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Impact of Property Tax on Housing-Market Disequilibrium in Different Regions: Evidence from Taiwan for the period 1982–2016

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Abstract: Although Taiwan has had a unique property tax system for a long time, oversupply and increasing prices have persisted in the regional market during recent decades. In order to shed light on this problem, this study investigated the impact of property taxation on housing markets in different regions from a disequilibrium viewpoint based on the stock-flow model. The panel data of 20 counties or cities in Taiwan for the period from 1982 to 2016 was examined. The empirical findings verified that housing price was the most important factor for influencing the long-run housing supply and demand in regions both with and without oversupply. The low interest rate policy was an important factor driving the long-run housing demand, but only in over-supply regions. The current property tax system cannot impact the long-run housing demand, only the short-run demand in both regions. Moreover, the property tax cannot effectively disturb the supply behavior in the long-run in both regions. This study also confirmed that housing-market disequilibrium existed in regions both with and without oversupply, making up the gap. The property tax's impact on the adjustment speed to long-run equilibrium in over-supply regions was weaker than under-supply regions.

Keywords: property tax; housing market; disequilibrium; region; Taiwan

1. Introduction

Based on the goal of “The equalization of land rights,” the idea, presented by Dr. Sun Yat-sen, that land should be fully used to the public's benefits, Taiwan has launched and practiced for many years a rare tax property system that separates taxation between land and housing. Although property tax can theoretically reduce investment return and house price fluctuation to stabilize the macro economy [1–6], an interesting and puzzling phenomenon in the different regions of Taiwan motivates us to explore the effect and role of the current property tax system on the regional housing market over recent decades.

Unlike most European countries, 95% of the housing supply in Taiwan is provided by private industry. Eleven counties or cities had an oversupply, defined as a vacancy rate of more than 15% according to the General Report of 2010 Population and Housing Census. These areas included Kaohsiung City, Yilan County, Hsinchu County, Miaoli County, Changhua County, Nantou County, Yunlin County, Chiayi County, Penghu County, Keelung City, and Hsinchu City. Paradoxically, as indicated by Yip and Chang (2003), the development of the housing market in these over-supply

regions was still booming (Figure 1). Looking at the policy instruments related to the regulation of the housing market in Taiwan, the Taiwanese government seems to have been turning a blind eye to property tax for decades. Instead, the phenomenon of increasing housing is more often explained by reference to planning policy or a series of low interest rate policies that stimulated household demand and subsidized purchase. Were these non-property tax mechanisms, such as planning decisions or low interest rates policies—designed to supply housing and spur housing demand, respectively—more impactful than the property tax? In other words, does the current property tax system impact the housing market according to regional variations? This question will be answered clearly by this study.

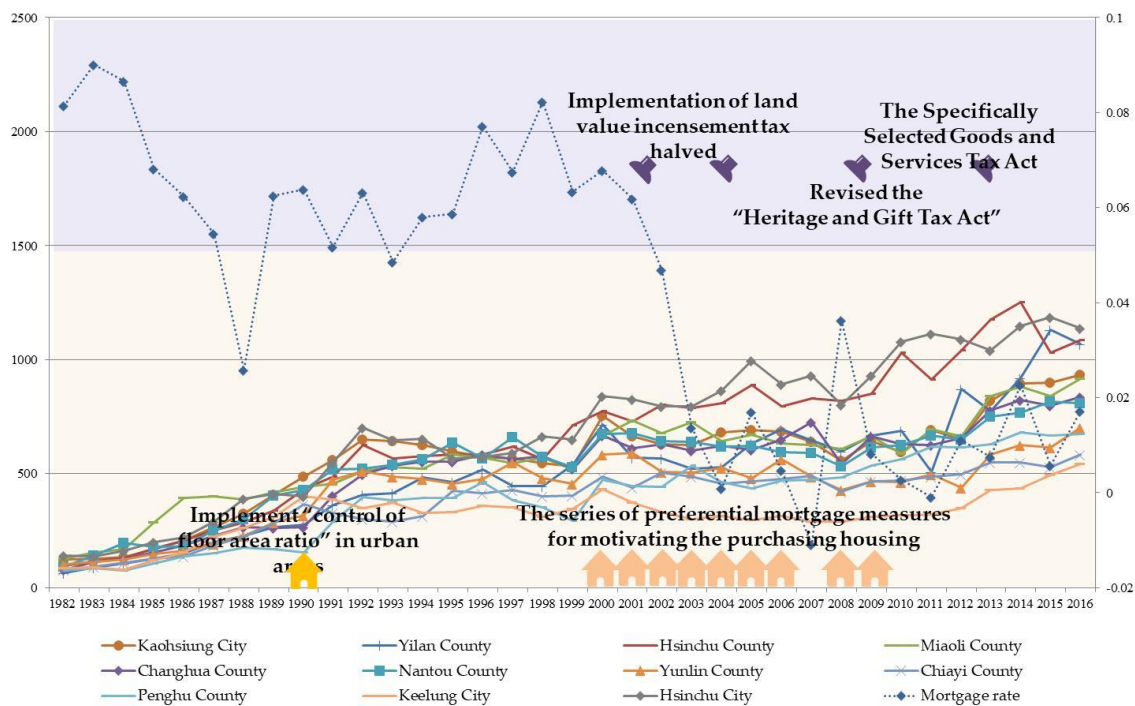


Figure 1. Housing price trends from 11 counties or cities with high vacant rates (>15%) and mortgage rates for purchasing a house in Taiwan for the period 1982–2016.

Unlike the general asset market [7], the housing market cannot quickly re-equilibrate in response to supply or demand shock because of the downward stickiness of house prices and loss aversion of sellers [8]. The housing market can experience sustained periods of excess supply or demand [9], which has also been evidenced in the USA [8–11], across 12 West European countries [12], and Ireland [13]. The evidence of regional housing markets still needs to be filled and studied [9]. Hence, this study will follow the stock-flow model to explore the behavior of supply and demand in regional housing markets to examine three issues as follows: (1) The effect of the property tax on housing demand in different regions; (2) the effect of the property tax on housing supply in different regions; and (3) the effect of the property tax on housing-market disequilibrium in different regions. This study will examine the effect of Taiwan's atypical property tax on the regional housing market from a more comprehensive and long-term perspective to provide policy feedback and a reference for practicing the property tax to regulate housing markets throughout the world.

