[Article title]

The relationship between turnover ratio and price in Taiwan's real estate market

Author Details *(please list these in the order they should appear in the published article)*

Author 1 Name: Chou, Mei-Ling

Department: Environmental Technology and Management

University/Institution: Taoyuan Innovation Institute of Technology

Town/City: Taoyuan City

State (US only):

Country: Taiwan (R.O.C.)

NOTE: affiliations should appear as the following: Department (if applicable); Institution; City; State (US only); Country.

No further information or detail should be included

Corresponding author: [Name] Chou, Mei-Ling

Corresponding Author's Email: lindachou@tiit.edu.tw

☒ *Please check this box if you do not wish your email address to be published*

Acknowledgments (if applicable):

Biographical Details (if applicable):

[Author 1 bio]

Structured Abstract:

This study used the 2000Q1 to 2012Q4 panel data of Taipei City, New Taipei City, and the Tao-Zhu area in Taiwan to examine the stationary of the turnover ratio and the lead-lag relation of the turnover ratio and housing price. The fixed effect models showed that the turnover ratio can explain the 12.81 % of the next period price variance, and the model with lower AIC and SBC value than price-volume model. This signifies that the turnover ratio and price model are superior fits for the panel data. The results of the Fisher cointegration test showed that more than one cointegration relation exists in the proposed models. The results of the Granger causality test showed that a strong interaction exists between Taipei City and

New Taipei City, which the (t-1) period turnover ratio led the t period price variance. But only the price variance in New Taipei City increased in conjunction with the price variance in the Tao-Zhu area.

Keywords: turnover ratio, stationary, panel data

Article Classification:

Research paper

For internal production use only

Running Heads:

The relationship between turnover ratio and price in Taiwan's real estate market

Chou, Mei-Ling
Taoyuan Innovation Institute of Technology, Department of Environmental Technology and Management, Taiwan (R.O.C.)
e-mail: lindachou@tiit.edu.tw

Abstract

This study used the 2000Q1 to 2012Q4 panel data of Taipei City, New Taipei City, and the Tao-Zhu area in Taiwan to examine the stationary of the turnover ratio and the lead-lag relation of the turnover ratio and housing price. The fixed effect models showed that the turnover ratio can explain the 12.81 % of the next period price variance, and the model with lower AIC and SBC value than price-volume model. This signifies that the turnover ratio and price model are superior fits for the panel data. The results of the Fisher cointegration test showed that more than one cointegration relation exists in the proposed models. The results of the Granger causality test showed that a strong interaction exists between Taipei City and New Taipei City, which the (t-1) period turnover ratio led the t period price variance. But only the price variance in New Taipei City increased in conjunction with the price variance in the Tao-Zhu area.

Keywords: turnover ratio, stationary, panel data

Introduction

The turnover ratio is a floating index of capital. In stock market studies, the turnover ratio was used to describe the transfer frequency of a stock, and found that the turnover ratio has a positive and long stable relation with stock prices (Yu, 2008). Regarding investments, real estate is always the capital with simultaneous consumption and investment. Therefore, this study analyzed the volume-price relationship for forecasting the transfer price or volume in a t+1 period. The price-volume was a significant index of the real estate market cycle.

Certain sub-markets have the same transfer volume though with different supply volume, signifying that their floating rates are not the same. Therefore, the transfer volume cannot be used to supplant the transfer behaviors of sub-markets efficiently. The turnover ratio is the percentage of the housing flows accounted for the housing stock during a certain time period, which describes the volatility in a target area. The turnover and the frequency of transactions are positively correlated, though most researchers pay little attention to the relation of price and turnover ratio, even related to their different effects in sub-markets.

