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Interactions between the New Housing Market and the Existing Housing Market in Lanzhou, China

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Abstract: **This article finds a unit root for both new home and old home prices. Tested by a residual-based technique and a multivariate trace test, these two categories of house prices appear to converge in the long run. New house prices are a weakly exogenous variable. The long-run elasticity of old home prices relative to new home prices is 0.72. There is a feedback mechanism between the two differential markets. The short-run elasticity of old home prices relative to new house prices is about -0.40. The short-run elasticity of new home prices relative to old house prices is 0.76. Both the new and old housing markets may contain a bubble.**

Keywords: **Housing assets, price, long run, short run, bubble, new home, weak exogeneity.**

I. INTRODUCTION

Lanzhou is the capital of Gansu Province in China. Lanzhou is a quickly growing business city in Gansu and even in West China. In 2017, it had a land area of 13,085.6 square kilometers, accounting for 2.88% of Gansu's total. It had a resident population of 3.26 million, accounting for 12.40% of Gansu's total. The aggregate GDP reached RMB 252.4 billion (about 36.05 billion US dollars), accounting for 33.83% of Gansu's total [1], [2].

Real estate developments have been expanded over time; particularly new housing assets have dominated the market. With accumulating housing stock, new home and old home markets interact, implying more complicated macroeconomic settings than usual faced with by regulators. Taking Lanzhou for an example, this paper examines the short- and long-run effects between these two sub-housing markets.

II. METHODS

This paper drove Engle-Granger tests [3] and Johansen tests [4]. Cheung-Lai [5] and Reinsel-Ahn [6] finite-sample corrections were taken into account.

Unit root tests include ADF [7], PP [8], DF-ERS [9], and the Zivot-Andrews break-point test [10].

An ECM was estimated [3]. Long-run and short-run elasticities were estimated. Weak exogeneity [11] and Granger causality tests [12] were performed.

III. DATA

House prices in Lanzhou include existing home prices (*EHP*) and new commodity home prices (*NHP*). Monthly data are for the 2011-2015 period. Prices are index changes as compared with the same month of last year [1, 2, 13].

Data were seasonally adjusted using the X-12 multiplicative method. Log data was used. Table 1 presents the data statistics. Fig.1. displays that intercepts linear trends may exist in the data.

TABLE I: DESCRIPTIVE STATISTICS FOR THE RAW DATA

	EHP	*NHP*
Mean	103.0950	102.0083
Median	103.2500	102.4500
Max	110.0000	107.4000
Min	96.80000	94.90000
Std. Dev.	3.944162	3.642838
Skewness	-0.007625	-0.506845
Kurtosis	1.913270	2.172746
Jarque-Bera	2.953034	4.279794
p-value	0.228432	0.117667
Period	Jan 2011-Dec 2015	
Observation	60	

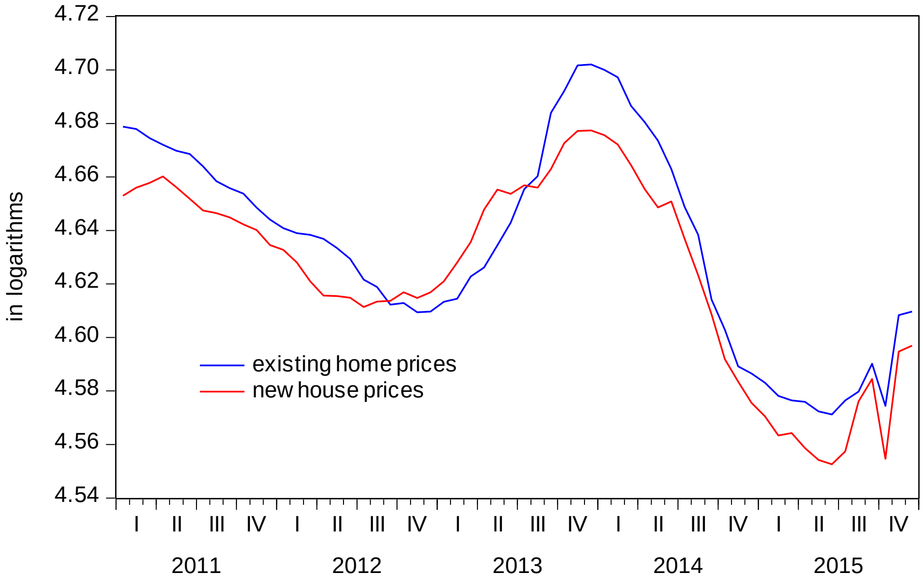

FIG. 1. MONTHLY CHANGES IN HOME PRICES IN LANZHOU, CHINA

IV. EMPIRICAL RESULTS

4.1. Unit Root

ADF and PP tests suggested a unit root for *EHP*, whereas DF-ERS tests suggested no unit roots for *EHP*. While there existed a structural break in *EHP*, $\alpha \approx 1$ (0.90) implied a unit root. Hence, *EHP* is most likely I(1).