2. Literature Review

2.1. Evidence from Disequilibrium of Housing Markets in Different Regions is Lacking

The traditional stock-flow model for explaining housing market dynamics has several puzzling assumptions, especially in the process of adjusting the housing price. Specifically, housing price is assumed to adjust nearly instantaneously so that demand for housing must quickly converge with the

existing stock at any point in time [8–11,14]. However, as evidenced by References [15,16], DiPasquale and William [11] proposed a revised seminal stock-flow model that departs from traditional methods. This model considers gradual price adjustment as well as expectations of housing price and new house supply. The traditional stock-flow model assumed only gradual supply adjustment. Moreover, in the revised stock-flow model, housing price as well as gradual adjustment according to vacancy rates—and hence gradual price adjustment—must be considered. Second, the current housing price is also positively related to past housing prices, and hence expectation from housing price variations is also included in the model. Lastly, the traditional model indicated that a permanent increase in price would lead to a permanent increase in new housing supply, neglecting the consideration of land. Specifically, the rise of land prices with a growing stock of units can absorb excess returns. Hence, an increase in housing price only temporarily prompts new housing supply since eventually the existing stock catches up to the longer run equilibrium stock. The disequilibrium of the housing market was also more clearly presented in their study [11]. This model has been widely applied in different empirical frameworks or regions in related studies, such as in References [17–19].

As market disequilibrium may originate from shifting supply conditions or demand conditions, Riddel [9,10] extended the model from Reference [11] into a multiple error-correction setting. This model can decompose market disequilibrium either generated by supply-side disturbances or demand-side disturbances. Unlike standard partial-adjustment models that allow for stock adjustment only through the past value of stock in the housing investment equation, inclusion of disequilibrium stock amounts generated by demand and supply shifts accounts for the magnitude, as well as the source, of the distortion that initiates stock adjustment. This model was gradually noted in related studies, such as References [12,13] that utilized cognate frameworks to study the housing supply in 12 West European countries and Ireland, respectively. Zabel [8] also proposed a similar dynamic model with vacancies, using an error correction mechanism to discuss the housing market, although the past value of housing price and stock were utilized as the adjustment mechanism.

However, the published literature for the stock-flow model was primarily focused on large, developed countries, such as the USA [8–11,20], Ireland [13], Spain [19], a dozen European countries, [12] and a group of Organization for Economic Co-operation and Development (OECD) countries [18]. On the other hand, the only studies to introduce the different-generated disequilibrium model to examine the dynamic of housing market are References [8–10,12,13]. Unfortunately, the evidence from regional housing markets in smaller, less developed countries is short. This study will follow the theoretical and empirical framework of disequilibrium to examine whether disequilibrium existed in the regional housing market and examine the effect of property taxation on disequilibrium.

2.2. Criticism of the Property Tax System of Taiwan

Property taxation, which has the effect of reducing investment return and house price fluctuation, deserves more attention because it is not only one of the most important sources for promoting local public facility resources in major countries, but is also an effective policy tool for regulating the operation of the housing market, further stabilizing the macroeconomy [1–6].

Based on the philosophy of the Three People's Principles, Dr. Sun Yat-sen designed four major economic mechanisms: "Landowner self-reported land price," "tax on self-reported land price," "buy land at self-reported land price," and the "social value of land goes to the public." To achieve the goal of "equalization of land rights," land is fully used to the public's benefits through redistributing its value. Among these, the "landowner self-reported land price" and "tax on self-reported land price" were the inspiration for the design of the current property tax system. Taiwan's property tax system is different from most Western countries, because it separates land and improvements [21]. Although Dr. Sun Yat-sen advocated that the landowner should initially declare the land value for the basis of leaving future land value taxes, the current design is still based on the "Official Declared Value of land (i.e., assessed land value)" issued by counties or municipalities every three years. That is because

of practical problems when a progressive tax rate is applied (from 1.0% to 5.5%) in excess of specific amounts when the property owner's total land value is greater than the average assessed land value of 700 square meters of land (i.e., the first tax bracket) within the same county. For example, when the property owner's total assessed land value is higher than the first tax bracket, the second tax bracket of 1.5% should be applicable to the exceeded land value between the first tax bracket and 500% of it. An additional improvement tax on completed housing is levied according to the present value of the house assessed by local real estate assessment committees and a fixed tax rate is designed based on different building types. Local government is responsible for setting the improvement tax rate. The tax rate of 1.2% is applied on owner-occupied houses, while 1.5% to 3.6% is applied on the owner's other residential properties (since 2014, the 2.4% is applied in the owner's second house, while for every additional house, 3.6% is applied in Taipei city). For commercial use, the rate ranges from 3.0% to 5.0%. For non-profit use, such as hospitals or civic organizations, the 1.5% to 2.5% rate is applied.

In term of the tax base for land value tax, as indicated by References [22–26], the criticism of land value tax includes: Market information, land valuation zones, land value assessment commission established by each local county (municipality), frequency of assessment for evaluating and approving the official assessed land value. The problems mentioned above induce a lower effective tax rate [25]. Firstly, a historical factor must be specifically stated before assessing the tax base. Before 1990, the “assessed land value” for levying the land value tax and the “assessed present land value” for transferring property were the same. However, considering the political and economic situation and the real estate market at that time, the government decided to separate the benchmarks for the two prices, irrevocably lowering the base for levying land value tax [27]. Secondly, the concept of land valuation zones is based on the similarity of site characteristics, and hence the assessed land value of the land valuation zones is expected to be influenced by similar market forces [21]. The individual factor of the parcel is easy to neglect. Moreover, the accuracy of valuation based on the size and sampling of land valuation zones has been questioned [26]. Thirdly, the assessed land value of land valuation zones are evaluated and approved by the land value assessment commission established by each local county. The members of the land value assessment commission could raise or reduce the assessed land value at will, especially considering the political benefits of lowering the tax base (declared land value on parcel) compared to the market price used as the tax base in western countries [25,26]. Fourthly, reevaluating assessed land value every three years has also been questioned, although the frequency of reevaluating assessed land value was revised from three years to two years in April 2017. Those problems mentioned above induce a lower effective tax rate [25]. Lam and Tsui [23] also indicated that people evade paying higher progressive tax rate for the land value tax by separating their land holdings across different counties. Besides, the differences of the tax brackets for accessed land value between urban counties and non-urban counties also expands the disparity of in the effective tax rate among counties, which will cause resources to be misplaced [22–24]. The issues with improvement taxation include that the current improvements value (i.e., tax base) is estimated by the cost approach; replacement costs of different types of improvements deducted depreciation are specified and released by local government [21]. Simplified replacement costs, linear depreciation, residual rate of 40% [26], and the adjustment rate for streets bearing location value [24] are also subject to criticism.