Due to lower interest rates, loans on favorable terms from the government, and a lower ratio of land value increase tax and inheritance tax, and housing prices have continued rising after the first quarter of 2003 in Taiwan. Specifically, Taipei, the capital of Taiwan, has the highest housing prices and price-income index. According to a study conducted by Huang and Teng (2005), the high housing prices would force the residents to move to low-price areas, such as New Taipei City and the Tao-Zhu area (which includes Taoyuan County, Husizhu City, and Husizhu County). The average distance from Taipei City to New Taipei City is thirty minutes by car, and from Taipei City to the Tao-Zhu area is an hour by car. This study found that numerous commuters living in New Taipei City or the Tao-Zhu area rode to Taipei City on public transit daily (see figure 1).

Figure 1: Google map of Taipei City, New Taipei City, and the Tao-Zhu area in Taiwan

The remainder of this paper is organized as follows: Section II presents a review of studies related to the housing price-volume and stock turnover ratio; Section III shows the data-descriptive statistics and reports an analysis of the empirical results; and finally, Section IV offers several concluding remarks.

Literature Review

Stein (1995) found a significant positive correlation between the volume and price in the U.S. real estate market between 1968 and 1992. Hua and Chang (1997) studied Taiwan's housing fluctuation patterns between the transaction price and volume by using the ECM model. The results also showed that transaction volume fluctuates in conjunction with housing market prices. Prices were affected by the (t-1) period volume. DiPasquale and Wheaton (1996) used the stock-flow model to verify the housing stock influencing the housing price by renting. The housing stock increased new building supply alongside the residential price level. The increased supply consequently reduced the rent level and price level.

The study by Arbel, Aanny, and Sulganik (2009) added the “mean reversion price” to simulate an adaptive expectation regression model within a real option framework to show that the optimal time of waiting before exercising a purchase is positively related to the price level. When prices are above (below) their long-term mean and recently experienced a negative (positive) trend, then the correlation between the price yield and the percent change in transaction volume is positive. When prices are above (below) their long-term mean and recently experienced a positive (negative) trend, then the examined price yield and volume correlation is negative. The last results were different to those of other studies, which may be because the study by Arcel et al. focused on first-time home-buyers as consumers and not investors. However, houses are not only consumption goods, but also investments.

This study analyzes the trading activity of the real estate market when transaction volume does not suffice. In addition, from the supply aspect, areas with the same transaction volumes may have different housing stocks. Increased supply volume may result in a rise in transfer choice. The turnover ratio is the percentage of the housing flows accounted for the housing stock during a certain time period, which describes the volatility of capital market, such as stocks or real estate markets. Lee and Swaminathan (2000) and Yu (2008) used the turnover ratio in their studies of the stock market, and found that the price momentum was more pronounced with high-turnover stocks, whereas low-turnover stocks tended to outperform the high-turnover stocks.

This study first conducted the panel unit root test to assess whether the turnover ratio is stationary, that is, not increasing without boundaries, and investigated the lead-lag relationship between prices and the turnover ratio by using panel cointegration tests and Granger causality tests to determine whether higher prices boost the higher turnover ratio, or if the latter results in higher prices. Furthermore, this study described the interaction between Taipei City, New Taipei City, and the Tao-Zhu area.

The Data

The quarterly data of turnover ratios between 2000Q1 and 20012Q4 were announced by the Housing Statistics, which were collected from the Ministry of the Interior. The quarterly presale housing unit prices between 2000Q1 and 2012Q4 are reported in the Cathay Real Estate Index Quarterly Report, which is surveyed by the Taiwan Real Estate Research Center and Cathay Real Estate[1]. In Figure 2, the presale housing unit prices in Taipei City, New Taipei City, and the Tao-Zhu area are of a long-term positive trend.

