ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 8, Issue 4, pp: (62-67), Month: October - December 2020, Available at: www.researchpublish.com

# The effect of Geographical Space and Policy Shocks on Urban House Prices

Gao- lu Zou

College of Tourism, Economic, and Culture, Chengdu University, Chengdu, China

***Abstract:*** **Located in Southwest China, Guiyang and Chengdu are two spatially close cities. Hence, their housing markets may move together due to similar macro-regulative policies, short geographical distance, and close trade ties. This paper tested for structural breaks and long-run equilibria for the new housing markets in Guiyang and Chengdu. Data were monthly house price indices over the period from January 2007 to December 2018. We conducted ADF, PP tests, and Perron tests (Model C). Cointegration tests used the Engle-Granger and Johansen methods. We found a long-run relationship, which may be attributed to busy business exchanges and frequent population migration. Guiyang's home prices were weakly exogenous. In the long run, the 1% change in the price in Guiyang leads to a 0.43% growth in Chengdu. A uni-directional causal effect was suggested running from Chengdu to Guiyang. In the short run, the 1% change in the price in Chengdu leads to a 0.16% growth in Guiyang. Both in the long and the short run, home investors may not gain from a portfolio across these two cities. Evidence shows that policy shocks can change price trends.**

***Keywords:*** **House price, long run, market, dynamic, Granger causality, ECM model.**

## I. INTRODUCTION

Located in Southwest China, Guiyang and Chengdu are the capitals of Guizhou Province and Sichuan Province, respectively. The distance between these two cities is 520 km. One can take a high-speed train to shuttle between these two cities, three hours are taken. Investments in housing properties in both cities have attracted many people. However, policy shocks (risks) exist. For example, since 2015, buying homes in non-residential cities are not allowed by the Central Government. Literature shows that urban and regional housing markets impact each other [1-12]. This paper tested for structural breaks and long-run equilibria for the new housing markets in Guiyang and Chengdu.

## II. METHODS

We conducted cointegration tests to examine long-run relations between housing markets [13-17]. The Johansen test used the following vector autoregressive model (VAR):

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

We estimated $\boldsymbol{\Pi} = \boldsymbol{\alpha\beta'}$. 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-$\chi^2$ tests were applied [18-21].

We tested for unit roots using the augmented Dickey-Fuller (ADF) [22-24], Phillips-Perron (PP) [25]. We tested for a structural shift using the following Perron IO Model C [26-28]:

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

## III. DATA

Data was the monthly new commodity house price index as compared with the same of last year. for the period from January 2007 to December 2018. Two time series are new house prices in Chengdu (HP_CHENGDU) and new house prices in Guiyang (HP_GUIYANG). Data were from NBSC [29]. We seasonally adjusted monthly series using the X-13 technique. Data were in logarithms. Data have non-zero means (TABLE I) and have moved upwards over time (FIGURE I). We accepted the normality for HP_GUIYANG and HP_CHENGDU at the 10% level.

**TABLE I: STATISTICS FOR HOUSE PRICES**

| Definition | New house prices in Guiyang | New house prices in Chengdu |
|---|---|---|
| Variable | HP_GUIYANG | HP_CHENGDU |
| Mean | 4.65 | 4.63 |
| Median | 4.65 | 4.64 |
| Maximum | 4.78 | 4.72 |
| Minimum | 4.55 | 4.53 |
| Std. Dev. | 0.04 | 0.04 |
| Skewness | 0.01 | -0.28 |
| Kurtosis | 3.61 | 2.38 |
| Jarque-Bera | 2.23 | 4.20 |
| Probability | 0.33 | 0.12 |

