Testing for the relationship between turnover ratio and price in Taiwan's real estate market

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Abstract

This paper examines the stationary of turnover ration and the lead and lag relation of turnover ratio and housing price. Therefore, we can describe the market transaction more simply by the turnover ratio than by the volume. The turnover ratio is the percent of transaction volume divided by the stocks of housing represented the regional floating which be related to the regional investment rate, but most researchers has paid little attention to this. By using Johansen tests and an ECM model to test the price-volume correlation for the years 2000-2009, this paper shows first, the turnover ratio is stationary after 1st difference. Second, the log unit price of Taiwan led the turnover ratio one quarter, and it in Taipei led the turnover ratio two quarter. The two variables have long-term balanced relations, and they are affected by their previous period. Third, the results of impulse response functions of Taiwan and Taipei are differently. To have more information of turnover ratio would be helpful to forecast the unit price variance. And the variance decomposition level is increasing quickly in Taiwan than it in Taipei.

Keywords: turnover ratio, price-volume correlation, stationary, VAR model

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Introduction

Because of the lower interest rate, loan on favorable terms of the government, lower ratio of land value increase tax and inheritance tax, the housing price keeps increasing after the first season of 2003 in Taiwan. At the same time, the people real income growth ratio is negative which made the higher housing price become the first of the people's grievance in 2009.

Most housing volume-price relationship researches was used the transaction price and volume to be the important index of the real estate market cycle (Beaver, 1968; Foster, 1973; Karpoff, 1987；Gatzpaff, et al.,1995). But the supply between different sub-markets aren't the same which made the transaction volume can not be used in place of the sub-market supply very well. The turnover ratio would describe the difference between the sub-markets' supply better. The turnover ratio is the percent of transaction volume divided by the stocks of housing represented the regional floating which be related to the regional investment rate, but most researchers has paid little attention to this. Compare to figure 1, we found the same result which the variance of the Taipei's turnover ratio in figure 2 seem to be more close to it of housing unit price.

The study is organized into two parts. In first part, I test the stationary of the turnover ratio of Taiwan and Taipei by unit root test. In the second part, I built the VAR (Vector Autoregression) model to evaluate how the turnover ratio influence the housing price ,and use the VAR Granger Causality Tests to test the lead and lag relations of them.