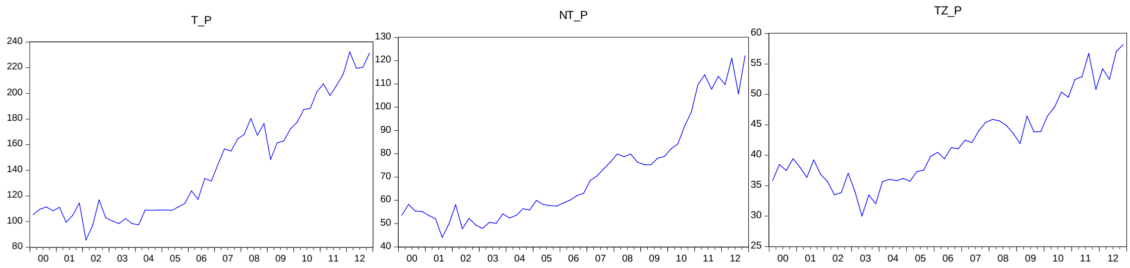

Figure 2: The presale housing unit price trend in Taipei City (T_P), New Taipei City, (NT_P) and the Tao-Zhu area (TZ_P), Q1, 2000-Q4, 2012

The descriptive statistics of the variables are reported in Table 1. The mean turnover ratio in Taiwan is 1.24 %, and the mean presale unit price is 55.37 thousand dollars/m^2. Even Taipei City has the highest presale unit price (143.91thousand dollars/m^2), though with the lowest turnover ratio (1.62 %). The Tao-Zhu area has the lowest presale unit price (42.05thousand dollars/m^2), though with the highest turnover ratio (1.75 %). The relationship between the turnover ratio and the price might be positive.

Table 2 is the correlation of the selected variables between Taipei City, New Taipei City, and the Tao-Zhu area. A higher correlation was present between Taipei City's turnover ratio (T_R) and New Taipei City's turnover ratio (NT_R) compared to between the Tao-Zhu area's turnover ratio (TZ_R). The results of the unit price of Taipei City showed an interaction between the three sub-markets.

[1]The unit price is estimated by following the equation carefully, and is superior compared to other price variables, such as asking price, mean price, and median price. They also control housing characteristics by classic house.

$$\ln P_i = \beta_0 + \beta_1(GF) + \beta_2(AVPING) + \beta_3(UNIT) + \beta_4(S) + \beta_5(V) + \beta_6(LOCATION)$$

(Pi is the unit price; GF is the building level; AVPING is the main area (ping); UNIT is the number of the case; V is the suite; S is the signal house; and LOCATION is the building location)

Table 1: Descriptive statics of the variables in Taiwan, Taipei City, New Taipei City, and the Tao_Zhu area, Q1, 2000-Q3, 2010

	The turnover ratio (%)				The presale unit price (thousand dollars/m^2)			
Var.	Taiwan	Taipei City (T_R)	New Taipei City (NT_R)	Tao-Zhu area (TZ_R)	Taiwan	Taipei City (T_P)	New Taipei City (NT_P)	Tao-Zhu area (TZ_P)
Mean	1.24	1.62	1.66	1.75	55.37	143.91	71.12	42.05
S.D.	0.21	0.35	0.32	0.33	1.49	5.98	3.03	0.97
Max.	1.57	2.34	2.28	2.46	79.77	232.37	122.19	58.17
Min.	0.79	0.88	0.82	0.99	42.96	85.67	44.06	30.00

Note: The housing price is the standard unit price of the per-sale house which collected by the government.

Table 2: Correlations among the selected variables in Taipei City, New Taipei City, and the Tao-Zhu area, Q1, 2000-Q4, 2012

Var.	T_R	T_P	NT_R	NT_P	TZ_R	TZ_P
T_R	1.0000	-0.1110	0.8760	-0.1651	0.6915	-0.1718
T_P	-0.1110	1.0000	-0.1993	0.9640	-0.1829	0.9592
NT_R	0.8760	-0.1993	1.0000	-0.2419	0.6372	-0.2153
NT_P	-0.1651	0.9640	-0.2419	1.0000	-0.1390	0.9475
TZ_R	0.6915	-0.1829	0.6372	-0.1390	1.0000	-0.1956
TZ_P	-0.1718	0.9592	-0.2153	0.9475	-0.1956	1.0000

Empirical Findings

This study uses the panel data, which include the time series data and cross-section data. Cross-sectional techniques facilitated examining whether the regional price levels were persistent. Hsiao (1985) indicated that the panel data provided a larger sample size. Furthermore, Baltagi (2001) suggested that the panel data had more advantages, as follows: (1) this could control the individual difference; (2) provides more information to reduce the colinear problem; (3) could reduce the bias from individual or group; (4) and could test the complex behavior.

