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The Impact of Property Tax on Housing Consumption

– An Empirical Study on the UK, the US and Japan

Cong Yu[1,a,*]

[1]*School of Economics, Renmin University of China, Beijing, 102208, China*
a. yucong@ruc.edu.cn
**corresponding author*

Abstract: Real estate taxes, as a type of tax instrument, assume the role of providing local revenue and regulating the real estate market in many countries. Out of the stimulating effect of consumption on the economy, scholars studied the impact of real estate taxes on consumption. This paper constructs a model of housing consumption expenditure applying Keynes' absolute income hypothesis. Using data from Japan, the UK and the US Office of National Statistics, an empirical study is conducted through OLS regressions, fixed effects models and random effects models. The results show that real estate taxes are negatively related to residential housing consumption expenditure and that the imposition of real estate taxes significantly reduces residential housing consumption.

Keywords: real estate tax, residential housing consumption expenditure, fixed effect regression, random effect regression

1. Introduction

The real estate tax, as a tax instrument, assumes the role of providing local fiscal revenue and regulating the real estate market in many countries. In the US, real estate tax has become one of the main sources of local government tax. In the UK, council tax also provides financial support to the government for the construction of urban public measures. Taxes also create distortions to residential consumption. As a direct result of property taxation, residents have more money to spend on taxes, reducing their disposable income. However, this taxation also affects residents' consumption of housing. Consumption, as one of the drivers of economic growth, is the focus of economic research. Exploring the impact of different economic policies on consumption is conducive to better-regulating consumption to stimulate the economy. This paper will analyse the impact of property taxes on housing consumption through OLS, fixed effects and random effects regressions using data from Japan, the UK and the US.

Current mainstream theories on residential consumption include Keynes' absolute income hypothesis, Pegu's real balance income theory, Friedman's persistent income theory and life cycle theory. The absolute income theory suggests that consumption is determined by income in the short run and that the marginal propensity to consume decreases as income increases. The real balance income theory suggests that prices are a factor that affects consumption, and that price increases at the same rate as disposable income decreases the real value of consumers' assets and discourages real consumption. The persistent income theory assumes that consumers' income is composed of

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persistent and temporary income and that there is no fixed ratio between consumers' temporary consumption and their temporary income. Life cycle theory assumes that consumers are perfectly rational and that they have different marginal propensities to consume at different stages of their lives, and that they plan their consumption to achieve maximum utility. Based on the characteristics of housing consumption, this paper refers to Keynes' absolute income theory and introduces income into the model for consideration.

Consumers' perception of indirect tax is low, and the tax burden will be underestimated, so consumers' behavior is mainly affected by direct tax, and has significant negative effects. For housing consumers in the commercial housing market, the direct tax they receive is mainly the real estate tax levied by the state on their ownership. As consumers pay real estate tax every year, the cost of housing ownership has increased significantly [1]. When the tax is implemented, consumers who have invested will adjust the optimal housing consumption, while consumers who have not yet invested may turn to other investment fields due to the uncertainty of expected income. At the same time, consumers who purchase houses to improve their living needs will also consider the increase in housing costs and adjust their house purchase behavior reasonably. Therefore, the real estate tax has a significant impact on residents' housing consumption [2].

Chadha et al. decomposed the aggregate consumption of residents using the link between savers and borrowers in the framework of banks' pricing of credit risk to examine the relationship between housing consumption and house price changes. This relationship proved to be significant [3].

Ju et al. argue that the life-cycle-continuous income hypothesis is more appropriate for housing consumption analysis and construct a housing consumption function based on this, incorporating variables such as house prices, income and wealth. The findings show that lagged and current-period house price fluctuations are negatively related to current-period housing consumption with a significant crowding-out effect; future-period house price fluctuations are in the same direction as the change in housing consumption with a positive wealth effect [4].

Chen et al. empirically analysed the impact of property tax re-structuring on residents' house price and rent expectations, drawing on a scenario-based between-group experimental design and micro-experimental (survey) data from management research methods. The study found that controlling for other factors, property tax reform may reduce house price expectations but have little effect on house rent expectations [5].

Similarly, Zhang used the life-cycle theory to study housing demand. He studied housing demand in China's mass cities through a model of residents' housing motives with income and price elasticities of less than one, and the main significant factors affecting housing demand were the level of household income and average age [6].