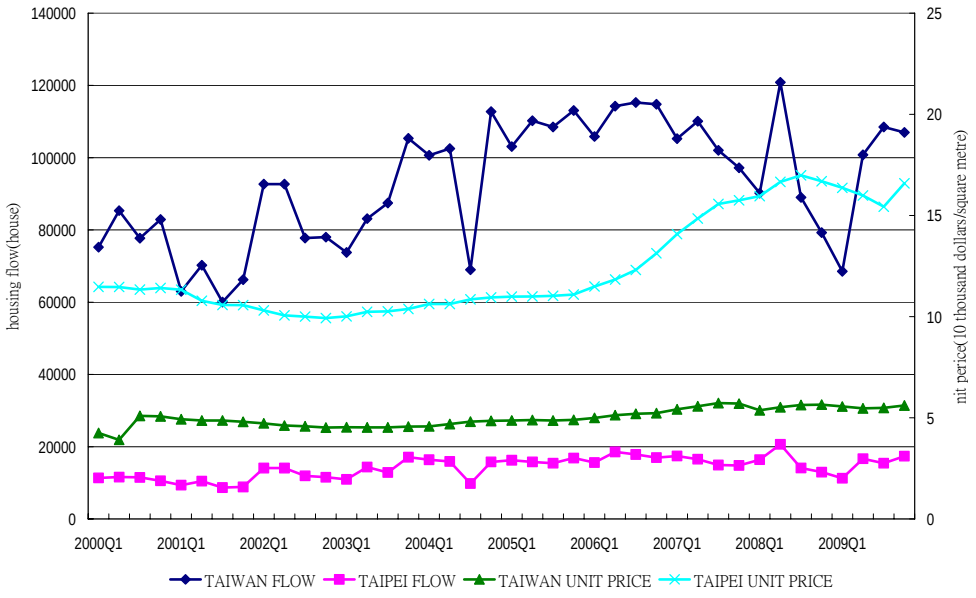


Figure 1: The relationship between housing flow and unit price

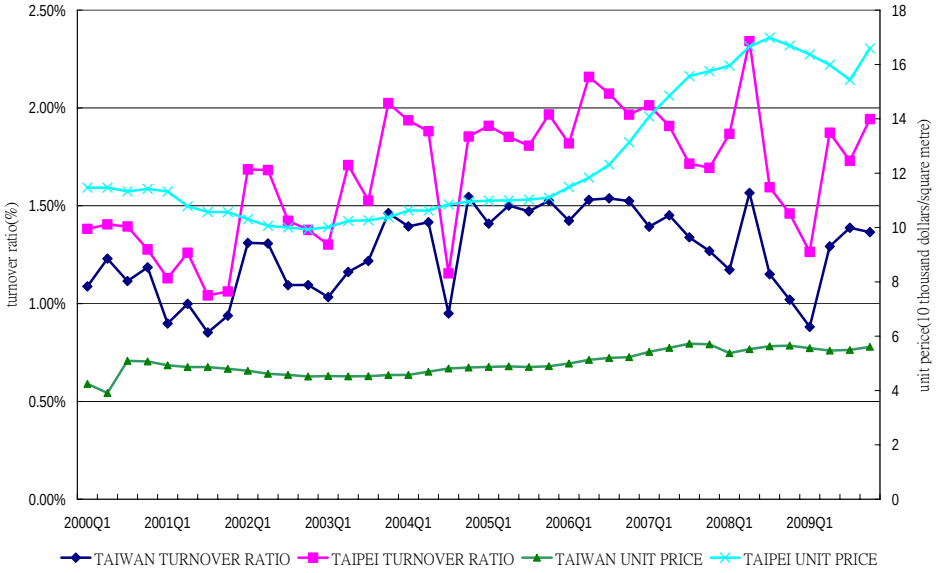


Figure 2: The relationship between turnover ratio and unit price

Data and empirical model

Data

The quarterly data of housing stocks, transaction volume during 2000Q1 to 2009Q4 are announced by the Housing Statistics which collected from the Ministry of the Interior. The quarterly transaction unit prices during 2000Q1 to 2009Q4 are reported on the Cathay Real Estate Index Quarterly Report which survey by the Taiwan Real Estate Research Center and the Cathay Real Estate[1]. In table 1, the mean turnover ratio in Taiwan is 1.26% which is less than it in Taipei (1.66%). And the average unit price in Taiwan is 50,030 dollars/m^2, and it in Taipei is 124,248 dollars/m^2.

Empirical model

Within the real estate economics literature, evidences on price-volume correlation are not the same. Stein(1995) pointes the “down payment effect” affect the price-volume correlation. The less housing price reduces transaction. Berkovec and Goodman(1996), Hort(2000) used the search model to have the same results.

Hua and Chang(1997) found the numbers of transaction are affected by the cycle, supply and demand. When business cycle was moved from bottom to recovery, the higher consumption demand led to larger transaction volume. On the other hand, the investor

[1]The unit price is estimated by following equation carefully, and it is better than the other price variables like asking price, mean price or median price. They also control the housing characteristic 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 level of building; AVPING is the main area(ping)，UNIT is the number of the case; V is the suite; S is the signal house，LOCATION is the building location。)

became the supplier when the cycle turned down, the numbers of transaction decreased led to the housing price cut down. Genesove and Mayer(2001) also found the decreasing housing price would result in the supply and transaction volume decreasing. They implied the correlation between turnover ratio and price is negative.

Summary statistics for the data are given in Table 1 which includes the mean, standard deviations, skewness and kurtosis. The turnover ratio and the unit price in Taipei are both higher then those in Taiwan. To check the stationary of the data, the Augmented DF test for a unit root of TRATIO, TPPRICE, DTPPRICE, TCRATIO, TCPPRICE and DTCPPRICE are presented in the seven and eight rows in Table 1. The null hypothesis of a unit root cannot be rejected for the four variables at least are at a 1% significance level. As the table1 indicates that the variables are stationary after 1st difference.