Random and fixed effects test

Because land supply is limited, and everyone requires housing to satisfy living demand, only when the housing prices are above an owner's base price is housing supply present. Therefore, this study used the fixed effects model to integrate real market conditions. This study used three models.

Model 1 used the unit price as the dependence variable to test the relation between the turnover ratio and housing price. Model 2 used the logarithm unit price as the dependence variable to test the interaction between the turnover and the variance of unit price. Model 3 was used to test the relation between the price-volume during the research period to compare the relation between the turnover ratio and price. In the study by Hua and Chang (1997), the price was affected by the (t-1) period transfer volume. Therefore, the current study added the (t-1) period turnover ratio in the proposed model to test the lead-lag relation between the turnover ratio and price.

The tests results are shown in Table 3. The results of the Hausman test for the three models showed that the null hypotheses were rejected, signifying that the models were fixed effect models. The fixed effect tests also rejected H_1 and H_2; this study hence used the variable intercept model with fixed effect. The three models are as follows:

Model 1: $P_{it} = \alpha_i + \beta_{1i} R'_{it} + \beta_{2i} R'_{it-1} + \mu_{it}$ [1]

Model 2: $LP_{it} = \alpha_i + \beta_{1i} R'_{it} + \beta_{2i} R'_{it-1} + \mu_{it}$ [2]

Model 3: $P_{it} = \alpha_i + \beta_{1i} S'_{it} + \beta_{2i} S'_{it-1} + \mu_{it}$ [3]

where *P* is the presale housing unit price, *LP* is the logarithm presale housing unit price, *R* is the turnover ratio, and *S* is the transfer volume. The intercept is represented by α, which was different in the sub-markets. β is the coefficient of the independent variables to test how they affected the dependent variables. μ is the residential term. *i* represents the three sub-markets, as i=1,2,3, and *t* is the time period of the quarter data, as t=1,2,…,43.

Table 3: Random and fixed effects tests results

Model1: $P_{it} = \alpha_i + \beta_{1i} R'_{it} + \beta_{2i} R'_{it-1} + \mu_{it}$			Model2: $LP_{it} = \alpha_i + \beta_{1i} R'_{it} + \beta_{2i} R'_{it-1} + \mu_{it}$			Model 3: $P_{it} = \alpha_i + \beta_{1i} S'_{it} + \beta_{2i} S'_{it-1} + \mu_{it}$		
Random effects-Hausman Test Null: had random effects								
Statistic	d.f.	Prob.	Statistic	d.f.	Prob.	Statistic	d.f.	Prob.
784.09	2	0.0001*	1554.09	2	0.0001*	756.04	2	0.0001*
Fixed effects test-Likelihood Ratio Null $H_1: \beta_1 = \beta_2 = \beta_3$								
Statistic	d.f.	Prob.	Statistic	d.f.	Prob.	Statistic	d.f.	Prob.
392.05	(2,121)	0.0001*	777.04	(2,121)	0.0001*	378.02	(2,121)	0.0001*
Fixed effects test-Likelihood Ratio Null $H_2: \alpha_1 = \alpha_2 = \alpha_3, \beta_1 = \beta_2 = \beta_3$								
Statistic	d.f.	Prob.	Statistic	d.f.	Prob.	Statistic	d.f.	Prob.
253.54	2	0.0001*	331.11	2	0.0001*	249.58	2	0.0001*

Note: * denotes the 95% significance level.