Zhang differs from the former by using the absolute income function hypothesis and Tobin's mobility hypothesis. He finds that residents' disposable income remains the most important influencing factor on housing consumption. Housing consumption of Chinese residents squeezes out daily consumption, as evidenced by a significant negative correlation between the share of housing consumption and the Engel coefficient. At the same time, the income elasticity of housing demand of Chinese residents is 0.923 (<1), which is in the inelastic range [7].

In the following section, this paper will put forward theoretical assumptions based on previous studies in the methodology section and use OLS regression, fixed effect model and random effect model to build an econometric model. Data sources and data processing methods will also be included in this section. In this part of the regression, this paper analyzes and tests the results of the regression and examines the credibility of the results. The summary part summarizes the research methods, data and result analysis of this paper.

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2. Methodology

2.1. Theoretical Hypothesis

Based on the above analysis, it is easy to find that there are various ways in which the amount of real estate tax affects residential housing consumption. Firstly, an increase in the real estate tax will reduce the demand for housing and therefore the price of housing in the real estate market. However, the amount of real estate taxes is also part of housing consumption, so an increase in real estate taxes will also increase residential housing consumption. Since the tax in the market is not fully borne by the purchaser of the house, the effect of the real estate tax on housing consumption is negative. Therefore, this study tests the following hypothesis, that the amount of real estate taxes is negatively related to housing consumption.

2.2. Model Construction

Previous scholars have used OLS regressions and dummy variable controls to study the impact of housing capital gains taxes on residential behaviour [8]. On this basis, econometric models are constructed using OLS regression, fixed effect, and random effect models.

$$hce_i=\alpha_1+\alpha_2 tax_i+income_i+hp_i+\varepsilon_i \quad (1)$$

Equation (1) is an OLS regression model with subscript i representing the country. The previous research separated housing consumption and non-housing consumption for independent research [9]. hce is the log of annual housing consumption expenditure of the country's residents, tax the log of annual real estate taxes of the country's residents, $income$ is the log of disposable income of the country's residents, hp is the log of the average value of housing for the country's residents, and ε is the error term.

$$hce_{jt}=\beta_1+\beta_2 tax_{jt}+\sum \beta_i X_{ijt}+\mu_i \quad (2)$$

Equation (2) is a fixed and random effects model with subscript j denoting country, t representing year and X_i being the control variable. The equation for the relationship between housing consumption with respect to income, initial wealth endowment and house price were derived theoretically [4]. Meanwhile, studies show that housing consumption is also related to house size [10], and here income, *income*, and average value per housing unit, *hp*, are chosen as control variables.
In the above model, the explanatory variable is the amount of real estate taxes. Data sources were property tax data from Japan, the UK and the US. The UK mainly calculates council tax and stamp duty collected in the year, the US uses its property tax statistics directly, and Japan's property tax amounts are summed to include house purchase tax, fixed asset tax and special landholding tax. The statistical measure is the annual real estate tax amount per capita

The explanatory variable is the housing consumption expenditure of residents. Housing consumption here includes the purchase of a home and the cost of upgrading facilities.

The control variables include the disposable income of residents and the value of each home. Disposable income measures the purchasing power of residents, while the value of each home includes information on both the size of the home and the price per square metre. After controlling for these variables, this model can have a clearer idea of the impact of the property tax.

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2.3. Data Sources and Processing

The data used in this paper are from the national statistical offices of Japan, the UK and the US. This paper selected panel data from 2008 to 2018 for the regression analysis.

The real estate tax data for Japan include house purchase tax, fixed asset tax and special land tenure tax. The value of each housing unit is obtained by multiplying the house price per square metre by the average area of the house, where the house price per square metre is obtained by weighting the house prices in each area by quantity weights from the annual housing price survey conducted by the Japan Bureau of Statistics, and the average area of the house is obtained by linear interpolation of the data from the Residential Land Survey conducted every five years in Japan. All data are converted to US dollars at the current year's yen to US dollar exchange rate. UK property tax data includes council tax and stamp duty and all data is converted to US dollars at the current year's sterling to US dollar exchange rate.