Table 1: the summary statistics and the results of unit roots test of the data

Var.	TRATIO (%)	TPPRICE (dollar/m^2)	DTPPRICE	TCRATIO (%)	TCPPRICE (dollar/m^2)	DTCPPRICE
Mean	1.2625	5.0030	1.6061	1.6616	12.4248	2.5023
S.D.	0.2122	1.4724	0.0900	2.3416	2.4327	0.1852
Skewness	-0.3288	-0.0674	-0.2668	-0.2181	0.7884	0.6934
Kurtosis	1.9247	2.3474	2.6910	2.1325	1.9498	1.8447
LEVEL						
ADF Test	0.4814	0.8373	-3.1720	0.3181	1.3088	-2.1223
1st difference						
ADF Test	-8.0632***	-7.3743***	-8.0498***	-0.6540***	-2.4027***	-2.3827***

Note1:All the data are quarterly. TRATIO is Taiwan turnover ratio of; TPPRICE is Taiwan unit price; DTPPRICE is the logarithm of Taiwan unit price; TCRATIO is Taipei turnover ratio; TCPPRICE is Taipei unit price; DTCPPRICE is the logarithm of Taipei unit price

Note2: The value in the ADF test is t-statistic value.

Note3:*** is the t-statistic significant at 0.01.

Vector Autoregression Estimates

To carry out the analyses of turnover ratio and unit price, I conduct the following three econometric procedures. First, the Johansen(1991) test with a structural break in short-run dynamics is used to examine the number of common trends in the series. Second, the error correction model is estimated and Granger causality for cross-relationship is defined in the context of the error correction model. Third, the impulse response functions of these spreads and their standard errors are derived to inspect the speed of the market adjustment to a shock.

Johansen Cointegration test

If the variables is I(1), we should use cointegration test the level first. We test the cointegration of variables by Johansen test which is more powerful. The Johansen cointegration test is based on the rank of canonical correlations between the levels and the first differences of data after correcting for any short-run dynamics and allowing for a break in the short-run dynamics. My primary interest is in examining the led and lag relation of turnover ratio and log unit price, so I assume the two variables have following vector autoregressive (VAR) model as following:

$$Y_t = A_0 + \sum_{s=1}^{k} A_i Y_{t-i} + \varepsilon_t \text{, and } Y_t = [Y_{it}, Y_{2t}, ..., Y_{nt}] \quad (1)$$

where the Y_t is the turnover ratio (or the log of unit price) of *t* period. If the variables is I(1) and have cointegration relation, it is convenient to rewrite equation (1) as the ECM form:

$$\Delta Y_t = A_0 + \prod Y_{t-1} + \sum_{i=1}^{s-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (2)$$

where $\prod = -\left[I - \sum_{i=1}^{s} A_i \right]$, and $\Gamma_i = -\sum_{j=i+1}^{s} A_j$. The Johansen and Juselius (1990) examine a cointrgration relation based on the hypothesis of the rank of Π_i. If the rank of Π_i is equal to *q* and less than the numbers of variables, *n*. Π_i can be expressed as $\alpha\beta'$ where α and β are $n \times q$ matrices, α is called the adjustment matrix, and β is called the cointegration matrix. The $\prod Y_{t-1}$ is the error correction term, and the rank of the cointegration matrix would be test by the null hypothesis rank(Π)=*q*.

Table 2 is the results of cointegration test which include the trace test and maximum eigenvalue test. Because the Johansen test statistics in Table 2 shows the turnover ratio and log unit price in Taiwan and which in Taipei have cointegration relation. The results examine the stability of long-run parameters under unstable short-run parameters.

Table2: the result of Johansen cointegration test

		Trace Statistic	Max-Eigen Statistic
TAIWAN	none	27.15742***	19.7854***
	at most 1	7.3721	7.3721
TAIPEI	none	35.6129**	28.2586**
	at most 1	7.3543	7.3543

Note1:null hypothesis is $\lambda_{r+1} = 0$.

Note2:*** is the value significant at 1%; ** is the value significant at 5%.