Panel data unit root test and cointegration tests

Before testing the relationship between the turnover ratio and unit price, the variables should be stationary. This study used unit root tests for the panel data, according to the study by Levin, Lin, and Zhu (LLC, 2002) and Im, Pesaran, and Shin (IPS, 2003). The IPS (2003) test is prescribed for panels with a high degree of heterogeneity in the cross-section dynamics. Unlike LLC (2002), which assumed that all the series are stationary under the alternative, IPS (2003) is consistent under the alternative that only a fraction of the series is stationary. Table 4 described the results of the panel data unit root tests, which indicate that the variables in the three models were stationary after the first difference.

The Fisher (combined with Johansen) cointegration test is based on the rank of canonical correlations between the levels and the first differences of data after correcting and allowing a break in any short-run dynamics. If the variables are I (1), the cointegration test is required. This study tested the cointegration of variables by using the Fisher cointegration test, which is superior. Table 5 showed that more than one cointegration relation exists between the turnover ratio and the price. Results were similar for the turnover ratio and logarithm price and the transfer volume and price.

Equation Estimation

Table 6 shows that compared to the three models, the adj. R-square of Model 2 was higher than that of the other models. The AIC and SBC of Model 2 were lower than those of Model 1 and Model 3 as well. Model 2 appears superior for describing the price variability, of which the (t-1) period turnover ratio could describe 12.81 % of the price variability in Model 2. The intercepts in Model 2 showed that the housing price variability of Taipei City was higher than that of New Taipei City and the Tao-Zhu area.

The results of Model 1 and Model 2 showed that the turnover ratio in the (t-1) period and the price (or logarithm price) had a positive relation. The (t-1) period turnover ratio increased in conjunction with the t period variability of price. Model 3 results showed that the volume-price relation is positive, which is the same as the Taiwanese research conducted by Hua and Chang (1997).

Granger causality Tests

The last step of the empirical study requires testing for causality with the Granger test (1969). The Granger causality tests were used to test the forecast ability between two variables. x had a higher ability to forecast y, signifying that x granger caused y. Table 7 and Figure 3 display the interaction between the turnover ratios and prices of sub-markets. The results of Model 2 were more similar to those of Model 1. The historical data of the turnover ratio is seemingly superior for describing the variance of logarithm price compared to the price.

Figure 3 displayed there was a strong relation was present between Taipei City and New Taipei City, as follows: (1) The turnover ratio in Taipei City set the variance percept of price in New Taipei City; (2) The turnover ratios in Taipei City and New Taipei City set the variance percept of price in Taipei City; (3) The turnover ratio in New Taipei City and the variance percept of price in Taipei City set the variance percept of price in New Taipei City; (4) The turnover ratio in Taipei City set the turnover ratio in New Taipei City. Finally, the relationship between the Tao-Zhu area and New Taipei City was stronger than it between the Tao-Zhu area and Taipei City. The Tao-Zhu area only be caused by the variance percept of price in New Taipei City.

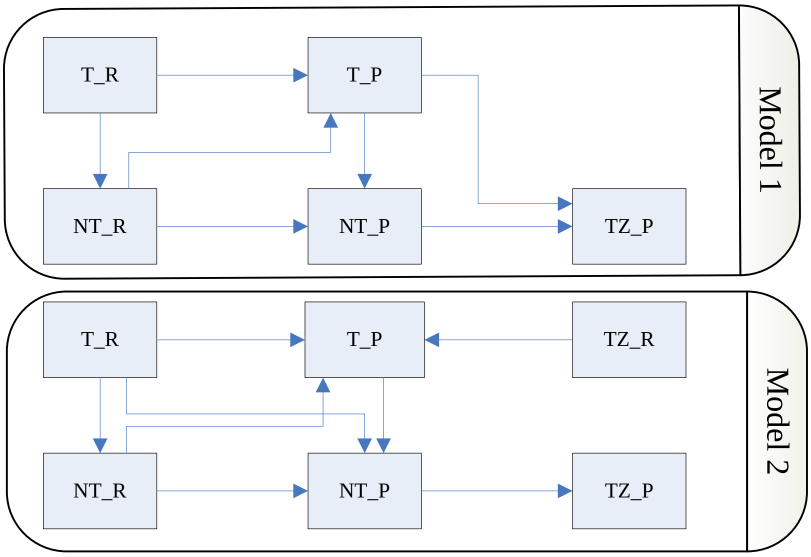

Figure 3: The results of interaction of the three sub-markets by the Granger causality test