In a comparative study between Sydney and Taipei, Chan and Chen [28] indicated that property taxes and fees in Taipei may not have any substantial dampening impact on house price because of the very low level of the levy, compared to Sydney. Bourassa et al. [29] also indicated low user cost of owner-occupied housing and housing price inflation are the critical factors for explaining the high rate of homeownership in Taiwan. Chen [30] utilized the user cost model to examine the relationship between the house price and user cost in both Taiwan and Taipei City, the results of which reveal that the relationship in the long run only existed in Taiwanese regions rather than Taipei City because Taipei City had a higher expected appreciation of housing price than user cost. Observing the variation of effective property tax rate per house in 20 counties or cities in Taiwan for a period from 1982 to 2013

could find only a slightly increasing trend in most cities or even a slight decline in some Taiwanese cities (see Figure 2).

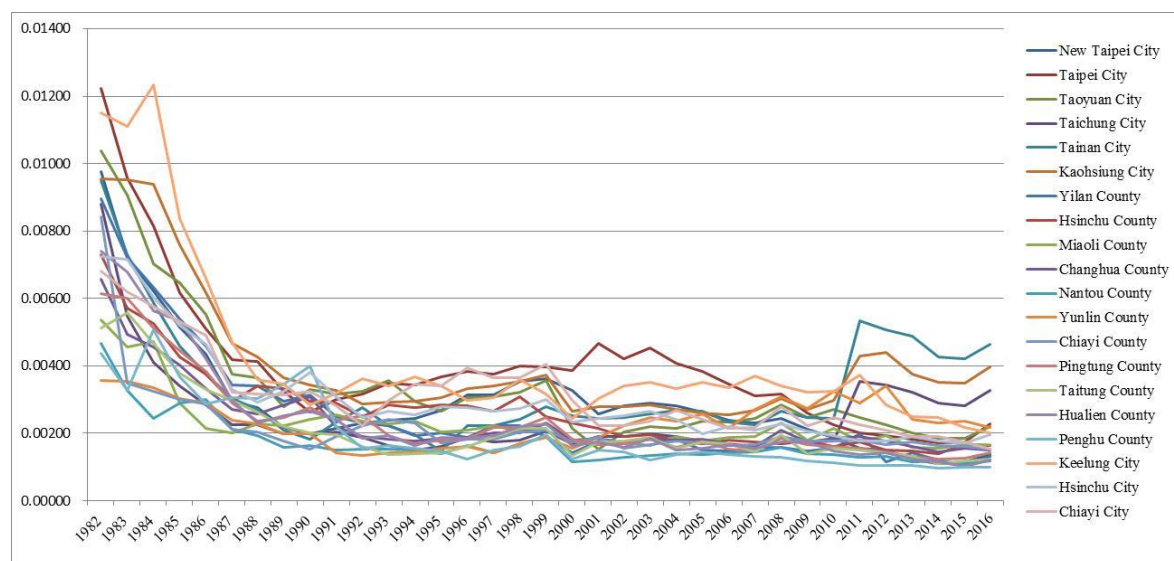


Figure 2. Effective property tax rate per house of 20 counties or cities in Taiwan for the period 1982–2016.

In summary, the property tax system of Taiwan also causes the related discussion related to inequity of taxation [26,31], the inefficiency of damping rising housing prices [25,28], and encouraging the speculation of land [22,23,32]. However, a more comprehensive and long-term perspective for examining the impact of the unique property tax on housing market in different regions was in short supply. This study will fill this gap.

3. Materials and Methods

3.1. Empirical Procedure

This study will investigate the effect of property taxation in different regions, disequilibrium in different regions, and the effect of property taxation on disequilibrium in different regions. All of these empirical procedures will be practiced separately. We utilized the annual frequency panel data of 20 cities or counties in Taiwan during the period from 1982 to 2016.

The over-supply and under-supply regions are segmented based on a standard of vacancy rates higher than 15% as indicated by the most recent General Report of 2010 Population and Housing Census. The over-supply regions include Kaohsiung City, Yilan County, Hsinchu County, Miaoli County, Changhua County, Nantou County, Yunlin County, Chiayi County, Penghu County, Keelung City, and Hsinchu City. Taipei City, New Taipei City, Taoyuan City, Taitung County, Hualien County, Penghu County, Taichung City, Chiayi City, and Tainan City are included in the under-supply regions.

3.1.1. First Step: Panel Unit Root to Examine the Stationarity of Variables

To avoid any spurious correlation between dependent variables and independent variables, this study firstly utilized the panel unit root to examine whether the variables were stationary, including the Im–Pesaran–Shin (hereafter referred as the IPS test) unit root test proposed by Reference [33], which is the between-group panel unit root tests that allows heterogeneity of the autoregressive root as an alternative to Reference [34]. In other words, the IPS test allows for an individual root across the regions. The null hypothesis for this test is that all panels have a unit root, and the alternative is that panels are stationary [35].

3.1.2. Second Step: Autoregressive Distributed Lag Model (ARDL) to Examine the Co-Integration Relationship

If these variables are non-stationary, following Reference [36], the examination of cointegrating relationship among the series was to be tested using the panel Autoregressive Distributed Lag model (ARDL). This method has the advantage of avoiding the classification of variables into $I(0)$ or $I(1)$ and applying appropriately with small samples [37,38]. The ARDL bounds test for panel data was utilized to test a cointegration relationship, as introduced by Reference [37]. The standard for bounds test was 6.36 at a level of 1% statistical significance or 4.85 at level of 5% of statistical significance

3.1.3. Third Step: Two-Stage Least Squares (TLSS) to Estimate Long-Run Model and Seemingly Unrelated Regression Model (SURM) to Examine the Short-RUN Model

If a cointegration relationship was found among variables, the long-run and short-run relationship were then examined in this study, respectively. Following References [9,10,12], the two-stage least squares (TLSS) was utilized to estimate the long-run relationships among variables, and seemingly unrelated regression model (SURM) was utilized in evaluation of short-run model to account for contemporaneous correlation of the error terms. The comprehensive empirical model included the city/counties and time dummy.

3.2. Empirical Variables

Following the related literature of stock-flow models [8–13,19], the dependent/independent variables, the definitions and sources utilized in the empirical procedure are displayed in Table 1. Most of the variables were in natural logarithmic form, except for mortgage rate, financing cost, and effective rate of property tax. Among the utilized variables, the mortgage rate for housing demand as well as the financing and cost of housing supply were macro variables due to statistic restrictions, while other variables were panel data based on counties or cities. Moreover, although the vacancy rate or rents for houses were often utilized in the literature for explaining the endogenous relationship with the housing market, the statistical shortage on vacancy rate and undeveloped rental market for housing in Taiwan [39] forced us to exclude them from the empirical model.

Table 1. Empirical variables, definitions, data sources.