Error Correction Model Estimates

Due to above Johansen test statistics, we use the error correction model (ECM) to estimate the led and lag relation of turnover ratio and log unit price. Table 3 is the VEC estimate results of Taiwan, and Table 4 is the results of Taipei. By the value of AIC, SC and LR[2], both the best lag length of TAIWAN and TAIPEI are lag 1. Table 3 tell us that the TRATIO (-1) affect the TRATIO, and the TRATIO(-1) and DTPPRICE (-1) affect the DTPPRICE at least at the significant level of 10%. Table 4 shows that DTCPPRICE (-1) affect the DTCPPRICE, and the DTCPPRICE(-1), DTCPPRICE(-2) affect the TCRATIO. But all the relationships are not stable. So, we use the Granger Causality Tests to identify the lead and lag relation of the turnover ratio and unit price.

Table3:TAIWAN-ECM estimates

	DTPPRICE		TRATIO	
	Coeff.	t-ratio	Coeff.	t-ratio
COINTEQT	0.0122	1.8588*	-0.1657	-2.4067**
TRATIO(-1)	-0.0261	-1.8170*	0.3528	2.3403**
DTPPRICE (-1)	0.9711	26.6460***	0.2556	0.6692
C	0.0770	1.2573	0.4079	0.6350

Note1:*** is the value significant at 1%; ** is the value significant at 5%; * is the value significant at 10%

Note2:the test of the serial correlation by the value of Ljung-BoxQ and Breush-Godfrey LM are not significant.

Table4:TAIPEI- ECM estimates

	DTCPPRICE		TCRATIO	
	Coeff.	t-ratio	Coeff.	t-ratio
COINTEQTC	-0.0390	-3.0594***	0.2197	1.3119
TCRATIO(-1)	-0.0198	-1.4742	0.2651	1.5009
TCRATIO(-2)	-0.0216	-1.5603	0.0093	0.0514
DTCPPRICE (-1)	1.2516	8.2068***	-4.0406	-2.0175**
DTCPPRICE(-2)	-0.2472	-1.6184	4.2258	2.1614**
C	0.0537	1.0843	0.4247	0.6525

Note1:*** is the value significant at 1%; ** is the value significant at 5%; * is the value significant at 10%

Note2:the test of the serial correlation by the value of Ljung-BoxQ and Breush-Godfrey LM are not significant.

[2] AIC: Akaike information criterion; SC: Schwarz information criterion; LR: sequential modified LR test statistic (each test at 5% level

Granger Causality Tests

Table 5 is the result of Granger Causality Tests. Only the TCRATIO Granger Cause DTCPPRICE significantly (Chi-square=4.8236) which means the turnover ratio leads the log unit price two period. The lead and lag relation of TRATIO and DTPPRICE in Taiwan is not significant.

Table5: VAR Granger Causality Tests[3]

	H0	LAG	chi-square
TAIWAN	TRATIO does not Granger Cause DTPPRICE	1	2.6767
	DTPPRICE does not Granger Cause TRATIO	1	0.0001
TAIPEI	TCRATIO does not Granger Cause DTCPPRICE	2	4.8236***
	DTCPPRICE does not Granger Cause TCRATIO	2	0.6558

Note1:*** is the value significant at 0.01.

Impulse response function and variance decomposition

The impulse response function helps us to know the influence of the one S.D. Innovation Shock of turnover ratio on the current unit price and future unit period. The influence would be positive, negative, continuous or jumpily. Figure 3 and 4 plot the impulse response functions of turnover ratio(log unit price) spreads to a one-unit shock of log unit price (turnover ratio). The blue lines in the Figure 3 show how the previous impulse of the variable itself affects the future period, and the red lines show the correlation between the turnover ratio and unit price. Next we use the variance decomposition can explain the influence level.

In the top left of figure 3, we can found that TRATIO has short-term and small response to one S.D. innovation of DTPPRICE. The variance decomposition level of DTPPRICE from TRATIO is 2% in 1st period (see appendix Ⅳ). In the bottom left of figure 3 shows that response of TRATIO to DTPPRICE is short-term, and tend to zero in 3rd period.

As the top right of figure 3 indicates that TCRATIO affect DTPPRICE positively and over a long period of time in Taipei. The variance decomposition level of TCRATIO from DTCPPRICE is 25% in 2nd period (see appendix Ⅴ). In the bottom right of figure 3 shows that the response of DTCPPRICE to TCRATIO is negative and increases quickly.