Table 4: The results of panel data unit root tests

Model 1: $P_{it} = \alpha_i + \beta_{1i}R'_{it} + \beta_{2i}R'_{it-1} + \mu_{it}$				
Method	Statistic	Prob.	Cross-sections	Obs
Level				
Null: Unit root(assumes common unit root process)				
LLC	2.5579	0.9947	9	373
Null: Unit root (assumes individual unit root process)				
ADF	4.2505	0.9996	9	373
PP	4.7540	0.9992	9	375
Method	Statistic	Prob.	Cross-sections	Obs
1st difference				
Null: Unit root(assumes common unit root process)				
LLC	-11.4166	0.0001*	9	354
Null: Unit root (assumes individual unit root process)				
ADF	250.924	0.0001*	9	354
PP	1433.63	0.0001*	9	366

Model 2: $LP_{it} = \alpha_i + \beta_{1i}R'_{it} + \beta_{2i}R'_{it-1} + \mu_{it}$				
Method	Statistic	Prob.	Cross-sections	Obs
Level				
Null: Unit root(assumes common unit root process)				
LLC	2.5579	0.9947	9	373
Null: Unit root (assumes individual unit root process)				
ADF	4.2505	0.9996	9	373
PP	4.7540	0.9992	9	375
Method	Statistic	Prob.	Cross-sections	Obs
1st difference				
Null: Unit root(assumes common unit root process)				
LLC	-11.4166	0.0001*	9	354
Null: Unit root (assumes individual unit root process)				
ADF	250.924	0.0001*	9	354
PP	1433.63	0.0001*	9	366

Model 3: $P_{it} = \alpha_i + \beta_{1i}S'_{it} + \beta_{2i}S'_{it-1} + \mu_{it}$				
Method	Statistic	Prob.	Cross-sections	Obs
Level				
Null: Unit root(assumes common unit root process)				
LLC	2.7901	0.9974	9	354
Null: Unit root (assumes individual unit root process)				
ADF	2.7466	1.0000	9	354
PP	3.4707	0.9999	9	375
Method	Statistic	Prob.	Cross-sections	Obs
1st difference				
Null: Unit root(assumes common unit root process)				
LLC	-11.5091	0.0001*	9	354
Null: Unit root (assumes individual unit root process)				
ADF	258.354	0.0001*	9	354
PP	1407.48	0.0001*	9	366

Note: * denotes the 95% significance level.

Table 5: the panel data cointegration tests of model 1, model 2 and model 3

Model	Model1: $P_{it} = \alpha_i + \beta_{1i} R'_{it} + \beta_{2i} R'_{it-1} + \mu_{it}$		Model2: $LP_{it} = \alpha_i + \beta_{1i} R'_{it} + \beta_{2i} R'_{it-1} + \mu_{it}$		Model 3: $P_{it} = \alpha_i + \beta_{1i} S'_{it} + \beta_{2i} S'_{it-1} + \mu_{it}$	
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Eigenvalue	Trace Statistic	Eigenvalue	Trace Statistic
None	20.69*	16.87*	24.16*	17.53*	17.37*	17.71*
At most 1	14.90*	14.90*	19.67*	19.67*	5.521	5.521

Note: * denotes the 95% significance level.