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

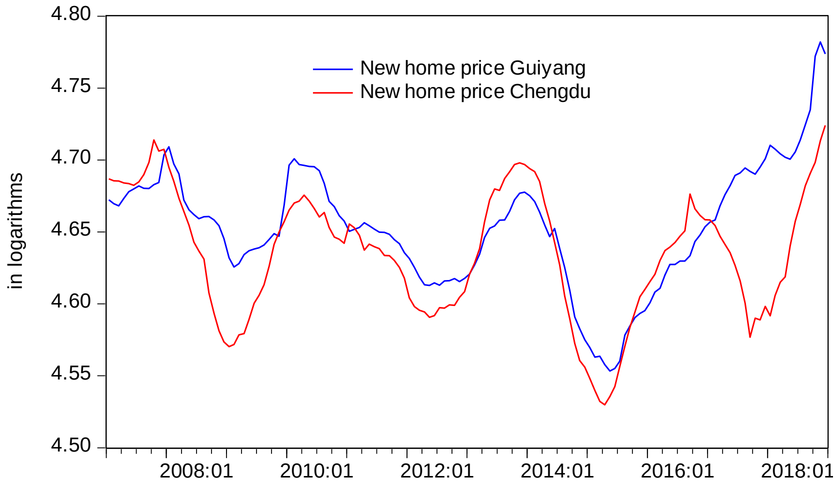


**FIGURE I: NEW HOUSE PRICES IN GUIYANG AND CHENGDU, CHINA (2007.01-2018.12)**

## IV. EMPIRICAL RESULTS

The ADF, PP tests consistently indicated that HP_CHENGDU and HP_GUIYANG were I(1) (TABLE II). They both had a shift occurring around May 2015. For HP_CHENGDU $\alpha \approx 1(0.82)$ and for HP_GUIYANG $\alpha \approx 1(0.81)$ (TABLE III). Thus, both HP_CHENGDU and HP_GUIYANG ~ I(1).

**TABLE II: THE UNIT ROOT TESTS**

| Log variable | Methods | k | Level | k | First dif. |
|---|---|---|---|---|---|
| HP_GUIYANG | ADF | 13 | -0.89 | 12 | -3.24** |
| HP_CHENGDU | | 13 | -2.78 | 12 | -4.12*** |
| HP_GUIYANG | PP | 7 | -0.84 | 5 | -5.89*** |
| HP_CHENGDU | | 9 | -2.61 | 7 | -5.86*** |

Notes: k is the lag length. Tests selected k using the t-statistic for ADF tests, the Newey-West method for PP tests. k was set between 1 and 12 [30]. Test equations contained only intercept [31]. **Significance at the 5% level. ***Significance at the 1% level.

ISSN 2348-1218 (print)
International Journal of Interdisciplinary Research and Innovations ISSN 2348-1226 (online)
Vol. 8, Issue 4, pp: (62-67), Month: October - December 2020, Available at: www.researchpublish.com

**TABLE III: THE BREAK-DATE TESTS (THE PERRON MODEL C)**

| Log variable | k | α | $t^*_\alpha$ | $T_b$ |
|---|---|---|---|---|
| HP_GUIYANG | 9 | 0.81 | 20.9 | June 2016 |
| HP_CHENGDU | 10 | 0.82 | 26.4 | May 2015 |

Note: We report α only for space reduction. $T_b$ was the break date. The lag k was chosen between 2 and 12 according to [30]. On the last lagged term $|t| \geq 1.80$. $\lambda = 0.15$. 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 [26].

Engle-Granger tests suggested the existence of cointegration (TABLE IV). Also, the Johansen test suggested a cointegrating vector (TABLE V). Hence, HP_CHENGDU and HP_GUIYANG were cointegrated.

The normalized cointegrating vector **β** is:

$$\boldsymbol{\beta} = \log(\mathrm{HP\_GUIYANG}) - \underset{(0.39)}{2.31}\log(\mathrm{HP\_CHENGDU}) + \underset{(1.83)}{6.06}t, \quad (3)$$

where t-statistics are in parentheses.

At the 10% level, we accepted the null hypothesis of weak exogeneity for both HP_GUIYANG but rejected the null for HP_CHENGDU at the 1% level (TABLE VI). Thus, in the long run, home prices in Guiyang had influenced that of Chengdu but not vice versa. The long-run elasticity of home prices in Chengdu relative to Guiyang was 0.43 (1/2.31).

