79–93.
- Zhang, P., & Hou, Y. (2019). Urban Residents' Willingness to Pay Property Tax in China: A Simulation Analysis under Different Exemption Schemes. *Journal of Public Administration (Gonggong Xingzheng Pinglun)*, 2, 45–64.
- Zhang, P., & Hou, Y. (2016). A Model for the Ability-to-Pay Index of China's Real Property Tax, Tax Burden Distribution and Redistributive Effects. *Economic Research Journal (Jingji Yanjiu)*, 12, 118–132.
- Zhang, P., & Hou, Y. (2016). An Empirical Analysis on the Ability-to-Pay of Property Tax in China. *Journal of Public Administration (Gonggong Xingzheng Pinglun)*, 2, 134–154.
- Zhang, B., Huang, X., Tang, J., & Cai, L. (2005). Analysis on the Rate and Burden of Property Tax Effects. *China Land Science (Zhongguo Tudi Kexue)*, 2, 52–56.
- Zhou, J., Liu, Y., & Ju, F. (2014). An Analysis on the Impact of Real Estate Tax on Housing Price from the Perspective of Interregional Differentiation. *Seeker (Qiu Suo)*, 5, 36–42.
- Zhou, J., & Guo, M. (2020). Measurement of Housing Market Bubble Level in 35 Large and Medium-Sized Cities in China. *Statistics & Decision (Tongji Yu Juece)*, 1, 48–52.
- Zodrow, G., R. (2001). The Property Tax as a Capital Tax: A Room with Three Views. *National Tax Journal*, 54(1), 139–156.
- Zodrow, G., R., & Mieszkowski, P. (1986). Pigou, Tiebout, Property Taxation, and the Underprovision of Local Public Goods. *Journal of Urban Economics*, 19(3), 356–370.