Variables	Definition	Data Sources
Dependent variables		
Housing Demand, <i>HD</i>	Housing demand = Housing stock/(ownership ratio*number of household)	The data of ownership ratio and number of households from 1982 to 1993 was calculated by authors following the related definition based on Survey of Family Income and Expenditure, and data from 1994 to 2016 from the Report on the Survey of Family Income and Expenditure.
Housing stock, <i>HS</i>	Numbers of housing stock = Prior to housing stock + number of the housing completion – subtract the number of housing demolished	Data from 1991 to 2007 from Housing Statistics, and then data from 1982 to 1990 and 2008 to 2016 were calculated by the same way.
Independent variables		
Housing Prices, <i>HP</i>	Median housing price per household (in NTD 1 million)	Data from 1982 to 1991 from the report on the housing survey in Taiwan area, data from 1992 to 2010 from second-hand real estate transactions prices, and data from 2011 to 2016 from registering the actual selling price.
Disposal income, <i>DI</i>	Median disposal income per household (in NTD)	Data from 1982 to 1997 from the Report on the Survey of Family Income and Expenditure, and 1998 to 2016 from the counties and cities statistics handbook

Table 1. Cont.

Variables	Definition	Data Sources
Mortgage rate, <i>MIR</i>	Average mortgage rates of five major banks for purchasing the new housing	Taiwan Economic Journal
Effective rate of property tax per household, <i>PTR</i>	Effective rate of property tax per household = (actual land value and housing taxation ÷ ownership – adjusted number of households)/(housing price)	Actual land value and housing taxation from 1982 to 2016 was obtained from the census and statistics report.
Financing cost, <i>FC</i>	Average benchmark interest rate of five major banks for lending	Taiwan Economic Journal
Construction cost, <i>CC</i>	Construction cost index of Taipei city	Taipei's counties and cities statistics handbook
Demand-generated disequilibrium, ε	Residual from housing demand in long-run model	
Supply-generated disequilibrium, v	Residual from housing supply in long-run model	

3.3. Empirical Model

3.3.1. Housing Demand Model

In the long-run model for housing demand, the dependent variable was ownership-adjusted housing stock *HD*, which was calculated by housing stock *HS* divided by adjusted number of households based on ownership ratio, as utilized by Reference [9]. The independent variables for housing demand in long-run models included the median existing housing prices per household *HP*, median disposable income per household *DI*, mortgage rate *MIR*, and effective rate of property tax per household *PTR*. Instruments include lagged on period of median existing housing prices *HP*(−1), construction cost *CC*, financing cost *FC*, and median disposable income per household *DI*. The change of median existing housing prices per household ΔHP was a dependent variable in the short-run model. The independent variables for housing demand in the short-run model included the change of median disposal income per household ΔDI , lagged on period of median existing housing stock ΔHS (−1), change of mortgage rate ΔMIR , change of construction cost ΔCC , and the change of effective rate of property tax per household ΔPTR . The empirical functions of housing demand are as follows:

$$HD_{it} = \tau_i + \beta_{1i} \ln HP_{it} + \beta_{2i} \ln DI_{it} + \beta_3 MIR_t + \beta_4 PTR_{it} + e_{it} \quad (1)$$

$$\Delta \ln HP_{it} = \tau_i + \delta_{1i} \varepsilon_{it-1} + \delta_{2i} v_{it-1} + \delta_{3i} \Delta \ln DI_{it} + \delta_{4i} \Delta \ln HS_{it-1} + \delta_5 \Delta MIR_t + \delta_6 \Delta CC_t + \delta_{7i} \Delta PTR_{it} + e_{it} \quad (2)$$

As housing demand was indicated by ownership-adjusted housing stock, the negative sign in the long-run model for housing demand was expected in *HP* and *DI*, while the positive sign in the long-run model for housing demand was expected in *MIR* and *PTR*. In the short-run model, the ΔDI was expected to be positive, as well as ΔHS (−1), ΔMIR , ΔCC , and ΔPTR .

For the effect of demand-generated disequilibrium ε_t on housing demand, when the housing demand is higher (lower) than long-run equilibrium, the housing price should decrease (decline) in the next period. A negative relationship is hypothesized. For the effect of supply-generated disequilibrium v_t on housing demand, when the housing supply is higher (lower) than long-run supply equilibrium, the housing price should decline (increase) in the next period. The negative sign is hypothesized. Therefore, given the model parameters, this study will test the two hypotheses for model consistency such that:

$$H_0 : \delta_1 \geq 0 \text{ v.s } H_1 : \delta_1 < 0,$$

$$H_0 : \delta_2 \geq 0 \text{ v.s } H_1 : \delta_2 < 0,$$

3.3.2. Housing Supply Model

The dependent variables for housing supply in the long run or short run models are housing stock HS , ΔHS , as utilized by References [8,9,19]. The independent variables in the long-run model include the existing housing prices per household HP , construction cost CC , financing cost FC , and effective rate of property tax per household PTR . Instruments included change of housing stock ΔHS , change of existing housing price ΔHP , change of financing cost ΔFC , and change of construction cost ΔCC . The short-run independent variables for housing supply included the change of lags 0 and 2 periods in the median existing housing prices per household ΔHP , $\Delta HP(-2)$, change of lags 1 and 2 periods of the financing cost $\Delta FC(-1)$, $\Delta FC(-2)$, construction cost $\Delta CC(-1)$, $\Delta CC(-2)$, and effective rate of property tax per household $\Delta PTR(-1)$, $\Delta PTR(-2)$. The empirical functions of housing supply are as follows:

$$\ln HS_{it} = \tau_i + \alpha_1 \ln HP_{it} + \alpha_2 \ln FC_t + \alpha_3 CC_t + \alpha_4 \ln PTR_{it} + e_{it} \quad (3)$$

$$\begin{aligned} \Delta \ln HS_{it} = & \tau_i + \gamma_1 \varepsilon_{it-1} + \gamma_2 v_{it-1} + \gamma_3 \Delta \ln HP_{it} + \gamma_4 \Delta \ln HP_{it-2} + \gamma_5 \Delta \ln FC_{it-1} \\ & + \gamma_6 \Delta \ln FC_{it-2} + \gamma_7 \Delta CC_{it-1} + \gamma_8 \Delta CC_{it-2} + \gamma_9 \Delta \ln PTR_{it-1} + \gamma_{10} \Delta \ln PTR_{it-2} + e_{it} \end{aligned} \quad (4)$$

In this, the negative sign in the long-run model for housing supply was expected in FC , CC , and PTR , while the positive sign in the long-run model for housing demand was expected in HP . In the short-run model, the ΔHP , $\Delta HP(-2)$ was expected to be positive, as well as $\Delta FC(-1)$, $\Delta FC(-2)$, $\Delta CC(-1)$, $\Delta CC(-2)$, $\Delta PTR(-1)$, and $\Delta PTR(-2)$.