Table 6: the estimate results of model 1, model 2 and model 3

Model	Model1: $P_{it} = \alpha_i + \beta_{1i} R'_{it} + \beta_{2i} R'_{it-1} + \mu_{it}$			Model2: $LP_{it} = \alpha_i + \beta_{1i} R'_{it} + \beta_{2i} R'_{it-1} + \mu_{it}$			Model 3: $P_{it} = \alpha_i + \beta_{1i} F'_{it} + \beta_{2i} F'_{it-1} + \mu_{it}$		
Var.	Coefficient	t-Statics	Prob.	Coefficient	t-Statics	Prob.	Coefficient	t-Statics	Prob.
intercept	47.0497	5.3263	0.0001*	3.8887	47.6867	0.0001*	41.9287	5.3339	0.0001*
β_{1i}	1.0286	0.1780	0.8591	0.0088	0.1657	0.8687	0.0003	0.7155	0.4757
β_{2i}	13.6555	2.3798	0.0189*	0.1281	2.4186	0.0171*	0.0013	2.6037	0.0104*
Intercept with Fixed Effects									
α_1	=47.0497+56.3991=150.4985			=3.8887+0.7130=4.6017			=41.9287+61.6956=103.6243		
α_2	=47.0497+(-19.6124)=27.4373			=3.8887+(-0.1703)= 3.7184			=41.9287+(-28.6533)= 13.2754		
α_3	=47.0497+(-36.7867)=10.263			=3.8887+(-0.5427)= 3.346			=41.9287+(-33.0424)=8.8863		
Adj. R-squared	0.8622			0.9257			0.8690		
Log likelihood	-387.1207			168.9832			-523.2596		
AIC	6.2241			-2.6029			8.4976		
SBC	6.3367			-2.4904			0.0938		

Note: * denotes the 95% significance level.

Table 7: the Granger causality tests results in model 1 and model 2

Model 1: Null Hypothesis	F-statistics	P-value	Model 2: Null Hypothesis	F-statistics	P-value
T_P does not Granger Cause T_R	0.2117	0.8102	T_LP does not Granger Cause T_R	0.0273	0.9731
T_R does not Granger Cause T_P	5.8408*	0.0064	T_R does not Granger Cause T_LP	7.1332*	0.0025
T_P does not Granger Cause NT_R	0.1037	0.9018	T_LP does not Granger Cause NT_R	0.2257	0.7991
NT_R does not Granger Cause T_P	5.9098*	0.0060	NT_R does not Granger Cause T_LP	5.9408*	0.0059
NT_R does not Granger Cause T_R	0.9907	0.3812	NT_R does not Granger Cause T_R	0.9907	0.3812
T_R does not Granger Cause NT_R	6.3576*	0.0043	T_R does not Granger Cause NT_R	6.3576*	0.0043
NT_P does not Granger Cause NT_R	0.8152	0.4506	NT_LP does not Granger Cause T_R	0.0659	0.9364
NT_R does not Granger Cause NT_P	3.7070*	0.0344	T_R does not Granger Cause NT_LP	3.7745*	0.0325
NT_P does not Granger Cause T_R	0.1720	0.8427	NT_LP does not Granger Cause NT_R	0.7192	0.4940
T_R does not Granger Cause NT_P	3.0809*	0.0500	NT_R does not Granger Cause NT_LP	3.9330*	0.0285
NT_P does not Granger Cause T_P	1.2856	0.2889	T_LP does not Granger Cause TZ_R	0.9279	0.4046
T_P does not Granger Cause NT_P	4.2900*	0.0213	T_ZR does not Granger Cause T_LP	3.5454*	0.0393
TZ_P does not Granger Cause T_P	2.6299	0.0859	NT_LP does not Granger Cause T_LP	1.9131	0.1623
T_P does not Granger Cause TZ_P	6.3556*	0.0043	T_LP does not Granger Cause NT_LP	6.3396*	0.0044
TZ_P does not Granger Cause NT_P	0.6690	0.5185	TZ_LP does not Granger Cause NT_LP	0.2446	0.7843
NT_P does not Granger Cause TZ_P	6.1259*	0.0051	NT_LP does not Granger Cause TZ_LP	5.9304*	0.0059

Note: * denotes the 95% significance level.

Conclusion

This study used three models with the panel data to study the stationary of the turnover ratio in Taipei City, New Taipei City, and the Tao-Zhu area, closing the geographical distribution, and tested the turnover ratio stationary in the three sub-markets. By using the fixed and random effect test, this study rejected the null hypothesis of the Hausman test, showing that the model had no random effect. The three models were fixed effects models.

