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Research Article

Dynamics between Chengdu and Kunming's New Home Markets

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Abstract: Chengdu and Kunming are two spatially close cities located in West China. We argue that similar macro-regulative policies, close geographical, historical, and trade ties, may not only produce significant short-run dynamics but also lead to a long-term equilibrium between housing markets in neighboring cities. This paper aims to study the interactions between Chengdu and Kunming's new home markets. Data were monthly home price indices over the period from January 2006 to December 2015. We tested for unit root using the ADF, PP, and ERS-DF-GLS tests and the Perron test. We tested for cointegration by driving the Johansen trace test. Also, we tested for weak exogeneity and Granger causality and estimated ECMs. We found a long-run relationship between Chengdu and Kunming's new home markets. Bi-directional causal effects or a feedback effect between the two markets was indicated. The short-run (in four months) elasticity of home price in Kunming relative to that in Chengdu was about 0.27. The short-run (in two months) elasticity of home price in Chengdu relative to that in Kunming was about 0.37. The short-run dynamics may have facilitated the formation of the long-run relation. Across-city portfolios are difficult to gain. Shocks like the RMB Four Trillion Investment Plan initiating from 2009 may have changed home price trends.

Keywords: Cointegration, equilibrium, new home price, market, short-run dynamic, weak exogeneity.

INTRODUCTION

Located in West China, Chengdu and Kunming are the capitals of Sichuan Province and Yunnan Province, respectively. In 2018, Chengdu and Kunming metropolitan areas had 14.76 and 5.72 million population, respectively [1]. They are geographically neighboring cities. The distance between these two cities is 650 km. By high-speed train, one can take about four hours to go between these two cities. Hence, their trade exchanges are enormous, and population movements are frequent.

The Central Government has made a similar macro-regulative housing policy for cities nationwide. Over the past four years, the critical central housing policy is that homes are built for residence but not for speculation. Policy, in general, quickly impacts new home purchasing and development activities. Literature has indicated that housing markets in different cities may affect each other [2, 3] and cross-border housing price dynamics [4]. Hence, we argue that new home markets in Chengdu and Kunming may contain short-run dynamics from one city to another. Markets may achieve equilibrium in the long run. This article mainly aims to examine the interactions between the new home markets in Chengdu and Kunming. Our study focuses on the new home markets because China's city new housing market activities have accounted for most of the housing output over the past two decades [5-7].

METHODOLOGY

We conducted cointegration tests to obtain potential long-run relations between home prices in various urban housing markets [8, 9]. The Johansen trace test applies the following vector autoregressive model (VAR):

$$\Delta y_t = \Gamma_1 \Delta y_{t-1} + \ldots + \Gamma_{k-1} \Delta y_{t-k+1} + \Pi y_{t-k} + \mu + \Phi D_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where y_t are a set of I(1) variables, μ denotes the intercept. k: lag order. D_t is the seasonal dummy. ε_t is the error term. We estimated $\boldsymbol{\Pi} = \boldsymbol{\alpha\beta}'$. The cointegration vector $\boldsymbol{\beta}$ represents the long-run relationship and $\boldsymbol{\alpha}$ reflects the short-run dynamic. By placing a zero restriction on $\boldsymbol{\alpha}$, we tested for weak exogeneity [10].

Given that variables were cointegrated, we estimated a valid linear error-correction model (ECM) between I(1) variables. We conducted the Granger causality test in estimated ECMs; Wald-χ^2 tests were applied.

We tested for unit roots using the augmented Dickey-Fuller (ADF) [11], Phillips-Perron (PP) [12], and Elliott-Rothenberg-Stock modified Dickey-Fuller tests (detrended by GLS) (ERS-DF-GLS) [13]. We tested for a structural break and thus estimated the following Perron IO Model C [14]:

$$y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \delta D(TB)_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \text{ .... } (2)$$

Under the null hypothesis of a unit root, $\alpha = 1$. The t_α-value on α (t_α^*) is used to evaluate the null hypothesis.

DATA

Data was the monthly newly-completed home price index for the period from January 2006 to December 2015. Prices were nominal indies as compared with the same month of last year. Two time series are new home prices in Chengdu (HP_CHENGDU) and new home prices in Kunming (HP_KUNMING). We collected data in NBSC [15]. We seasonally adjusted monthly series using the X-12 technique. Data were transformed into logarithms.

Data have non-zero means (Table-1). Prices between the two cities appear to move together (Figure-1). Hence, data implicitly contain constant and trend. The Jarque-Bera statistic shows that we accept the normality for HP_CHENGDU and HP_KUNMING at the 1% and 10% level, respectively.