For the effect of demand-generated disequilibrium ε_t on housing supply, if the housing demand is higher (lower) than long-run equilibrium, housing supply should increase (decline) in the next period. Therefore, demand-generated disequilibrium ε_t is expected to have a positive impact on housing supply. On the other hand, when the housing supply is higher (lower) than long-run equilibrium of housing supply, housing supply should decline (increase) in the next period. Hence, the supply-generated disequilibrium v_t is expected to have a negative impact. Therefore, given the model parameters, this study will test the two hypotheses for model consistency such that:

$$H_0 : \gamma_1 \leq 0 \text{ v.s } H_1 : \gamma_1 > 0,$$

$$H_0 : \gamma_2 \geq 0 \text{ v.s } H_1 : \gamma_2 < 0,$$

The coefficients of the disequilibrium variables indicate the adjustment speed to long-run equilibrium. The reciprocal of coefficients of disequilibrium indicate how long is required for the housing market to return to long-run equilibrium. For example, the coefficients of demand-generated disequilibrium on housing demand is -0.5 , which means that returning to long-run equilibrium requires 2 years (i.e., $1/0.5 = 2$). This study also expected that when the property tax is included in the model, the adjustment speed to long-run equilibrium should be accelerated in all regions. In other words, the coefficients of disequilibrium must be increased.

4. Results

4.1. Related Test

The summary statistics (mean value and standard deviation) of all variables are expressed in Table 2. All variables in all regions were a normal distribution, as indicated by the significance of the Jarque–Bera test. On the other hand, the correlation relationship between lagging independent variables and housing price was examined in order to avoid multicollinearity. The results are included in Tables A1 and A2 in the Appendix A. In summary, they have a higher correlation relationship (less than 0.8) among disposal income or construction cost and house price. The remaining variables have a moderate or low correlation. Although the correlation relationship existed, these variables were mainly selected based on the published literature on stock-flow models [9–13,18–20], all variables selected were still put in the follow-up empirical model.

Table 2. Descriptive statistic of all variables.

Over-Supply Regions								
Variables	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque–Bera	Obs.
HD	1.1583	1.9462	0.8232	0.1688	1.6069	6.4291	354.3236 ***	385
HS	200,732	998,052	21,802	202,474	2.5805	9.2605	1056.0120 ***	385
HP	503.5221	1250.3940	65.8767	244.5471	0.3241	2.9703	6.75343 **	385
DI	699,124	1,124,580	326,855	180,407	0.0698	2.4066	5.9609 *	385
MIR	0.0422	0.0902	−0.0109	0.0297	−0.1799	1.6312	32.1308 ***	385
FC	0.0457	0.0902	0.0079	0.0249	0.0456	1.6880	27.7470 ***	385
CC	72.2826	106.1900	40.4200	21.9423	0.1197	1.7822	24.7092 ***	385
PTR	0.0027	0.0123	0.0010	0.0016	2.7724	12.9149	2070.1620 ***	385
Under-Supply Regions								
HD	1.2117	1.8105	0.1157	0.1839	−0.5817	9.0329	495.4563 ***	315
HS	453,859	1,441,727	50,890	369,738	0.7404	2.7511	29.5937 ****	315
HP	571.7096	2398.2730	59.6291	350.7525	1.9590	10.0029	845.1277 ***	315
DI	755477	1,298,557	346,347	219,817	0.3167	2.6874	6.5498 **	315
MIR	0.0422	0.0902	−0.0109	0.0297	−0.1799	1.6312	26.2888 ***	315
FC	0.0457	0.0902	0.0079	0.0249	0.0456	1.6880	22.7021 ***	315
CC	72.2826	106.1900	40.4200	21.9487	0.1197	1.7822	20.2166 ***	315
PTR	0.0029	0.0122	0.0010	0.0017	2.2113	9.0964	744.5079 ***	315

Notes: *, **, and *** denote significance at the 10%, 5% and 1% level, respectively. HD = housing demand; HS = housing stock; HP = median housing price per household; DI = disposal income; MR = mortgage rate; PTR = Effective rate of property tax; CC = construction cost; FC = financing cost.

The panel unit root tests for the individual variables are presented in Table 3. Based on the IPS test, the household stock, housing price, disposal income, and construction cost were non-stationary in level, but stationary in their first differences. Since not all the variables were integrated at the same level, the panel ARDL bounds test approach is a more suitable empirical method to examine the cointegration relationship among variables. The results from bounds test indicated that the F-statistics for housing demand and housing supply in over-supply regions were 5.4408 and 6.1761, respectively. In the under-supply regions, the F-statistics for housing demand and housing supply were 11.5248 and 6.4827, respectively. The all of bounds test was higher than critical values at 5% significance level indicated by Reference [37], confirming the existence of a long-term equilibrium relationship among the variables; hence, the selected empirical variables were suited to act together.

Table 3. Results for the unit root test.

	Over-Supply Regions		Under-Supply Regions	
	Level	Differences	Level	Differences
HD	−4.7197 ***	−21.4144 ***	−3.8789 ***	−14.5667 ***
HS	2.8783	−8.4047 ***	2.5710	−10.1195 ***
HP	−1.4521 *	−18.4144 ***	0.0917	−12.6655 ***
DI	1.2955	−24.0873 ***	2.3266	−14.3581 ***
MIR	−3.0847 ***	−23.2942 ***	−2.7902 **	−21.0704 ***
FC	−5.2941 ***	−22.7287 ***	−4.7887 ***	−20.5588 ***
CC	1.2145	−12.9718 ***	1.0986	−11.7335 ***
PTR	−9.2067 ***	−13.5144 ****	−8.1525 ***	−11.3633 ***

Notes: *, **, and *** denotes significance at the 10%, 5% and 1% level, respectively. The unit root test is conducted with individual trends and intercepts for each variable and its lag length is selected by using the Schwarz information criterion (SIC). IPS is Im–Pesaran–Shin unit root test proposed by Reference [33]. HD = housing demand; HS = housing stock; HP = median housing price per household; DI = disposal income; MR = mortgage rate; PTR = Effective rate of property tax; CC = construction cost; FC = financing cost.

