Estimating Causal Relationship between Property Price and Rental Price for Hong Kong

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Abstract. Using annual data, this study aim to investigate the causal relationship between sale price and rental price of residential property in Hong Kong over the period 1980-2011.The cointegration test used is the Autoregressive distributed lagged (ARDL) cointegration approach of Pesaran et al. (2001) that based on the estimation of an unrestricted error correction model (UECM) and the causality test is based on Granger et al. (2000). Two different hypotheses are put forward for empirical investigation in this study: 1) residential property prices and rentals are correlated and linked together and 2) residential prices and rentals are not correlated because of market segmentation. The ARDL cointegration results provide strong evidence to support the hypothesis that residential property price and rental price are cointegrated. However, the causality results suggest that there is no evidence of long-run causality from property price to rental price and vice versa for all markets at 95% level. The Granger et al. (2000) causality results support the view of the market segmentation hypothesis that property price has no lead effect on rental price for all residential property markets.

Keywords: ARDL Cointegration, Causality, Property Price, Rentals

1. Introduction

The causal relations between sale price and rental price on property markets have long been a primary financial concern of investor. There are two alternative hypothesis had put forward for empirical analysis in the literature. The first hypothesis is based on the view that both rental and sales markets have the same underlying asset and it is generally believed that these two markets should be closely related (Rosen, 1979). A second hypothesis is that the sales and rental markets are not correlated. An obvious supporting argument is that of market segmentation as different players with different characteristics participate in two completely different markets (Straszheim, 1978). The causal relationships between sale market and rental markets had been studied since 1970s. However, earlier studies, such as Straszheim (1978) and Rosen (1979) traditionally used data from the developed economies because quality data are only available for relatively long periods. Until the mid-1990s, Cheung, Tsang and Mak (1995) had examined the causal relationship between property sale price changes and rental price change in the Hong Kong residential property markets. Using quarterly data, CTM (1995) found that causal relationship are not found in 29 out of 40 cases and support the market segmentation hypothesis. In another study, Lu and So (1999) found the causal relationships between rental markets and property markets in Taipei and support the first hypothesis that two markets are linked together. Motivated by the conflicting results of previous studies, this research aims to re-examine causal relationship between the sales price and rental price of residential properties with various residential property size categories in Hong Kong over the period of 1980-2011.

2. Research Methods and Data

2.1. Pesaran ARDL Cointegartion Model and the Data

The annual data series on residential property price and residential rental price were extracted from the Hong Kong property review and the Hong Kong monthly digest of statistics. The estimation period covers a period of 32 years from 1980 to 2011. The four categories of private residential units are classified according to sizes; from the smallest class (U40) to largest class (O100), representing floor areas of 39.9 m^2 and below (U40), 40.0 to 69.9 m^2 (U69), 70.0 to 99.9 m^2 (U99), 100 m^2 and over (O100), respectively. Given the disaggregated data set, it is possible for us to perform submarket tests across the different size categories. In contrast to the traditional Engle-Granger approach and Johansen cointegration approach which have been widely applied in the empirical literature, the Pesaran et al. (2001) cointegration approach has not been

applied in any property price and rental price cointegration study for Hong Kong. Since this research use annual data to examine the long term relationship between property price and rental price, the Pesaran test is very useful in this annual data study that cannot employ traditional cointegration approaches due to a small sample size.

$$DY_t = a_0 + a_1 time + \sum_{i=1}^{K} b_i DY_{t-i} + \sum_{i=0}^{K} d_i DX_{1t-i} + + g_1 Y_{t-1} + g_2 X_{1t-1} + \mu_t \quad (1)$$

An unrestricted error correction model (UECM) is constructed to test for the existence of a long-run relationship in equation 1, where Y is the dependent variable, the X is independent variable and all variables in logarithm, K is the number of lags, and D represents the differences. The intercept and time trend may be added to UECM based on the empirical results in equation 1. The maximum number of lags (k) is 3 due to the limited sample size of 32 in this study. We then use bounds testing approach to examine for the presence of a long-run relationship between property price and rental price using two separate statistics. Firstly, we use the F-statistics to determine the significance of the lagged levels of the included variables in the underlying autoregressive distributed lag model in Equation 1. The Pesaran approach gives two sets of critical values, one set assuming that all the underlying variables are I(0), and the second set assuming that all underlying variables are either I(0), or I(1). For each application, this provides a band covering all the possible classifications of the variables into I(0) and I(1). The second test is a t-test on the lagged level dependent variable. The statistics have a non-standard distribution and depend on whether the variables are individually I(0) or I(1).

