

Research Article

Short-Run Dynamics between Urban Housing Markets: Toda-Yamamoto Tests

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Abstract: Similar fundamentals such as geography, population, transport, trade and macro-policy may produce dynamics between commodity prices across cities. This study tested for the short-run dynamics between new home prices in Xi’an and Lanzhou. We used the Toda-Yamamoto technique, which does not depend on the property of unit root and cointegration. Data were monthly changes. The period is from 2006M01-2015M12. A feedback effect was suggested. In the short run, geographical diversification for housing properties can be achieved between these two Northwest China’s metropolises.
Keywords: Dynamics, housing, price, short run, Granger causality, levels VAR.

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INTRODUCTION

Xi'an and Lanzhou are the capitals of Shanxi Province and Gansu Province, respectively. Xi'an and Lanzhou are two cities located in the inland area of northwest China, and both were the main cities on the ancient Silk Road. Xi'an had been one of the most important capitals in ancient China. The economic and social development of the two major cities has been quick in recent years. But compared to other big cities in China, such as Chengdu, Chongqing, Suzhou, Guangzhou, and Nanjing, they are lagging behind. Despite this, the real estate economy is still growing rapidly. The distance between these two cities is 500 km. Because the two cities are geographically close to each other, people migrate frequently between two cities. Housing markets are likely to contain short-run dynamics that drive each other’s market. The dynamics will help the formation of a long-term equilibrium. City and regional housing markets appear to impact each

other [1-5]. This paper tested for the short-run effects between new housing markets in Xi’an and Lanzhou.

METHODOLOGY

To examine the short-run dynamics between time series, we can conduct a Granger causality test. In general, we need to test for unit root and cointegration and constructing a linear error-correction model (ECM) given the existence of cointegration, or a linear vector autoregressive model (VAR) given the nonexistence of no cointegration between I(1) series.

Instead, we can drive the Granger causality test using the Toda-Yamamoto lag-augmented VAR technique [6]. Toda and Yamamoto [6] argue that this technique is free of dependence on the property of unit root in data and cointegration between integrated variables. A bivariate Toda-Yamamoto lag-augmented levels VAR is written as:

$$y_t = \delta_0 + \delta_1 t + \beta_1 x_{t1} + \dots + \beta_k x_{tk} + \beta_{k+1} x_{t(k+1)} + \dots + \beta_{k+d} x_{t(k+d)} + \varepsilon_t \tag{1}$$

Where the order of integration of y_t and x_t is at most two (denoted $d \leq 2$) around a linear trend (t). ε_t is

assumed to be i.i.d. We tested the null hypothesis of no Granger causality using Wald- χ^2 [7]:

$$H_0: \beta_1 = \beta_2 \dots = \beta_k = 0 \tag{2}$$

We tested for unit root using the ADF and PP tests to examine the order in data [8, 9].

DATA

Data was the monthly new commodity house price index as compared with the same month of last year. for the period from January 2006 to December 2015. Two time series are new house prices in Lanzhou

(HP_LANZHOU) and new house prices in Xi'an (HP_XIAN). Data were from NBSC [10]. We seasonally adjusted monthly series using the X-12 technique. Data were in logarithms. Data have non-zero means (Table 1) and have moved smoothly over time (Figure 1). We accepted the normality for HP_XIAN and HP_LANZHOU at the 10% level.

Table-1: Statistics for house prices

Definition	New house prices in Xi'an	New house prices in Lanzhou
Variable	HP_XIAN	HP_LANZHOU
Mean	4.65	4.65
Median	4.65	4.65
Maximum	4.75	4.76
Minimum	4.54	4.55
Std. Dev.	0.05	0.04
Skewness	-0.06	-0.25
Kurtosis	2.36	2.73
Jarque-Bera	2.12	1.59
Probability	0.35	0.45

Notes: The log of new house price indices as compared with the same of last year. Seasonally adjusted (X-12, multiplicative).