4.2. Results

The empirical results for the long-run housing demand in different regions of Taiwan from 1982 to 2016 were shown in Panel 1–2 and 5–6 of Table 4. The results indicated the long-run housing price elasticity was 0.0947 to 0.1354 in over-supply regions and 0.0662 to 0.1236 in under-supply regions. Income only significantly impacted long-run demand in under-supply regions, rather than in over-supply regions. On the other hand, since the coefficient is not in line with theoretical expectations, the significant impact of mortgage rates on housing demand highlights the importance of driving the long-run demand in over-supply regions compared to under-supply regions. Moreover, the lag of housing stock only significantly impacts the demand in under-supply regions. The mortgage rate cannot significantly influence the short-run demand in both regions. On the other hand, the coefficient of property tax revealed a negative and insignificant impact, implying that property taxation cannot significantly impact long-run housing demand. In the short-run model, the significant impact revealed on disposable income in all regions and housing classes of stock only had an impact in under-supply regions. The coefficient of property tax was negative and statistically significant in all regions in the short-run model; implying that a jump in the effective rate of property taxation will be met by a decrease in housing price.

The empirical results for the long-run housing supply in different regions in Taiwan from 1982 to 2016 are shown in Panel 3–4 and Panel 7–8 of Table 4. In contrast to property tax which defied theoretical expectations, other variables were in line with theoretical expectations, although only housing price was statistically significant. The short-run housing supply is indicated in Panel 3–4 and 7–8 of Table 5. Almost all variables were in line with theoretical expectations, but only a few were statistically significant.

The housing-market disequilibrium in different regions was revealed in Table 5, based on the results of demand and supply-generated disequilibrium. In over-supply regions, the demand-generated disequilibrium had a negative impact on housing demand, but the coefficient was not significant. Supply-generated disequilibrium had a significantly negative impact on housing demand. On the housing supply side, the demand-generated and supply-generated variable had a negative impact, but only the coefficient of the latter was significant. In under-supply regions, demand-generated disequilibrium also had a positive and insignificant impact on housing supply. Other results are similar.

Table 4. The Impact of property tax on the long-run housing market in Taiwan for 1982 to 2016.

Variable	Over-Supply Regions				Under-Supply Regions			
	Demand Side (Dependent Variable = HD)		Supply Side (Dependent Variable = HS)		Demand Side (Dependent Variable = HD)		Supply Side (Dependent Variable = HS)	
	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 7	Panel 8
<i>HP</i>	−0.0947 ***	−0.1354 ***	0.5851 *	0.7840 *	−0.0662 *	−0.1236 **	0.7185 **	1.1498 *
<i>DI</i>	0.9610	0.0012			−0.2180 ***	−0.2228 ***		
<i>MIR</i>	0.0223	0.8578 ***			0.0975	0.0729		
<i>FC</i>			−0.2326	−0.4233			−1.0004	−1.0686
<i>CC</i>			−0.1216	−0.2157			−0.2899	−0.7810
<i>PTR</i>		−14.1705		120.5529		−28.1383		45.0861
<i>C</i>	1.9932 ***	1.9665 ***	8.8395 ***	7.7277 ***	4.5571 ***	5.0555 ***	9.4096 ***	8.6983 ***
Adjusted R ²	0.7372	0.7267	0.9773	0.9456	0.5080	0.5070	0.7646	0.8092
Sample	374	374	374	374	306	306	306	306

Notes: *, **, and *** denote significance at the level of 10%, 5% and 1%, respectively. The values in parentheses are *T*-values. *C* represents the intercept term. HD = housing demand; HS = housing stock; HP = median housing price per household; DI = disposal income; MR = mortgage rate; PTR = Effective rate of property tax; CC = construction cost; FC = financing cost. The annual frequency data on 20 counties or cities of Taiwan were utilized between 1982 and 2016. The over-supply and under-supply regions were segmented based on standard of more than 15% of vacant rate indicated by most recent General Report of 2010 Population and Housing Census. The over-supply region includes Kaohsiung City, Yilan County, Hsinchu County, Miaoli County, Changhua County, Nantou County, Yunlin County, Chiayi County, Penghu County, Keelung City, and Hsinchu City. The Taipei City, New Taipei City, Taoyuan City, Taitung County, Hualien County, Penghu County, Taichung City, Chiayi City, and Tainan City are included in the under-supply region.

Table 5. The Impact of property tax on the short-run housing market and disequilibrium in Taiwan for 1982 to 2016.

Variable	Over-Supply Regions				Under-Supply Regions			
	Demand Side		Supply Side		Demand Side		Supply Side	
	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6	Panel 7	Panel 8
ΔDI	0.4232 ***	0.2314 ***			0.8027 ***	0.5069 ***		
$\Delta HS(-1)$	−0.1652	−0.1717			−0.6532 **	−0.6761 ***		
ΔMIR	0.1400	0.2671			−0.3761	−0.3772		
ΔCC	−0.2985 **	−0.0523			−0.2020	−0.0563		
ΔHP			−0.0035	−0.0075			0.0116	0.0072
$\Delta HP(-2)$			0.0118	0.0114			−0.0096	−0.0390 **
$\Delta FC(-1)$			0.0494	0.0533			0.1582	0.2022 **
$\Delta FC(-2)$			−0.1001	−0.0958			−0.2404 **	−0.1641
$\Delta CC(-1)$			−0.0005	−0.0004			−0.0014	−0.0005
$\Delta CC(-2)$			0.0002	0.0003			−0.0005	−0.0003
ΔPTR		−208.6405 ***				−186.8485 ***		
$\Delta PTR(-1)$				−1.0395				−18.0653 ***
$\Delta PTR(-2)$				−0.1283				−4.1260
Demand-generated disequilibrium	−0.0551	−0.0752	−0.0055	−0.0126	−0.0455	−0.0652	0.0053	0.0022
Supply-generated disequilibrium	0.2732 ***	0.1488 ***	−0.0271 ***	−0.0294 ***	0.1877 ***	0.0230	−0.0254 **	−0.0279 ***
C	0.0620 ***	0.0347 ***	0.0143 ***	0.0143 ***	0.0670 ***	0.0418 ***	0.0209 ***	0.0178 ***
Adjusted R ²	0.2075	0.6522	0.0763	0.0817	0.3165	0.6674	0.0734	0.1748
Data	363	363	352	352	297	297	297	297

Notes: **, and *** denote significance at the level of 10%, 5% and 1%, respectively. The values in parentheses are *T*-values. C represents the intercept term. HD = housing demand; HS = housing stock; HP = median housing price per household; DI = disposal income; MR = mortgage rate; PTR = Effective rate of property tax; CC = construction cost; FC = financing cost. The annual frequency data on 20 counties or cities of Taiwan were utilized between 1982 and 2016. The over-supply and under-supply regions were segmented based on standard of more than 15% of vacant rate indicated by most recent General Report of 2010 Population and Housing Census. The over-supply region includes Kaohsiung City, Yilan County, Hsinchu County, Miaoli County, Changhua County, Nantou County, Yunlin County, Chiayi County, Penghu County, Keelung City, and Hsinchu City. The Taipei City, New Taipei City, Taoyuan City, Taitung County, Hualien County, Penghu County, Taichung City, Chiayi City, and Tainan City are included in the under-supply region.