The US housing consumption data uses data from the American Housing Survey (AHS), which is surveyed in odd years and obtained by linear interpolation in even years. As averages are not calculated for the US in the early years of the survey, averages are calculated by weighting the quantities in that survey. In this case, for example, the highest interval for the real estate tax amount is $600+ for 2007-2013 statistics, $525+ for 2015-2019 and $625+ for 2021. For the lower interval, it may be appropriate to choose the median of the interval for estimation and a fixed value for the highest interval, calculated as follows.

$$tax_i \text{ (applicable to 2011-2019)} = \sum med_{ij} \times w_j + 800 w_h \quad (3)$$

$$tax_i \text{ (applicable to 2021)} = \sum med_{ij} \times w_j + 1000 w_h \# \quad (4)$$

In equation (3) and (4), tax_i denotes the annual property tax value per capita in year i, med_{ij} denotes the median of interval j in year i, w_j denotes the quantity weight of the interval and w_h is the highest interval quantity weight.

Housing consumption per capita and average housing value was calculated as above, with specific amounts selected as follows: housing consumption per capita of $4,000 in 2011-2019 and $5,000 in 2021; and average housing value of $1,100,000. The descriptive statistics for the data are shown in Table 1.

Table 1: Descriptive statistics of the data.

	(1) Japan	(2) UK	(3) USA
Housing consumption expenditure	191.448 (31.002)	57,584.920 (3742.292)	14,575.400 (807.977)
Income	32,676.360 (3296.056)	27,677.360 (1773.038)	254,503.100 (18760.450)
Housing price	107,149.200 (17968.770)	285,232.100 (23168.960)	39,378.450 (3486.457)
Tax	602.256 (82.233)	1,815.805 (166.662)	2,744.165 (202.452)

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Table 1: (continued).

Log of housing consumption expenditure	5.244 (0.158)	10.960 (0.064)	9.586 (0.055)
Log of income	10.390 (0.098)	10.227 (0.064)	12.445 (0.072)
Log of housing price	11.569 (0.169)	12.558 (0.081)	10.577 (0.088)
Log of tax	6.392 (0.133)	7.501 (0.088)	7.915 (0.072)
Observations	11	11	11

Source: Data sources are the National Bureau of Statistics of Japan, the UK and the USA. The data in the table are means and the data in brackets are the corresponding standard deviations

According to Table 1, housing consumption expenditure in the UK is significantly higher than in Japan and the US. At the house price level, the US has the highest house prices, but the UK has a larger standard deviation in the data and house price fluctuations have been more pronounced in recent years. Property taxes are significantly higher in the US than in the UK and Japan, and lowest in Japan.

3. Regression

3.1. Analysis of OLS Regression Results

In this section, this paper will analyze the results of empirical regression to explore the impact of real estate tax on residents' housing consumption. The OLS regression results are shown in Table 2.

Table 2: OLS regression results.[a,b]

	(1) Japan	(2) UK	(3) USA
Log of tax	1.667** (0.618)	-0.210 (0.157)	1.568*** (0.343)
Log of income	-0.336 (0.498)	0.954** (0.302)	0.064 (0.090)
Log of housing price	-0.234 (0.277)	0.208 (0.152)	-0.776** (0.274)
R^2	0.958	0.921	0.927
Adj R^2	0.939	0.887	0.896
Obs	11	11	11

Note: [a] The independent variable is the logarithm of tax, the data in the table is the regression coefficient of the corresponding variable, and the data in brackets is the corresponding standard deviation. [b] *** p<0.01; ** p<0.05; * p<0.1

The regression results for both Japan and the US show a significant positive relationship between real estate taxes and housing consumption, possibly indicating that the amount of real estate taxes

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account for a larger portion of residential consumption expenditure in both countries. However, neither house prices nor income is significantly related to housing consumption in Japan. The results for the UK show a negative but insignificant relationship between the amount of property tax and housing consumption, possibly because the two paths affecting housing consumption do not differ significantly. The UK regression results show a significant positive relationship between income and housing consumption, which is in line with our perception. Meanwhile, the results for the US show a significant positive correlation between house prices and housing consumption, possibly due to the fact that rising house prices discourage home purchases.

It should be noted that the results of the OLS regressions need to be further explored. There is a strong correlation between the variables used in this exercise, which may lead to inaccurate regression results.