Model 1 regarded the unit price as the dependence variable to test the relation between the turnover ratio and housing price. Model 2 used the logarithm unit price as the dependence variable to test the interaction between the turnover and the variance of unit price. Model 3 was used to test the relation between the price-volume during the research period to compare the relation between the turnover ratio and the price.

The results of the panel data unit root test indicate that the turnover ratio of the variables in the three models were stationary after the first difference between 2000Q1 and 2012Q4. This signifies that the turnover ratio or the transfer volume would not increase without long-term limitations. The Fisher (combined with Johansen) cointegration test results showed that more than one cointegration relation existed between the turnover ratio and the price. The results were similar for the turnover ratio and logarithm price and the transfer volume and the price.

After the equation estimates, the results revealed that Model 2 is superior compared to Model 1 and Model 3 via the higher Adj. R-square and lower AIC or SBC values. The (t-1) period turnover ratio could describe 12.81 % of the price variance, and the Taipei City housing price variance was higher than that in New Taipei City and the Tao-Zhu area. The results were similar to those of the Taiwanese study conducted by Hua and Chang (1997).

The results of the Granger causality tests showed that a strong interaction exists between Taipei City and New Taipei City, showing that the (t-1) period turnover ratio led the t period price variance. The historical data of the turnover ratio can describe the price variance in Taipei City and New Taipei City. Both the turnover ratio and the price variance in Taipei City, which is the metropolis of Taiwan and has the highest housing prices, affected the housing prices in New Taipei City. And results also displayed the relationship between the Tao-Zhu area and New Taipei City was stronger than it between the Tao-Zhu area and Taipei City, which only the price variance in New Taipei City increased in conjunction with the price variance in the Tao-Zhu area.

Reference

Baltagi, B.H. (2001) Econometric Analysis of Panel Data. England: John Wiley and Sons.

DiPasquale, D. and W. C. Wheaton. (1996), Urban Economics and Real Estate Markets. New Jersey:Prentice-Hall, Inc.

Granger, C.W.J. (1969) “Investigating Causal Relations by Economic Models and Cross-Spectral Methods”, Econometrica, 37 (March), pp:424–438.

Hsiao, C. (1985) “Benefits and limitations of panel data”, Econometric Reviews, 4(1), pp:121-174.

Hua, Ching-Zhun and Chang Ching-Oh. (1997) “Housing fluctuation patterns between transaction price & volume”, Journal of housing studies, 5(JAN), pp:1-15

Hui-Tzu Huang &Ruey-Jaw Teng (2005) “A Study on The Residential Choice Behavior of Consumer: The Impact Effect of Income, Local Finance and Housing Price”, Yu Da Academic Jurnal, 9(March), pp:247-257.

Im, K., Pesaran, H. and Shin, Y. (2003) “Testing for unit root in heterogeneous panels”, *Journal of Econometrics*, 115, pp: 53–74.

Levin, A., Lin, C. and Zhu, C. J. (2002) “Unit root tests inpanel data: asymptotic and finite-sample properties”, *Journal of Econometrics*, 108, pp: 1–24.

Lee, C. M. C., and B. Swaminathan. (2000) “Price Momentum and Trading Volume”, *Journal of Finance*, 55, pp: 2017–2069.

Stein, J. C. (1995) “Prices and Trading Volume in the Housing Market: A Model with Down-payment Effects”, *The Quarterly Journal of Economics*, 110(2), pp:379-406.

Yu C. (2008) “Institutional Trading and Price Momentum”, *International Review of Finance*, 8(March), pp:81-102.

Yuval Arbel, Danny Ben-Shahar & Eyal Sulganik (2009) “Mean Reversion and Momentum: Another Look at the Price-Volume Correlation in the Real Estate Market”, *Journal of Real Estate Finance Economic*, 39(April), pp:316-335.