5. Discussion

5.1. The Effect of Property Taxation on Housing Demand in Different Regional Markets

Compared to long-run evidence from the USA [9], the elasticity of housing prices and disposable income were lower in our study, but the mortgage rate was higher in our study. The responsiveness of mortgage rates to long-run housing demand in Taiwanese over-supply regions was also much higher than evidence from 22 OECD countries (the highest coefficients was -0.207 estimated in United States [18], Ireland (coefficient was 0.016 in the long run) [13] and Spain (coefficients ranged from -0.356 to -0.358 in the long run) [19]. From evidence of short-run housing demand in different regions from 1982 to 2016, disposable income was an important explanatory variable for short-term housing demand in both regions. Income elasticity was higher in the under-supply regions than over-supply regions. This result was also more pronounced than evidence from literature across OECD countries [18].

Importantly, observing the effect of property tax on long-run demand, the negative and not significant coefficients implied that property tax cannot significantly impact long-run demand, only short-run demand. This was in conflict with the theoretical expectations derived from empirical studies [3,5]. As indicated by Reference [28], the low cost for owning housing is the critical factor for explaining why increasing house prices have persisted in Taipei for a long time. The results echo the viewpoint that the high rate of owner occupancy is a critical factor in shaping market decisions for housing in Taiwan [40], because of the low user cost of owner-occupied housing and housing price inflation [29].

The empirical findings from this study verified that housing price is the important factor for impacting the long-run housing demand in all regions. The traditional factors influencing household behavior, such as household income, had an impact only in under-supply regions. Moreover, the results revealed that a low interest rate policy was an important factor driving long-run housing demand in over-supply regions [41–44] rather than under-supply regions. From the short-run perspective of housing demand, income still played an important role in all regions. On the other hand, the coefficient, which was out of line with theoretical expectations, implied that the current property tax system cannot properly impact housing demand in the long term, only in the short term.

5.2. The Effect of Property Tax on Housing Supply in Different Regional Markets

In summation, housing price, which had a statistically significant coefficient, revealed that housing price was a critical factor for explaining the long-run housing supply in all regions. Compared to evidence from related literature, including 12 Western European countries [12] and 22 OECD countries [18], Denmark [45], United States [9,11], Switzerland [17], Ireland [13], and Spain [19], the long-run supply elasticity of 0.5851 to 0.7840 in over-supply regions and 0.7185 to 1.1498 in under-supply regions was not low, but it was lower than the 1.2965 indicated by earlier local literature on Taiwan [46]. Moreover, the insignificant coefficient of construction and financing costs in the long-run and short-run model of the two regions also echoes the “Pre-sale system” [41,47], and “Control of floor area ratio” in urban areas since the 1990s [27]. Since May 1991, Taiwan’s government decided to implement “control of floor area ratio” in urban areas (followed by that full control of floor area ratio has been strictly implemented since June 1999). This policy has prompted developers to rush to build.

The evidence also indicated that property taxation did not have an important impact on determining developer behavior in the long run. In other words, developers may not be afraid of the impact of excessive supply of housing on their finances because property taxes have never been their focus. From a short-run perspective, property taxation had a statistically significant and negative impact on housing supply in under-supply regions, but not in the over-supply regions.

5.3. The Effect of Property Taxation on the Housing-Market Disequilibrium in Different Regions

The empirical findings based on the coefficient sign of demand and supply-generated disequilibrium were consistent with the results of empirical studies of the housing market in other countries [9,10,12,13] (Table 6). These findings revealed clearly that housing-market disequilibrium existed in different regions.

Table 6. Comparison the signs of disequilibrium between this study and related literature.

	Housing Demand	Housing Supply
Demand-generated disequilibrium	–* Boulder Colorado, USA [10]	– Boulder Colorado, USA [10]
	–* USA [9]	– USA [9]
	–♦ 12 West European countries [12]	–♦ 12 West European countries [12]
	–* Irish [13]	– Irish [13]
	– Over-supply regions in Taiwan	– Over-supply regions in Taiwan
	– Under-supply regions in Taiwan	– Under-supply regions in Taiwan
Supply-generated disequilibrium	+ Boulder Colorado, USA [10]	–* Boulder Colorado, USA [10]
	+* USA [9]	–* USA [9]
	–♦ 12 West European countries [12]	–♦ 12 West European countries [12]
	+* Irish [13]	–* Irish [13]
	+* Over-supply regions in Taiwan	–* Over-supply regions in Taiwan
	+* Under-supply regions in Taiwan	–* Under-supply regions in Taiwan

Notes: + indicate the positive sign of variable, and - indicate the negative sign. * Denotes that the variable reaches statistical significance; ♦ Denotes that it cannot be determined whether the variables reached statistical significance because the article did not reveal.

Some evidence helps us interpret these results. Firstly, the insignificant impact of demand-generated disequilibrium on housing supply implies that if a situation occurred whereby housing demand was above its long-run equilibrium, then developers would not respond with a significant increase in supply. Stevenson and Young [13] indicated that developers aspire to potential profits in the future from restricting new supply, even if the housing demand is above long-run equilibrium. Taiwanese developers exhibit similar behavior.

On the other hand, interesting findings of a significant and positive impact of supply-generated disequilibrium on housing demand in all regions indicated that when the housing supply was higher than its long-run equilibrium, housing prices will rise in the subsequent period. This result can be explained by the differing myopic expectations of future price movements among home purchasers and developers as suggested by Reference [13]. Housing supply in Ireland was subject to planning permission due to concerns of the mass media during the period from 1999 to 2003 and this led to a significant amount of housing entering the market late. This phenomenon is similar to the viewpoint of Reference [48], who indicated that delays in planning may similarly extend housing bubbles. In Taiwan, due to the launch of the control of floor area ratio in cities since 1990 and full implantation of floor area rate since 1996, a large number of houses entered the market in the early 1990s. However, the recession caused by the Asian financial crisis in 1997 also accelerated the recession of the housing market. The government tried to rescue the sluggish real estate market through low interest rate policies since the 2000s. Since the Severe Acute Respiratory Syndrome (SARS) epidemic was controlled in the second half of 2003 and housing prices have increased since then, making the positive sign of supply-generated disequilibrium on housing price.