[3] The best lag length is defined by the value of AIC, SC and LR.

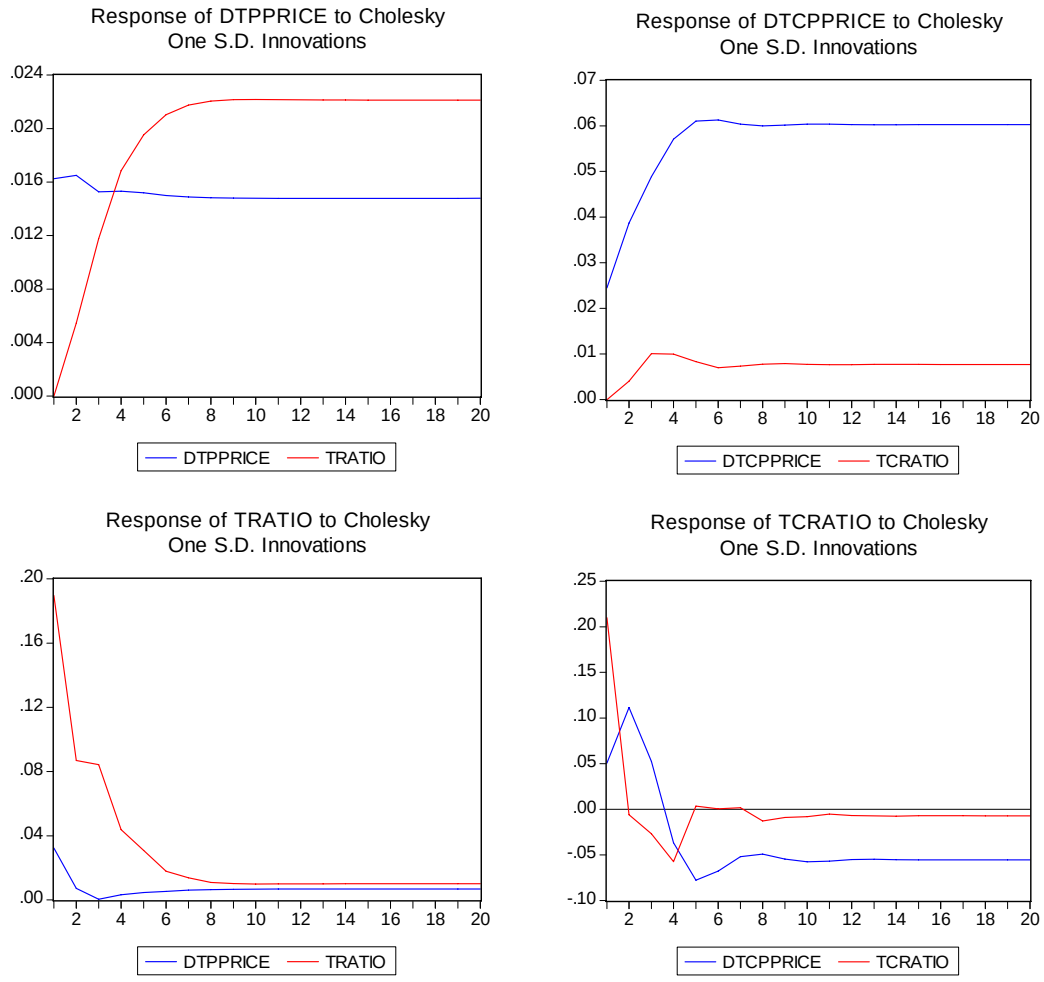


Figure 3: the impulse response function in Taiwan and Taipei

Conclusion

This paper study the "stationary" of turnover ratio in Taiwan real estate market, and test the Taipei turnover ratio stationary in sub-market. The empirical results indicate that the turnover ratio of Taiwan and Taipei are stationary after 1st difference during 2000Q1 to 2009Q4.

The Johansen test statistics shows the turnover ratio and log unit price in Taiwan and which in Taipei were stability of long-run parameters under unstable short-run parameters. The correlation between turnover ratio and unit price are not stable in the ECM model, so we use the Granger Causality Tests to define the lead and lag relation of the two variables. The result shows only TCRATIO Granger Cause DTCPPRICE significantly, and the turnover ratio leads the unit price one period in Taipei.