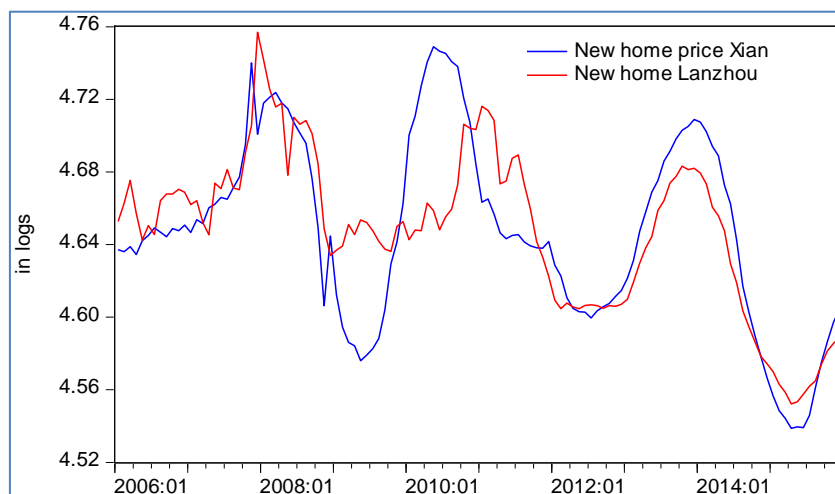


Fig-1: New house prices in Xian and Lanzhou, China (2006.01-2015.12)

EMPIRICAL RESULTS

The ADF, PP tests consistently showed that HP_LANZHOU and HP_XIAN were I(1) (Table 2). Thus, $HP_LANZHOU \sim I(1)$. $HP_XIAN \sim I(1)$. We can estimate Toda-Yamamoto levels VAR(k+1) models to test for non-Granger causality (Table 3 and Table 4).

Table 5 reports the results of Granger causality based on the estimated VARs. At the 1% level, we rejected all the null hypothesis of non-Granger causality. Thus, HP_LANZHOU Granger caused HP_XIAN and vice versa, indicating that a feedback effect exists between two home markets.

Table-2: The unit root tests

Log variable	Methods	k	Level	k	First dif.
HP_XIAN	ADF	12	-1.33	12	-4.15***
HP_LANZHOU		12	-1.35	11	-4.45***
HP_XIAN	PP	8	-2.43	8	-9.13***
HP_LANZHOU		4	-1.65	1	-9.11***

Notes: k is the lag length. k between 1 and 12 [11]. Tests selected k using the t-statistic for ADF tests, the Newey-West method for PP tests. Intercept only [12]. ***Significance at the 1% level.

Table-3: VAR estimation for Toda-Yamamoto testing (Dependent: HP_XIAN)

Lagged term	Coefficient	Std. Error	t-Statistic	p-value
HP_LANZHOU(-1)	0.14	0.10	1.37	0.17
HP_LANZHOU(-2)	-0.18	0.14	-1.24	0.22
HP_LANZHOU(-3)	-0.03	0.13	-0.20	0.85
HP_LANZHOU(-4)	0.23	0.13	1.81	0.07
HP_LANZHOU(-5)	-0.10	0.12	-0.82	0.42
HP_LANZHOU(-6)	0.41	0.12	3.46	0.00
HP_LANZHOU(-7)	-0.62	0.12	-5.01	0.00
HP_LANZHOU(-8)	0.36	0.14	2.53	0.01
HP_LANZHOU(-9)	-0.11	0.15	-0.72	0.47
HP_LANZHOU(-10)	-0.09	0.10	-0.94	0.35
HP_XIAN(-1)	0.80	0.11	7.51	0.00
HP_XIAN(-2)	0.03	0.16	0.19	0.85
HP_XIAN(-3)	0.29	0.15	1.90	0.06
HP_XIAN(-4)	0.09	0.13	0.71	0.48
HP_XIAN(-5)	-0.20	0.13	-1.59	0.12
HP_XIAN(-6)	-0.04	0.13	-0.27	0.79
HP_XIAN(-7)	-0.30	0.13	-2.31	0.02
HP_XIAN(-8)	0.06	0.13	0.43	0.67
HP_XIAN(-9)	-0.02	0.13	-0.12	0.91
HP_XIAN(-10)	0.07	0.11	0.64	0.52
t	0.00	0.00	-1.62	0.11
Constant	0.90	0.22	4.09	0.00