2.2. Estimation Procedures of Causality Models

After testing for the existences of cointegrating relationship, the Pesaran ECM is then estimated to perform Granger non-causality tests as noted by Granger et al. (2000). If the cointegration relationship is established in equation 1, we may adopt the bivariate VAR model to test the Granger causality by including the error correction term (ECT) in Eq. (2) and Eq. (3). Adding the error correction term into Eq. (2) and (3) and where y_{1t} and y_{2t} denote rental price and property price, the causality model is specified in equation 2 and 3. We are able to examine the potential short-term causality and long-term equilibrium relations with equation 2 and 3. If cointegration exists between Y_{1t} and Y_{2t}, an error correction term is required in testing Granger causality as shown below in equation 2 and 3. According to Engle and Granger (1987), the existence of the cointegration implies a long-term causality among the set of variables as manifested by [A1] + [A2] = 0 in which A1 and A2 denotes the speed of adjustment in equation 2 and 3.

$$DY_{1t} = d_0 + A1ECT + \sum_{i=1}^{K} d_{1i} DY_{1t-i} + \sum_{i=1}^{K} d_{2i} DY_{2t-i} + \mu_{2t} \quad (2)$$

$$DY_{2t} = d_0 + A2ECT + \sum_{i=1}^{K} d_{1i} DY_{1t-i} + \sum_{i=1}^{K} d_{2i} DY_{2t-i} + \mu_{2t} \quad (3)$$

3. Empirical Results

3.1. ARDL Cointegration Results

Before conducting the ARDL cointegration tests, the conventional ADF tests are carried out to determine the order of integration of the variables. All the variables under investigation are I(1) variables at 95% level. The unit root results necessitated the use of the ARDL approach to cointegration. When the causal relationship is assumed to run from property price to rental price, the results in Table 1 indicates that the F-statistics and t-statistics of general residential property, small, medium, large and luxury size of residential properties are higher than their respective upper bound critical values of 5.73 (F-statistics) and 3.22 (t-statistics) at 95% level, respectively. The results suggest the small, medium, large, luxury residential real estate (U40, U69, U99 and O100) and aggregate residential property price are cointegrated with the rental price over the period 1980-2011. If the causal realationship is assumed to run from rental price to property price, the results of F- and t-statistics in Table 1 suggest that the rental price and property price in all markets are also cointegrated. The cointegration results suggest that there is evidence of stable long-run relationship between the variable from both direction of causality and therefore the ECM will be tested for both directions.

Table 1 Results of ARDL Cointegration tests

Asset Type	Property Price- to Rental Price		Rental Price to Property Price	
	F-Statistics	**t- Statistics**	**F-Statistics**	**t- Statistics**
Residential property (overall)	11.6739(1+T)**	-4.7814(1+T)**	15.5872((1+T)**	-5.5498((1+T)**
Small size (U40)	15.3123(1+T)**	-5.4748(1+T)**	11.6658 (1+T)**	-4.8174((1+T)**
Medium size (U69)	9.6385(1+T)**	-4.2423(1+T)**	15.8359 (1+T)**	-5.5044 (1+T)**
Large size (U99)	7.1893(1+T)**	-3.7068(1+T)**	11.0449(1+T)**	-4.6445(1+T)**
Luxury size (O100)	8.4968(2+T)**	-4.1223(2+T)**	10.7030(2+T)	-4.6254(2+T)**

Notes1.The upper bound limit of the critical value for the F-test is 5.73 (5%) and 4.78 (10%) and the upper bound limit of the critical value of t-test is 3.22 (5%) and 2.91 (10%). Critical values obtained from Pesaran et al. (2001) 2. ** /*Significance at the 5% and 10% level, respectively. 3. Figure in brackets indicates the numbers of lags and the time trend.