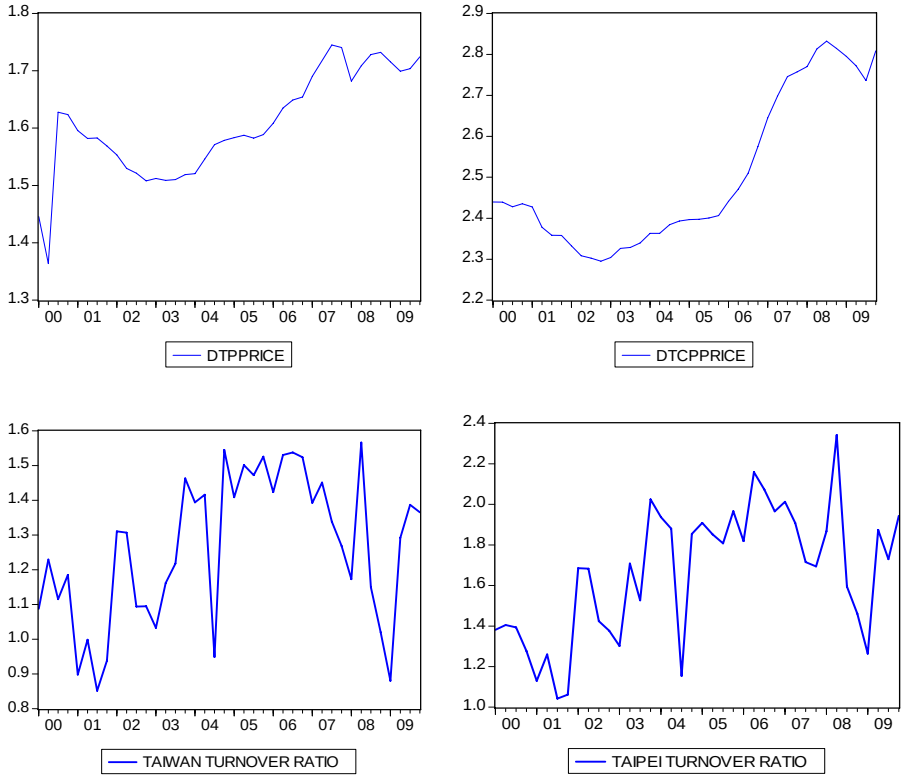
The results of impulse response functions of Taiwan and Taipei are differently. In Taiwan, TRATIO has short-term and small response to one S.D. innovation of

DTPPRICE, and the responses of TRATIO to DTPPRICE are short-term and negative, and tend to zero in 3rd period. In Taipei, TCRATIO affect DTCPPRICE negatively and over a long-term, and the response of DTCPPRICE to TCRATIO is positive and increases slowly.

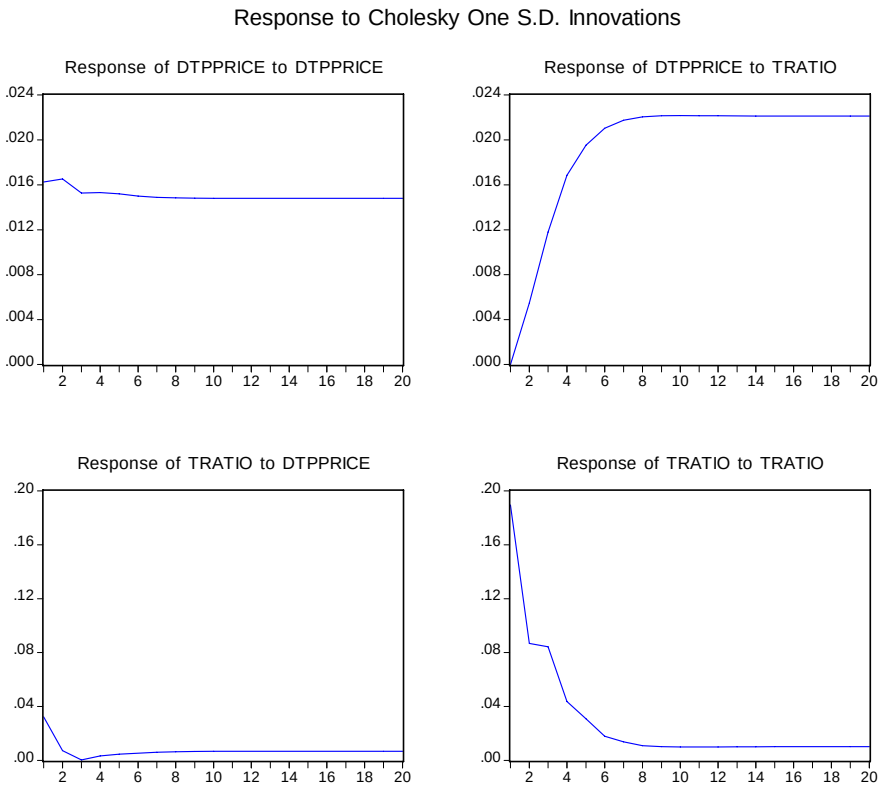
It should be concluded, from what we has been said above, that having more information of turnover ratio would be helpful to forecast the log unit price variance. And the variance decomposition level is increasing quickly in Taipei than it in Taiwan.