ADF tests suggested no unit roots for *NHP*. PP tests suggested a unit root. DF-ERS tests suggested more than one unit root for *NHP*. There wasn't a structural break in *NHP*. Hence, *EHP* is also most likely I(1).

TABLE II: THE UNIT ROOT TESTS (ADF TESTS)

Log variable	***k***	**Level**	***k***	**First difference**
EHP	10	-2.09	9	-3.33*
NHP	9	-5.17***	-	-

Notes: All tests encompass an intercept and a trend. The lag length *k* was decided using the *t*-test [14]. * and ***denote rejection of the null of a unit root at the levels of 10% and 1 %, respectively.

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TABLE III: THE UNIT ROOT TESTS (PP TESTS)

Log variable	*k*	Level	*k*	First difference
EHP	5	-1.76	5	-5.89***
NHP	5	-1.66	5	-7.25***

Notes: All tests encompass an intercept and a trend according to [15]. The lag *k* was decided using the Newey–West (NW) bandwidth technique [16]. ***denotes rejection of the null of a unit root at the 1% level.

TABLE IV: THE UNIT ROOT TESTS (DF-ERS TESTS)

Log Variable	*k*	Level	*k*	First difference
EHP	2	-3.24*	-	-
NHP	0	-1.21	2	-1.96

Notes: Truncation lags, *k*, were chosen using the modified Akaike information criterion (MAIC). The MAIC is suggested to dominate all other criteria [9]. Test equations contained the intercept and a trend. Critical values used are in Table 1 [17]. *denotes rejection of the null of a unit root at the 10% level.

TABLE V: THE ZIVOT-ANDREWS BREAK-DATE TEST FOR EHP

		Coefficient	Standard Error	*t*-Statistic	p-value	T_{za}
Parameter	θ	-0.007227	0.007385	-0.978647	0.3347	
	β	0.000365	0.000266	1.374422	0.1783	
	γ	-0.000318	0.000431	-0.739216	0.4648	
	α	0.902942	0.120742	7.478265	0.0000	June 2013
k=10	t-1	-0.155358	0.150831	-1.030011	0.3103	-
	t-2	0.548140	0.184294	2.974268	0.0054	
	t-3	0.279975	0.258441	1.083322	0.2863	
	t-4	0.208391	0.258419	0.806408	0.4256	
	t-5	-0.005305	0.271716	-0.019525	0.9845	
	t-6	-0.317189	0.272796	-1.162733	0.2530	
	t-7	0.119797	0.264339	0.453193	0.6533	
	t-8	0.618368	0.271523	2.277406	0.0292	
	t-9	0.044253	0.252576	0.175209	0.8620	
	t-10	-0.541823	0.254809	-2.126390	0.0408	
	Constant	0.443107	0.562956	0.787108	0.4367	
	R-squared	0.980787	Mean dependent var	4.628035		
	Adjusted R-squared	0.972876	S.D. dependent var	0.038974		
	S.E. of regression	0.006419	Akaike info criterion	-7.012403		
	Sum squared resid	0.001401	Schwarz criterion	-6.433275		
	Log-likelihood	186.8039	Hannan-Quinn criteria.	-6.792683		
	F-statistic	123.9767	Durbin-Watson stat	1.855062		

Notes: Variable was in logarithmic values. Test equations included both a linear trend and a constant. The lagged length *k* (between 2 and 10) was selected using a general-to-specific recursive method. Thus, given lagged terms of variable, $x_{(t-k)}$, *t*-statistic on $x_{(t-k)} \geq 1.80$ but the term $x_{(t-(k+1))}$ is statistically insignificant. *k* was selected backward beginning from a maximum value of 10. This method is data-dependent. The trimming fraction is 0.29. The critical values for a sample of 71 were −6.25, −5.68, and −5.38 at 1%, 5%, and 10% levels, respectively [10]. T_{za} is the possible break date selected.

TABLE VI: THE ZIVOT-ANDREWS BREAK-DATE TEST FOR *NHP*

		Coefficient	Standard Error	*t*-Statistic	p-value	T_{za}
Parameter	θ	0.011476	0.006726	1.706200	0.0966	
	β	1.54E-05	0.000239	0.064369	0.9490	
	γ	-0.001803	0.000545	-3.310434	0.0021	
	α	0.239496	0.127346	1.880662	0.0681	-
k=9	t-1	-0.017599	0.116662	-0.150850	0.8809	
	t-2	-0.004851	0.151024	-0.032119	0.9746	
	t-3	0.543107	0.238634	2.275894	0.0289	
	t-4	0.312342	0.255443	1.222744	0.2294	
	t-5	0.669377	0.290257	2.306155	0.0270	
	t-6	0.647625	0.285040	2.272049	0.0292	
	t-7	0.240975	0.274404	0.878175	0.3857	
	t-8	0.909006	0.276462	3.287998	0.0023	
	t-9	0.810598	0.312027	2.597847	0.0135	
	Constant	3.525485	0.591087	5.964415	0.0000	
	R-squared	0.976151	Mean dependent var	4.618982		
	Adjusted R-squared	0.967539	S.D. dependent var	0.037154		
	S.E. of regression	0.006694	Akaike info criterion	-6.943705		
	Sum squared resid	0.001613	Schwarz criterion	-6.408338		
	Log-likelihood	187.5926	Hannan-Quinn criteria.	-6.739834		
	F-statistic	113.3453	Durbin-Watson stat	2.125031		

Notes: The same as those in Table 5.