In the short run, home prices in Chengdu Granger caused Guiyang but not vice versa (TABLE VII). Based on estimated ECMs (TABLE VIII), the short-run (in about three months) elasticity of home prices in Guiyang relative to home prices in Chengdu was about 0.16.

**TABLE IV: ENGLE-GRANGER TESTS**

| Dependent variable | $Z_\alpha$-statistic | p-value |
|---|---|---|
| HP_GUIYANG | -5.11 | 0.81 |
| HP_CHENGDU | -236 | 0.00 |

Notes: Intercept and trend included. We selected the lag order k using the t-statistic [32]. The selection was made from a maximum value of 10 downwards. Tests were at the 5% level. p-values in [33].

**TABLE V: JOHANSEN COINTEGRATION TESTS**

| r | k | Trace | O-L* | Cheung-Lai** | Reinsel-Ahn*** |
|---|---|---|---|---|---|
| 0 | 4 | 21.60 | 20.26 | 21.06 | 20.25 |
| ≤1 | | 1.11 | 9.16 | 9.52 | 1.04 |

Notes: r is the null hypothesis of the cointegration rank of at most r. Assumption: II. *5% Osterwald-Lenum asymptotical critical values [34]. **Cheung-Lai finite-sample critical value corrections [35]. ***Reinsel-Ahn finite-sample trace corrections [36]. The lag order was selected by AIC and SIC. LM statistic up to the lag order 1 for no serial correlation = 8.21, with a p-value of 0.08. Multivariate normality (Jarque-Bera) = 302, with a p-value of 0.00 [37].

**TABLE VI: WEAK EXOGENEITY TESTS**

| Log variable | $H_0$: $\boldsymbol{\alpha} = 0$ | Wald-$\chi^2$ | p-value |
|---|---|---|---|
| HP_GUIYANG | $\alpha_{11} = 0$ | 0.59 | 0.44 |
| HP_CHENGDU | $\alpha_{21} = 0$ | 18.8 | 0.00 |

Notes: **α** was defined by $\Pi = \boldsymbol{\alpha\beta}'$. **β** was the cointegration vector [13]. p-values were estimated based on [38].

**TABLE VII: GRANGER CAUSALITY TESTS**

| $H_0$ | Wald-$\chi^2$ | p-value |
|---|---|---|
| HP_CHENGDU to HP_GUIYANG | 37.1 | 0.00 |
| HP_GUIYANG to HP_CHENGDU | 0.20 | 0.98 |

Notes: Tests were conducted in estimated ECMs.

**TABLE VIII: ESTIMATES OF VECTOR AUTOREGRESSIVE MODELS (ECMS)**

| Dependent: | HP_GUIYANG | HP_CHENGDU |
|---|---|---|
| ec term | 0.01[0.77] | 0.04[4.50] |
| HP_GUIYANG(-1) | 0.42(4.85) | 0.04(0.44) |
| HP_GUIYANG(-2) | -0.18(-1.92) | -0.03(-0.26) |
| HP_GUIYANG(-3) | -0.03(-0.32) | 0.01(0.09) |
| HP_CHENGDU(-1) | 0.15(2.14) | 0.38(4.61) |
| HP_CHENGDU(-2) | 0.12(1.62) | 0.36(4.07) |
| HP_CHENGDU(-3) | 0.21(2.61) | 0.14(1.55) |
| Adj. $R^2$ | 0.47 | 0.55 |
| F-statistic | 22 | 28 |

Notes: t-statistics in parentheses.