Appendix

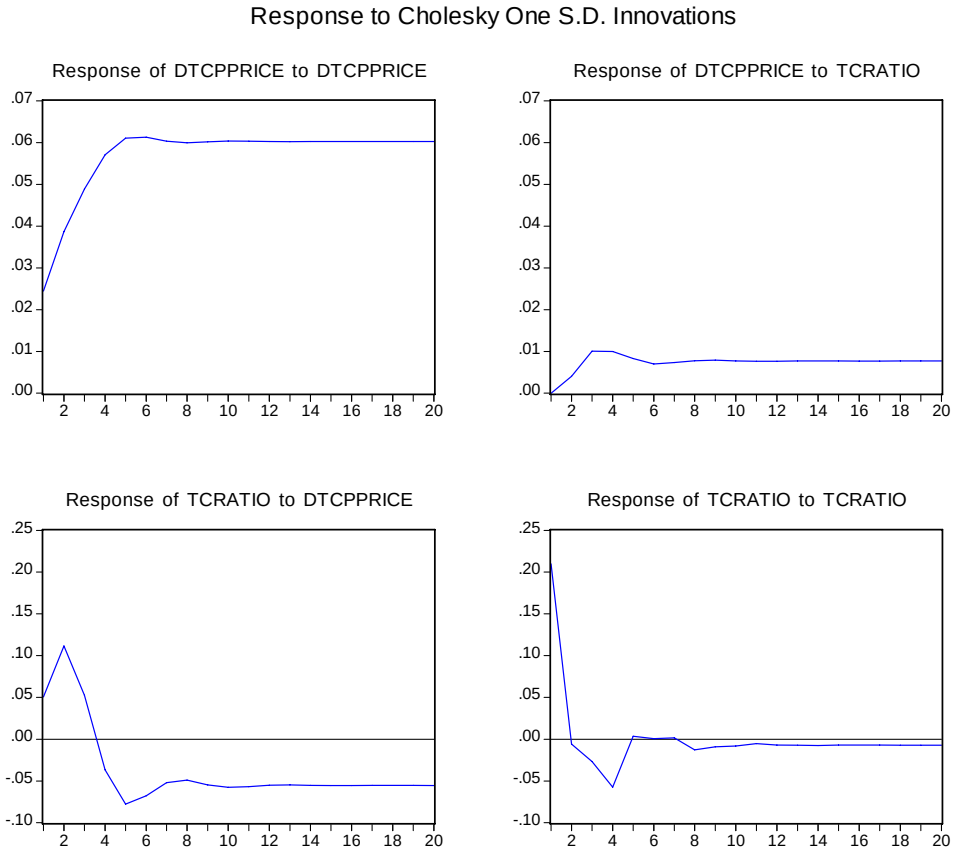
Ⅰ.The time series figures of the variables in the VAR model



Ⅱ. Impulse response to Cholesky one S.D.-Taiwan



Ⅲ. Impulse response to Cholesky one S.D.-Taipei



Ⅳ.The Variance Decomposition- Taiwan

Variance Decomposition of TRATIO:

PERIOD	S.E.	DTPPRICE	TRATIO
1	0.192288	2.829028	97.17097
2	0.211102	2.466469	97.53353
3	0.227315	2.127613	97.87239
4	0.231527	2.071683	97.92832
5	0.233623	2.075023	97.92498
6	0.234374	2.115010	97.88499
7	0.234860	2.173260	97.82674
8	0.235206	2.242973	97.75703
9	0.235524	2.317333	97.68267
10	0.235830	2.393676	97.60632
11	0.236138	2.470461	97.52954
12	0.236448	2.547063	97.45294
13	0.236761	2.623212	97.37679
14	0.237076	2.698869	97.30113
15	0.237391	2.774042	97.22596

Variance Decomposition of DTPPRICE:

PERIOD	S.E.	DTPPRICE	TRATIO
1	0.016248	100.0000	0.000000
2	0.023801	94.71586	5.284144
3	0.030639	82.01024	17.98976
4	0.038174	68.92950	31.07050
5	0.045493	59.69442	40.30558
6	0.052316	53.34860	46.65140
7	0.058578	49.00656	50.99344
8	0.064326	45.95729	54.04271
9	0.069625	43.74945	56.25055
10	0.074552	42.09550	57.90450
11	0.079169	40.81822	59.18178
12	0.083528	39.80418	60.19582
13	0.087667	38.97993	61.02007
14	0.091617	38.29645	61.70355
15	0.095404	37.72020	62.27980

Variance Decomposition of TRATIO:				Variance Decomposition of DTPPRICE:			
PERIOD	S.E.	DTPPRICE	TRATIO	PERIOD	S.E.	DTPPRICE	TRATIO
16	0.237706	2.848764	97.15124	16	0.099045	37.22756	62.77244
17	0.238021	2.923058	97.07694	17	0.102557	36.80142	63.19858
18	0.238336	2.996943	97.00306	18	0.105952	36.42910	63.57090
19	0.238651	3.070431	96.92957	19	0.109242	36.10097	63.89903
20	0.238965	3.143531	96.85647	20	0.112435	35.80960	64.19040

V. The Variance Decomposition- Taipei

Variance Decomposition of TCRATIO:				Variance Decomposition of DTCPPRICE:			
PERIOD	S.E.	TCPPRICE	TCRATIO	PERIOD	S.E.	TCPPRICE	TCRATIO
1	0.216034	5.505859	94.49414	1	0.024466	100.0000	0.000000
2	0.243186	25.36907	74.63093	2	0.045966	99.23202	0.767976
3	0.250204	28.35270	71.64730	3	0.067850	97.44653	2.553473
4	0.259321	28.39544	71.60456	4	0.089226	97.27329	2.726713
5	0.270739	34.29102	65.70898	5	0.108436	97.56353	2.436472
6	0.279081	38.15993	61.84007	6	0.124761	97.84501	2.154990
7	0.283863	40.22252	59.77748	7	0.138792	97.97856	2.021444
8	0.288353	41.87281	58.12719	8	0.151399	98.03815	1.961845
9	0.293610	43.84247	56.15753	9	0.163110	98.07358	1.926425
10	0.299313	45.88814	54.11186	10	0.174096	98.11133	1.888672
11	0.304695	47.75363	52.24637	11	0.184424	98.14471	1.855291
12	0.309713	49.38374	50.61626	12	0.194176	98.17093	1.829071
13	0.314599	50.89275	49.10725	13	0.203451	98.19019	1.809810
14	0.319501	52.33196	47.66804	14	0.212327	98.20606	1.793939
15	0.324377	53.70738	46.29262	15	0.220852	98.21993	1.780070
16	0.329172	55.00067	44.99933	16	0.229061	98.23224	1.767761
17	0.333872	56.21508	43.78492	17	0.236983	98.24285	1.757145
18	0.338503	57.36041	42.63959	18	0.244649	98.25205	1.747948
19	0.343077	58.44698	41.55302	19	0.252081	98.26013	1.739870
20	0.347596	59.47876	40.52124	20	0.259301	98.26736	1.732641

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