4.2. Cointegration

Engle-Granger tests suggested that variables may be cointegrated. Allowing for Cheung-Lai finite-sample corrections, the Johansen test suggested a cointegrating vector. However, allowing for Reinsel-Ahn finite-sample corrections, the Johansen test suggested no cointegrating vector. Taking all these tests into account, *NHP* and *EHP* are cointegrated. The normalized cointegration vector is

$$EHP = \underset{(0.09)}{0.72}\,NHP - \underset{(0.00)}{0.0003}$$

The adjustment coefficient for *EHP* is -0.32. The adjustment coefficient for *NHP* is -0.27. Hence, both variables need to be adjusted downwards, which implied a price bubble.

TABLE VII: ENGLE-GRANGER TESTS

Dependent variable	Z_α-statistic	p-value
NHP	−20.29	0.04
EHP	−15.52	0.13

Notes: Variables were in logarithms and first differences. Tests contained an intercept and a trend. Lags were chosen based on a t-statistic. p-values are provided in [18].

TABLE VIII: JOHANSEN COINTEGRATION TRACE TESTS

r	*k*	Eigenvalue	Trace	O-L*	C&L**	Reinsel-Ahn***
0	3	0.36	30.14	25.87	28.45	25.62
≤1		0.09	5.55	12.52	13.76	4.71

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Notes: *r* is the null hypothesis of the cointegration rank of at most *r*. Models I, II, III, IV, and V are proposed for the trace statistic [4, 19]. We chose Model IV [20]. *5% Osterwald-Lenum asymptotical critical values [21]. **5% Cheung-Lai finite-sample critical values [5]. ***Reinsel-Ahn finite-sample trace corrections [6]. The lag length *k* was selected by reducing the Akaike information criterion (AIC) to the extent possible.

4.3 Weak exogeneity

For α_{11}=0, LR=18.67 with a p-value of 0.00, which rejected the weak exogeneity of *EHP* at the 1% level. For α_{21}=0, LR=7.52 with a p-value of 0.01, which implies we can accept the weak exogeneity of variable *NHP* at the 1% level.

4.4 Estimation of ECM

Having the cointegrating vector detected built into the first-differenced VAR, we estimated an ECM (Table 9). Regarding the short-run effect of *NHP* on *EHP*, the estimates on the first and second terms are significant (*t* statistics = -2.43, -3.29). Regarding the short-run effect of *EHP* on *NHP*, the estimate on the second term is significant (*t* statistic = 3.35). Since *EHP* and *NHP* Granger caused each other, the short-run elasticity of old home prices relative to new house prices is about -0.40. The short-run elasticity of new home prices relative to old house prices is 0.76.

ECM estimates would be used to test for Granger causality.

TABLE IX: ECM ESTIMATES

		Estimate	*t*-statistic	Estimate	*t*-statistic
Error-correction term$_{t-1}$		-0.32	-5.08	-0.27	-2.97
	Lagged term	*EHP*		*NHP*	
EHP	t − 1	0.09	0.47	0.04	0.18
	t − 2	0.97	5.96	0.76	3.35
	t − 3	0.46	2.06	0.30	0.94
NHP	t − 1	-0.34	-2.43	-0.32	-1.61
	t − 2	-0.53	-3.29	-0.60	-2.62
	t − 3	0.10	0.58	0.34	1.41
Constant	-3.68	0.00	0.34	-0.00	-0.21
R-squared	0.67				
Adj. *R*-squared	0.62				
F-statistic	13.80				
Akaike AIC	-7.41				

4.5. Granger causality

By excluding lagged *NHP* variables, χ^2 is 16.21 with a p-value of 0.001, which suggests Granger causality from new home prices to old home prices. By excluding lagged *EHP* variables, χ^2 is 13.92 with a p-value of 0.003, which suggests Granger causality from old home prices to new home prices.

V. CONCLUDING REMARKS

This study proposes a cointegrating relationship between new commodity home prices and existing home prices in Lanzhou, Gansu Province, China. In the long run, they tend to move together. New house prices are weakly exogenous and so impacted old home prices in the long run. The long-run elasticity of old home prices relative to new home prices is 0.72.

Both of the adjustment coefficients for the cointegrating vector are negative. Hence, new commodity home prices, as well as existing home prices in Lanzhou, may contain a bubble.

In the short run, this study suggests a feedback relationship; new home and old home prices lead each other. The short-run elasticity of old home prices relative to new house prices is about -0.40. The short-run elasticity of new home prices relative to old house prices is 0.76.

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