## V. CONCLUDING REMARKS

New house prices in Guiyang and Chengdu were cointegrated. We attribute this to similar macro-regulative policies, particularly those made by the Central Government. Guizhou and Sichuan provinces are neighbors. Guiyang and Chengdu are their respective capitals. Due to fast shuttling, consumers are able to make purchasing decisions by comparison between cities. Thus, we found a causal effect from Chengdu to Guiyang. Short-run dynamics can help the formation of long-run connections. In the long or the short run, home investors may not benefit from housing geographical diversification. Investors can use the Chengdu new home market to forecast that of Guiyang in the short run but not vice versa.

Interestingly, we found that both markets had a structural shift occurring around May 2015. We may attribute this to a new housing policy that has not allowed home purchasing in non-residential cities. State Council has enacted the policy since 2015. Thus, a policy shock may have changed price trends.

## REFERENCES

[1] S. A. Gabriel, Mattey J. P., Wascher W. L., "House Price Differentials and Dynamics: Evidence from the Los Angeles and San Francisco." Economic Review, vol. no. 1, pp. 3-22, 1999.

[2] L. T. He, Winder R. C., "Price Causality between Adjacent Housing Markets within a Metropolitan Area: A Case Study." J. Real Estate Portfol. Manage., vol. 5, no. 1, pp. 47, 1999.

[3] S. Stevenson, "House Price Diffusion and Inter-Regional and Cross-Border House Price Dynamics." J. Prop. Res., vol. 21, no. 4, pp. 301-320, 2004.

[4] C.-C. Lee, Chien M.-S., "Empirical Modelling of Regional House Prices and the Ripple Effect." Urban Studies (Sage Publications, Ltd.), vol. 48, no. 10, pp. 2029-2047, 2011.

[5] R. Cunningham, Kolet I., "Housing Market Cycles and Duration Dependence in the United States and Canada." Appl. Econ., vol. 43, no. 5, pp. 569-586, 2011.

[6] V. Mikhed, Zemčík P., "Do House Prices Reflect Fundamentals? Aggregate and Panel Data Evidence." J. Housing Econ., vol. 18, no. 2, pp. 140-149, 2009.

[7] C. Leishman, "Spatial Change and the Structure of Urban Housing Sub-Markets." Housing Stud., vol. 24, no. 5, pp. 563-585, 2009.

[8] K. S. Islam, Asami Y., "Housing Market Segmentation: A Review." Review of Urban & Regional Development Studies, vol. 21, no. 2/3, pp. 93-109, 2009.

[9] E. C. M. Hui, Ng I., "Price Discovery of Property Markets in Shenzhen and Hong Kong." Constr. Manage. Econ., vol. 27, no. 12, pp. 1175-1196, 2009.

[10] M. J. Potepan, "Explaining Intermetropolitan Variation in Housing Prices, Rents and Land Prices." Real Estate Econ., vol. 24, no. 2, pp. 219-245, 1996.

[11] G. H. Hanson, 1998. Market Potential, Increasing Returns, and Geographic Concentration, NBER Working Paper No. 6429, National Bureau of Economic Research, Cambridge Massachusetts.

[12] S. Johansen, "Estimation and Hypotheses Testing of Co-Integration Vectors in Gaussian Vector Autoregressive Models." Econometrica, vol. 59, no. 6, pp. 1551-1580, 1991.

[13] R. F. Engle, Granger C. W. J., "Cointegration and Error Correction: Representation, Estimation and Testing." Econometrica, vol. 55, no. 2, pp. 251-276, 1987.

[14] S. Johansen, "Statistical Analysis of Cointegration Vectors." J. Econ. Dynam. Control, vol. 12, no. 2-3, pp. 231-254, 1988.

[15] S. Johansen, Juselius K., "Maximum Likelihood Estimation and Inference on Cointegration--with Applications to the Demand for Money." Oxford Bull. Econ. Statist., vol. 52, no. 2, pp. 169-210, 1990.

[16] S. Johansen, Likelihood-Based Inference in Cointegrated Vector Autoregressive Models, first ed., Oxford: Oxford University Press, 1995.

[17] C. W. J. Granger, "Testing for Causality." J. Econ. Dynam. Control, vol. 2, no. 4, pp. 329-352, 1980.