3.2. Causality Test Results

It is well understood in time series econometrics that the existence of cointegration relationship between any two variables does not prove any causality. We then carried out the Granger non-causality tests with error correction models as noted by Granger et al. (2000). Although property price found to be the long-run forcing variable to rental price for four types of property (U40, U69, U99 and O100)) and general residential property based on the ARDL cointegration tests, this is only a necessary but not sufficient condition for rejecting Granger non-causality. Hence, we have constructed the ECM, derived from the selected ARDL model based on SBC criterion, testing the significance of the coefficient of the lagged error correction term (ECT) and joint significance of the lagged differences of the explanatory variables using a Wald test. When causality is running from property price to rental price, the coefficients of the error correction terms (ECT) shown in Table 2 are not significant even at 90% level, As Granger et al. (2000) suggests that a non-significant error correction term is not an indication of long-run causality. In addition, as shown from the results of Wald test in Table 2, the joint significance of the lagged differences of explanatory variables are significant for all size of residential properties, indicating evidence of short-run causality on all residential properties.

Table 2 Granger non-causality Approach (Property price to rental price)

Asset type	**ECT (coefficients)**	**ECT(t-statistics)**	**Wald test**	$\overline{R}^2$	**LM**
Residential property (overall)	-0.1253	-1.4641	75.35**	0.73	0.7046
Small size (U40)	-0.1253	-1.4841	5.969**	0.7531	1.6878
Medium size (U69)	-0.0397	-0.5864	75.99**	0.7303	1.3842
Large size (U99)	-0.0414	-0.6286	64.52**	0.7034	0.5169
Luxury size (O100)	- 0.0234	-0.3503	11.83**	0.6064	0.509

Notes 1. The first column of ECT is the coefficient of the error correction term.2. The third column is the Chi-square (1) statistic from a Wald test on the lagged differences of the explanatory variables. Critical value (1) is 3.841 at 95% level and 6.63 at 99% level. The number of lags in the ECM is the same as in Table 1.3. LM (1) is the Lagrange Multiplier test for first order autocorrelation. Critical value Chi-square (1) is 3.841. 4. * Significance at the 90% level, and ** Significance at the 95% level.

When causality is assumed to run from rental price to property price, the coefficients on the error correction terms (ECT) shown in Table 3 are significant for small properties (U40) and overall residential properties at 90% level. In addition, the joint significance of lagged differences of explanatory variables (Wald tests) are significant for medium, large properties and general residential properties, indicating evidence of short-run causality on only medium and large properties from rental price to sale price. In summary, the Granger et al. (2000) causality results suggest that there is no evidence of long-run causality from property price to rental price and vice versa for all property markets at 95% level. This result obviously contrasts with the commonly held belief that it is the sale price lead rental price in the residential property market. The empirical results support the view of the market segmentation hypothesis that sale price has no lead effect on rental price for all property markets.

Table 3 Granger non-causality Approach (Rental price to Property price)

Asset type	**ECT (coefficients)**	**ECT (t-statistics)**	**Wald test**	$\overline{R}^2$	**LM**
Residential property(overall)	-0.1640	-1.8023*	71.25**	0.73	0.7046
Small size apartment (U40)	-0.1647	-1.8735*	1.0693	0.7204	2.008
Medium size apartment (U69)	-0.0945	-1.2281	60.66**	0.7418	0.536
Large size apartment (U99)	-0.0742	-1.0493	68.63**	0.7107	0.2632
Luxury size apartment (O100)	-0.0866	**-1.0888**	**0.24512**	**0.5684**	**0.031**

Notes. 1. The first column of ECT is the coefficient of the error correction term.2. The third column is the Chi-square (1) statistic from a Wald test on the lagged differences of the explanatory variables. Critical value (1) is 3.841 at 95% level. The number of lags in the ECM is the same as in Table 1. 3. LM (1) is the Lagrange Multiplier test for first order autocorrelation. Critical value Chi-square (1) is 3.841. 4. * Significance at the 90% level, and ** Significance at the 95% level.

4. Conclusion

This paper investigated the nature of the causal relationship between property price and rental price. The causality results in this study suggest that the two estate markets are not linked together. This result obviously contrasts with the commonly held belief that it is the price changes which lead rental movements. As we hypothesized, the phenomenon may have been a consequence of market segmentation. Further research should be considered for the cointegration and causality analysis of business real estate, such as offices, shops, factory and hotel.

5. References

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