Table-1: Statistical description for home prices

Definition	New home prices in Chengdu	New home prices in Kunming
Variable	HP_CHENGDU	HP_KUNMING
Mean	103.61	102.51
Median	104.19	102.21
Maximum	111.54	113.72
Minimum	92.72	94.93
Std. Dev.	4.96	4.32
Skewness	-0.44	-0.08
Kurtosis	2.11	2.52
Jarque-Bera	7.80	1.27
Probability	0.02	0.53

Notes: Prices are in indices as compared with the same month of the previous year. Seasonally adjusted by the X-12 (multiplicative).

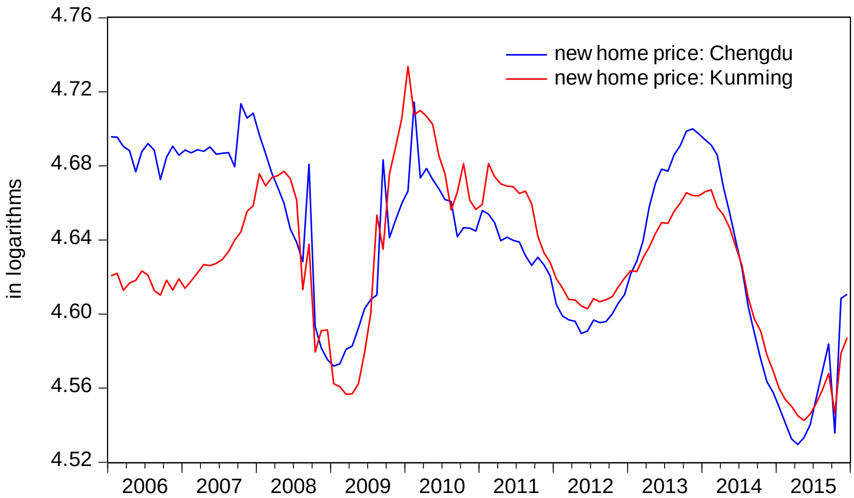

Fig-1: The log of the new home price index in Chengdu and Kunming, China (2006.01-2015.12).

EMPIRICAL RESULTS

The ADF, PP, and ERS-DF-GLS tests consistently indicated that HP_KUNMING was I(1) (Table-2), although the Perron test suggested that it contained a break occurring in August 2010, $\alpha \approx 1(0.72)$ (Table-3). Inconsistently, the ADF, PP, and ERS-DF-GLS tests indicated that HP_CHENGDU was I(0), I(1), and at least I(2), respectively. The Perron test suggested that HP_CHENGDU contained a break occurring in August 2009, $\alpha \approx 1(0.60$. We took HP_KUNMING as an I(1) variable and HP_CHENGDU as a nearly I(1) variable [16].

Table-2: The unit root tests

Log variable		k	Level	k	First dif.
HP_CHENGDU	ADF	6	-4.75***	-	-
HP_KUNMING		11	-2.45	11	-4.21***
HP_CHENGDU	PP	6	-2.77	7	-13.4***
HP_KUNMING		7	-2.56	7	-11.8***
HP_CHENGDU	ERS-DF-GLS	1	-1.91	5	-2.45
HP_KUNMING		10	-1.75	4	-2.81*

Notes: k is the lag length. Tests selected k using the t-statistic for ADF tests, the Newey-West method for PP tests, and modified for ERS-DF-GLS tests. k was set between 1 and 12 according to Ng and Perron [17]. Test equations contained both the trend and intercept [16]. ***Significance at the 1% level.

Table-3: The break-date tests (The Perron Model C)

Log variable	k	α	Std. error	t_α^*	p-value	T_b
HP_CHENGDU	11	0.60	0.08	7.42	0.00	Aug 2009
HP_KUNMING	11	0.72	0.08	9.22	0.00	Aug 2010

Note: We report α only for space reduction. T_b was the break date. The lag order k was chosen between 2 and 12 according to [17]. The critical values for the sample size of 100 were −6.21, −5.55, and −5.25 at the 1%, 5%, and 10% level, respectively [14].

Table-4: Engle-Granger tests

Dependent variable	Z_α-statistic	p-value
HP_CHENGDU	-8.03	0.57
HP_KUNMING	-10.9	0.35

Notes: Data are transformed into logarithms and in first differences. We selected the lag order k using the t-statistic [18]. The selection was made from a maximum value of 10 downwards. Tests were at the 5% level p-values in [19].