On the other hand, when the property tax is included in the model, the adjustment speed of disequilibrium of long-run equilibrium in different regions was slightly accelerated. However, the significant and positive effect of supply-generated disequilibrium on housing demand still revealed that the property tax cannot affect the operation in over-supply regions. Conversely, the coefficient has been transferred from a significant to an insignificantly impact in under-supply regions. In other words, the impact of property tax on the adjustment speed for long-run equilibrium in over-supply regions was weaker than in under-supply regions.

6. Conclusions

This study investigated the impact of the property tax on housing-market disequilibrium in different regions in Taiwan from 1982 to 2016 based on a classical stock-flow model as suggested by References [9,10,12,13]. The evidence from this study not only highlights the impact of property tax on housing supply and demand in different regions, but also clearly confirmed that a problematic property tax system will slow the adjustment rate to long-run equilibrium from disequilibrium. This empirical finding adds a new perspective in research investigating the impact of property taxation on the housing market.

The empirical findings verify that housing price was the important factor for influencing long-run housing demand in different regions. The low interest rate policy was an important factor driving the long-run housing demand in over-supply regions rather than under-supply regions, which verified the viewpoint that the Taiwanese government could stimulate household demand through a series of low interest rate policies to subsidize purchase. For short-run housing demand, income plays an important role in all regions. Importantly, the current property tax system cannot impact housing demand in the long term, only in the short-run term. From the supply side, housing price was a critical factor for explaining the long-run housing supply in all regions. The property tax cannot effectively disturb the supply behavior in the long-run in over-supply regions, but only impact the under-supply region in the short term. This study also confirmed that housing-market disequilibrium existed in different regions, making up the gap [9]. Moreover, although the property tax can accelerate slightly the adjustment rate to long-run equilibrium in most cases, its effect in over-supply region was still weaker than in under-supply regions.

Thus, this study gently advises that the Taiwanese government should attempt to solve the problem of the housing market at a fundamental level. First, important questions, such as how driving demand policies (such as setting the preferential mortgage rate) and curbing demand policies (such as imposing property taxes) are matched to cope with unpredictable changes in the housing market, should be carefully considered. During a boom cycle or in a better location, a modest increase in property taxes and a slowdown in the preferential interest rates to curb increases in housing prices will help the housing market operate better, and vice versa. Furthermore, housing supply should be regulated by the government, even though the majority of housing is provided by private developers in Taiwan. For this, one of the best means from the government's perspective is the land value tax. During a boom cycle or in a better location, strengthening the land value tax will help provide more housing and curb the increase in housing prices [28], and vice versa. Finally, the Taiwanese government should pay attention to the comprehensive reform of property tax policies, making property tax a good tool to regulate the operation of the housing market. Although the government had amended The Equalization of Land Rights Act in April 2017, to revise the frequency for reevaluating assessed land value from three years to two years, many reforms still need to be considered [22–24,49,50]. Firstly, we suggest that the policy goal of “the equalization of land rights,” that is, “lowering the tax burden providing local services,” “avoiding land holding concentration,” and “landowners’ manipulation of the market” should be preserved and realized in practice. In other words, the local government needs to clarify the relationship between the property tax and the supply of local public facilities/investments when setting the tax base and tax rate. Moreover, this study supports the way that the announced present value of the land and the assessed land value re-merged into the “benchmark land price” as the tax base for assessing land value. The evaluation for assessed land value can introduce the advanced Geographic Information System (GIS) in order to obtain an accurate and convincing tax base. Importantly, the land value assessment commission established by each local county (municipality) needs to be synchronized and reformed to avoid the intervention of political factors affecting the fairness and accuracy of valuation. From the perspective of tax rate reform, a proportional tax rate would be more appropriate than the current progressive tax rate. In other words, the housing tax should serve to share local public expenditure after deducting revenue from land related taxation, rather than establishing the base of capital inputs.

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Appendix A

Table A1. Correlation analysis of independent variables in long-run model.

Over-Supply Regions									
Demand Side					Supply Side				
	HP	DI	MIR	PTR	Correlation	HP	FC	CC	PTR
HP	1.0000	0.7580	−0.5625	−0.5750	HP	1.0000			
DI	0.7580	1.0000	−0.3194	−0.3747	FC	−0.5279	1.0000		
MIR	−0.5625	−0.3194	1.0000	0.4362	CC	0.7364	−0.7221	1.0000	
PTR	−0.5750	−0.3747	0.4362	1.0000	PTR	−0.5750	0.4472	−0.5169	1.0000

Under-Supply Regions									
HP	1.0000				HP	1.0000			
DI	0.7397	1.0000			FC	−0.4404	1.0000		
MIR	−0.4458	−0.2231	1.0000		CC	0.5975	−0.7221	1.0000	
PTR	−0.3943	−0.2892	0.4896	1.0000	PTR	−0.3943	0.5114	−0.5443	1.0000

HD = housing demand; HS = housing stock; HP = median housing price per household; DI = disposal income; MR = mortgage rate; PTR = Effective rate of property tax; CC = construction cost; FC = financing cost.

Table A2. Correlation analysis of independent variables in short-run supply model.

Over-Supply Regions								
Correlation	HP	HP(−2)	FC(−1)	FC(−2)	CC(−1)	CC(−2)	PTR(−1)	PTR(−2)
HP	1.0000							
HP(−2)	0.9384	1.0000						
FC(−1)	−0.4801	−0.4814	1.0000					
FC(−2)	−0.4915	−0.5004	0.7009	1.0000				
CC(−1)	0.7024	0.7280	−0.6981	−0.7657	1.0000			
CC(−2)	0.7074	0.7224	−0.6787	−0.7004	0.9854	1.0000		
PTR(−1)	−0.5153	−0.5296	0.3985	0.4034	−0.4824	−0.4720	1.0000	
PTR(−2)	−0.5343	−0.5851	0.4184	0.4345	−0.5273	−0.5084	0.9445	1.0000

Under-Supply Regions								
HP	1.0000							
HP(−2)	0.9407	1.0000						
FC(−1)	−0.4063	−0.3812	1.0000					
FC(−2)	−0.4333	−0.4182	0.7009	1.0000				
CC(−1)	0.5574	0.5868	−0.6981	−0.7657	1.0000			
CC(−2)	0.5658	0.5870	−0.6787	−0.7004	0.9854	1.0000		
PTR(−1)	−0.3060	−0.3485	0.4816	0.4818	−0.5241	−0.5058	1.0000	
PTR(−2)	−0.3235	−0.4074	0.4943	0.5041	−0.5664	−0.5409	0.9529	1.0000

HD = housing demand; HS = housing stock; HP = median housing price per household; DI = disposal income; MR = mortgage rate; PTR = Effective rate of property tax; CC = construction cost; FC = financing cost.

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