[18] J. Geweke, Meese R., Dent W., "Comparing Alternative Tests of Causality in Temporal Systems: Analytic Results and Experimental Evidence." J. Econometrics, vol. 21, no. 2, pp. 161-194, 1983.

[19] C. W. J. Granger, "Some Recent Developments in a Concept of Causality." J. Econometrics, vol. 39, no. 1-2, pp. 199-211, 1988.

[20] C. W. J. Granger, "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods." Econometrica, vol. 37, no. 3, pp. 424-438, 1969.

[21] D. A. Dickey, Fuller W. A., "Distribution of the Estimators for Autoregressive Time Series with a Unit Root." J. Amer. Stat. Assoc., vol. 74, no. 386, pp. 427-431, 1979.

[22] D. A. Dickey, Hasza D. P., Fuller W. A., "Testing for Unit Roots in Seasonal Time Series." J. Amer. Stat. Assoc., vol. 79, no. 386, pp. 355-365, 1984.

[23] S. R. Cunningham, "Unit Root Testing: A Critique from Chaos Theory." Rev. Finan. Econ., vol. 3, no. 1/2, pp. 1, 1993.

[24] P. C. B. Phillips, Perron P., "Testing for a Unit Root in Time Series Regression." Biometrika, vol. 75, no. 2, pp. 335-346, 1988.

[25] P. Perron, "Further Evidence on Breaking Trend Functions in Macroeconomic Variables." J. Econometrics, vol. 80, no. 2, pp. 355-385, 1997.

[26] P. Perron, "The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis." Econometrica, vol. 57, no. 6, pp. 1361-1401, 1989.

[27] E. Zivot, Andrews D. W. K., "Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis." J. Bus. Econ. Statist., vol. 10, no. 3, pp. 251-270, 1992.

[28] NBSC. National Data: Monthly Data - House Price Indices for Seventy Cities. Available online: //data.stats.gov.cn/ easyquery.htm?cn=E0104&zb=A0108&reg=610100&sj=202010 (accessed on 7 January, 2020).

[29] S. Ng, Perron P., "Lag Length Selection and the Construction of Unit Root Tests with Good Size and Power." Econometrica, vol. 69, no. 6, pp. 1519-1554, 2001.

[30] D. F. Hendry, Juselius K., "Explaining Cointegration Analysis: Part I." Energy J., vol. 21, no. 1, pp. 1-42, 2000.

[31] S. Ng, Perron P., "Unit Root Tests in Arma Models with Data Dependent Methods for the Selection of the Truncation Lag." J. Amer. Stat. Assoc., vol. 90, no. 429, pp. 268-281, 1995.

[32] J. G. MacKinnon, "Numerical Distribution Functions for Unit Root and Cointegration Tests." J. Appl. Econometrics, vol. 11, no. 6, pp. 601-618, 1996.

[33] M. Osterwald-Lenum, "A Note with Quantiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics." Oxford Bull. Econ. Statist., vol. 54, no. 3, pp. 461-472, 1992.

[34] Y.-W. Cheung, Lai K. S., "Finite-Sample Sizes of Johansen's Likelihood Ratio Tests for Cointegration." Oxford Bull. Econ. Statist., vol. 55, no. 3, pp. 313-328, 1993.

[35] G. C. Reinsel, Ahn S. K., "Vector Autoregressive Models with Unit Roots and Reduced Rank Structure: Estimation. Likelihood Ratio Test, and Forecasting." J. Time Ser. Anal., vol. 13, no. 4, pp. 353-375, 1992.

[36] J. A. Doornik, Hansen H., "An Omnibus Test for Univariate and Multivariate Normality." Oxford Bull. Econ. Statist., vol. 70, no. s1, pp. 927-939, 2008.

[37] S. Johansen, "Testing Weak Exogeneity and the Order of Cointegration in Uk Money Demand Data." J. Pol. Modelling, vol. 14, no. 3, pp. 313-334, 1992.