Table-5: Johansen Cointegration Tests

r	k	Trace	O-L*	Reinsel-Ahn**
0	4	28.17	20.26	25.35
≤1		4.75	9.16	4.28

Notes: r is the null hypothesis of the cointegration rank of at most r. Assumption: II. *5% Osterwald-Lenum asymptotical critical values [20]. **Reinsel-Ahn finite-sample trace corrections [21]. The lag order was selected by AIC = -11.5, and SIC = -10.9. LM statistic up to the lag order 1 for no serial correlation = 5.96, with a p-value of 0.20. Multivariate normality (Jarque-Bera) = 111, with a p-value of 0.00 [22].

Engle-Granger tests suggested no cointegration (Table-4). Asymptotically, trace tests suggested one cointegration relation at the 5% level (Table-5). Also, Reinsel-Ahn trace corrections suggested one cointegration relation. Hence, we suggest that there is a cointegrating vector.

The normalized cointegrating vector **β** is:

$$\boldsymbol{\beta} = \log(\text{HP\_CHENGDU}) + \underset{(2.26)}{10.2}\log(\text{HP\_KUNMING}) - \underset{(10.5)}{51.9}t \quad \text{.................... (3)}$$

Where t-statistics are in parentheses.

However, at the 1% level, we rejected the null hypothesis of weak exogeneity for both HP_CHENGDU and HP_KUNMING (Table-6). Thus, home prices in Chengdu and home prices in Kunming did not influence each other in the long run.

In the short run, home prices in Chengdu and Kunming Granger caused each other (Table-7). We estimated ECMs (Table-8). We suggest that the short-run (in about four months) elasticity of home prices in Kunming relative to home prices in Chengdu was about 0.27. The short-run (in about two months) elasticity of home prices Chengdu in relative to home prices in Kunming was about 0.37.

Table-6: Weak exogeneity tests

Log variable	H_0: $\boldsymbol{\alpha} = 0$	Wald-χ^2	p-value
HP_CHENGDU	$\alpha_{11} = 0$	11.2	0.00
HP_KUNMING	$\alpha_{21} = 0$	12.9	0.00

Notes: $\boldsymbol{\alpha}$ was defined by $\Pi = \boldsymbol{\alpha\beta}'$. $\boldsymbol{\beta}$ was the cointegration vector [9]. p-values were estimated based on [10].

Table-7: Granger Causality Tests

H_0	Wald-χ^2	p-value
HP_KUNMING to HP_CHENGDU	24.4	0.00
HP_CHENGDU to HP_KUNMING	19.1	0.00

Notes: Tests were conducted estimated ECMs.

Table-8: Estimates of Error-correction Models (ECMs)

	Dependent var.:	HP_CHENGDU	HP_KUNMING
Error-correction	Lagged term	-0.01(-3.70)	-0.01(-3.99)
HP_CHENGDU	1	-0.49(-3.70)	-0.02(-0.35)
HP_CHENGDU	2	-0.14(-1.25)	0.08(1.07)
HP_CHENGDU	3	0.01(0.10)	0.29(3.69)
HP_CHENGDU	4	0.01(0.12)	0.24(3.32)
HP_KUNMING	1	0.35(2.69)	-0.22(-2.35)
HP_KUNMING	2	0.39(2.96)	0.30(3.22)
HP_KUNMING	3	0.40(2.82)	0.30(2.99)
HP_KUNMING	4	0.27(1.92)	-0.002(-0.02)
Adj. R^2		0.25	0.35
F-statistic		5.82	8.77
AIC		-5.38	-6.08

Notes: t-statistics in parentheses.

CONCLUDING REMARKS

We found a long-run relationship between Chengdu and Kunming's new home markets. We attribute this to common macro-regulative policies made by the Central Government. Sichuan and Yunnan provinces are geographically adjacent. Chengdu and Kunming are their respective capitals. Two cities may tend to imitate each other in housing development and market management. Buyers may make purchasing decisions by comparing two close markets. Inter-city shuttling by high-speed trains is easy. Thus, we found bi-directional causal effects or a feedback effect between these two home markets. These short-run dynamics can facilitate the formation of a long-run relation. In the long run, home investors may not benefit from housing diversification between these two metropolises. In other words, a portfolio that simultaneously includes homes in both cities is difficult to gain. Investors can use the Chengdu new home market to forecast that of Kunming in the short run, and vice versa.

Interestingly, we found that both markets had a structural shift occurring around 2009. We may attribute this to the Great Wenchuan Earthquake in May 2008 and the RMB Four Trillion Investment Plan initiating from 2009. Shocks like significant events may have changed home price trends.

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