Notes: Adjusted R-squared=0.97, AIC=-6.46, F-statistic=197.5, DW=1.92.

Table-4: VAR estimation for Toda-Yamamoto testing (Dependent: HP_LANZHOU)

Lagged term	Coefficient	Std. Error	t-Statistic	p-value
HP_XIAN(-1)	0.73	0.11	6.51	0.00
HP_XIAN(-2)	-0.52	0.16	-3.19	0.00
HP_XIAN(-3)	0.06	0.16	0.35	0.72
HP_XIAN(-4)	-0.37	0.14	-2.67	0.01
HP_XIAN(-5)	0.22	0.13	1.66	0.10
HP_XIAN(-6)	-0.26	0.14	-1.93	0.06
HP_XIAN(-7)	0.28	0.14	2.05	0.04
HP_XIAN(-8)	0.18	0.14	1.34	0.19
HP_XIAN(-9)	0.00	0.14	0.01	0.99
HP_XIAN(-10)	-0.03	0.12	-0.22	0.83
HP_LANZHOU(-1)	0.99	0.11	9.32	0.00
HP_LANZHOU(-2)	-0.25	0.15	-1.67	0.10
HP_LANZHOU(-3)	0.08	0.14	0.58	0.56
HP_LANZHOU(-4)	-0.10	0.13	-0.78	0.44
HP_LANZHOU(-5)	0.03	0.13	0.21	0.83
HP_LANZHOU(-6)	0.06	0.12	0.50	0.62
HP_LANZHOU(-7)	-0.41	0.13	-3.14	0.00
HP_LANZHOU(-8)	0.50	0.15	3.36	0.00
HP_LANZHOU(-9)	-0.26	0.16	-1.64	0.11
HP_LANZHOU(-10)	-0.05	0.10	-0.46	0.64
t	0.00	0.00	-3.49	0.00
Constant	0.46	0.23	1.98	0.05

Notes: Adjusted R-squared=0.96, AIC=-6.36, F-statistic=121, DW=2.00.

Table-5: The Toda-Yamamoto Granger Causality Tests

H ₀	Wald- χ^2	DF	k	F	Adj. R ²	AIC	ARCH(8)	Ramsey(1) LR
HP_LANZHOU to HP_XIAN	654(0.00)	9	9	198	0.97	-6.46	17.6(0.02)	0.18(0.67)
HP_XIAN to HP_LANZHOU	218(0.00)	9	9	121	0.96	-6.36	2.34(0.97)	0.10(0.75)

Notes: The lag length k was selected using AIC. We preset k at two to twelve [13]. Assume that the data contained the maximal order of integration d at one, the study estimated the VAR($k+1$) system. The study estimated the Wald- $\chi^2(k)$ in order to test for H_0 (no Granger causality). DF denotes the degree of freedom. ARCH is the LM statistic for no ARCH. Ramsey denotes the Ramsey RESET F -statistic for constancy in the VAR model [14]. p-values in parentheses.

CONCLUDING REMARKS

New house prices in Xi'an and Lanzhou had indeed provided short-run dynamics to each other's markets. We attribute this to close geographical space, active trading activities, and frequent demographic movements. We found a feedback effect. We could expect that these short-run dynamics will help the formation of a long-run connection. In the short run, gaining from a home portfolio between these two cities is impossible. The Toda-Yamamoto test does not depend on the property of unit root and cointegration, although it is unable to reveal short-run elasticitic effects.

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