3.2. Analysis of the Fixed Effects and Random Effects Regressions Results

The results of the fixed effects and random effects regressions are shown in Tables 3 and 4 respectively

Table 3: OLS, Fixed effect and Random effect regression results. [a,b]

	(1) OLS	(2) FE	(3) RE
Log of tax	5.965***	-0.650**	6.354***
Log of income	-3.061***	1.101***	-3.565***
Log of housing price	-1.468***	0.653**	-1.951***
within R^2	-	0.959	0.282
between R^2	-	0.0002	1
overall R^2	0.991	0.0006	0.996
Adj R^2	0.990	-	-
Obs	33	33	33

Note: [a] The independent variable is the logarithm of tax, the data in the table is the regression coefficient of the corresponding variable, and the data in brackets is the corresponding standard deviation. [b] *** p<0.01; ** p<0.05; * p<0.1

The fixed effects model shows that the amount of property tax has a significant negative effect on housing consumption at the 0.05 level and a significant positive effect on both income and house prices. This suggests that the real estate tax works in practice in a greater way to influence residents' demand for housing and reduce housing consumption. At the same time, the fixed effect of the year positively affects housing consumption over the period 2010-2015, with the propensity of residents to consume housing on the increase.

The results for the random effects are quite counterintuitive, with both income and house prices significantly negatively affecting housing consumption, while the amount of property taxes is significantly positively affected. This is different from our economic intuition. The Hausman test was used here to determine the results of the fixed and random effects. The Hausman results show a large difference in the random effects results, so the fixed effects model is more reasonable for the regression results.

In terms of the overall results, the OLS and random effects models achieve relatively similar results and the coefficients are not very different. Both results show that property taxes are positively correlated with residential housing consumption, and more importantly, house prices and income are

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negatively correlated with housing consumption, which is contrary to mainstream consumption theory and our economic intuition. However, given the autocorrelation of the data itself, the OLS regression results may not be credible. The random effects model also differs significantly from the fixed effects results, too.

3.3. Discussion

Based on the results of the regressions, the OLS regressions show that there is a significant positive relationship between property taxes on housing consumption in both Japan and the US. However, the credibility of the OLS regression results needs to be further explored due to the small sample size and correlation between the variables. In the choice between fixed and random effects, the fixed effects model results were chosen for interpretation through the Hausman test. Property taxes have a significant dampening effect on housing consumption, and disposable income per capita and average price per housing unit have a significant positive relationship with housing consumption. The pathway of the impact of property taxes plays a dominant role in the reduction of housing demand. An increase in disposable income per capita increases the consumption of residents, who tend to spend a certain proportion of their consumption on housing [4], so an increase in disposable income per capita also increases housing consumption.

The impact of housing prices on housing consumption is also multifaceted. Firstly, higher house prices may discourage residents from buying a home, with residents choosing to rent rather than buy a home. The two points to examine in this logic are the effect of higher house prices on residents' incentives to buy and the question of the cost of buying and renting a home. Housing can be used as both a residence and an investment. The magnitude of the impact of house price fluctuations on housing demand is influenced by the elasticity of housing; if residents mostly use their homes as a necessary use good, then the impact of house price fluctuations on housing demand is smaller, and vice versa.

4. Conclusion

This paper has analysed the impact of property taxes on consumer spending using OLS, fixed effects and random effects models with data from Japan, the UK and the US Bureau of Statistics. The analysis of the empirical results shows that the OLS regression has the problem of autocorrelation of the variables, and the random effects model and the fixed effects model have significant differences, so only the fixed effects model has more reliable results. There is a significant negative relationship between property tax and housing consumption. In addition to being a way for local governments to generate revenue, property taxes may also have the effect of regulating residents' consumption and changing their consumption structure. Of course, further practice is needed to observe the concrete effect of this effect. It is important to note that this paper only considers the most direct effects of property taxes on residential consumption.

At the same time, this paper only explores the impact of property taxes on residents, as property taxes also play a large role in local government finances. According to the US government, most of the US state government's finances come from property tax collection. This means that the government has more control over its finances, which affects local economic development. It is also likely that the growth in income driven by economic development will lead to an increase in housing consumption.

As consumption theory progresses, the variables that influence consumption have expanded from income to include a variety of variables such as expectations and age. The impact of property taxes on housing consumption is also expanding. For example, the imposition of a real estate tax affects residents' expectations of future house prices, and this change in expectations affects people's housing

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consumption. One way to improve this paper would be to improve the econometric model using a more realistic consumption theory by introducing variables such as house price expectations or savings rates, which will not be explored in depth in this paper due to data availability and space issues.

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