A Bivariate Causality between Economic Growth and Property Price: Hong Kong Evidence

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***Abstract*—This study aims to investigate the cointegration and causality relationships between gross domestic product and property price in Hong Kong from 1980 to 2017. In contrast to other studies, the cointegration test used is the autoregressive distributed lagged (ARDL) cointegration (bounds testing) approach of Pesaran that based on the estimation of an unrestricted error correction model (UECM) and the causality test is based on non- causality test of Granger. The selection of Pesaran cointegration approaches instead of Johansen approaches address the problem of how to use a relatively small sample data to estimate the long-term relationship and the direction of causality between gross domestic product and property price that faced by many researchers in estimating the cointegrating relationships between gross domestic product and property price. The results of ARDL cointegration tests running from gross domestic product to residential and office property markets and vice versa provide strong evidence to support the hypothesis that the gross domestic product and residential and office properties are cointegrated. The results of Granger non causality test support to the view of wealth and collateral effect that property price has an important causal affect to economic growth in Hong Kong. The empirical results from cointegration and causality tests suggest that the economic growth are better predicted by including the lagged difference values of residential and office property price.**

***Index Terms*—Cointegration approach, Granger non-causality test, economic growth, property price, wealth Effect, collateral effect.**

I. Introduction

The causal relationships between property prices and economic growth has long been the subject of substantial debate in both the academic and practitioner. Despite the wide attention that the subject of asset price and consumption has received in the financial economics literature, until recently there have been only few studies for the subject of property price and economic growth. There are three main reasons to select the property markets in Hong Kong. Hong Kong is one of the major international financial center and business hubs in the World that have made Hong Kong, one of the most attractive places for both China and international investors. Second, the property markets in Hong Kong are one of the most dynamic and expensive markets in the World. Third and the most unique reason, the adoption of quantity easing program by the developed economies of United States, United Kingdom, European Union and Japan since 2008 provides an ideal background for re-examining the relationships between economic growth and property price in the emerging economies. Since the adoption the first United States quantity easing program in 2009, the Hong Kong residential property price and stock price increased by 275% and 175% (2009-2017), respectively. The objective of this empirical analysis is twofold. The first is to determine whether the gross domestic product (measures on economic growth) and property prices are cointegrated and linked together or both markets are segmented. The second is to explore the lead lag relationships and the possibility of feedback causality between gross domestic product and property prices, if both variables are cointegrated. With regard to the influence of GDP on property prices, it is reasonable to expect that an improvement in the performance of an economy would raise wage and profits and generate higher demand for residential and office properties. More importantly, as illustrated by Tsatsaronis and Zhu (2004) [1] that GDP would summarize the information contained in other macroeconomic factors which affect home buyers' purchasing power, such as unemployment rate and household income. Assuming the supply is relatively fixed, the sale price of residential and office properties will go up when GDP is rising. It is therefore hypothesized that GDP have a positive relationship with property prices. For the influence of property price and GDP, it is reasonable to assume the wealth effect hypothesis and credit price effect (collateral) hypothesis on property price and GDP relationships. Strong property price tends to stimulate wealth, which the strong wealth effect in turn support further economic growth. Alternatively, it is hypothesized that the credit-price hypothesis tends to suggest a causation from property prices to gross domestic product and admits the possibility of persistent spiraling upturns in both markets. The credit-price hypothesis assumed the property assets act as collateral to especially credit-constrained firms. The increase in property prices, thus, would be favorable to the firms and household's balance-sheet position in that they may get access to lower costs of borrowing and increase economic activity. Gross domestic product can be raised by the simulated economic activity due to the rise of property asset price. Thus, the credit-price hypothesis tends to suggest a reverse causality from property prices to gross domestic product and admits the possibility of persistent spiraling upturns in both markets and thus the effect of feedback causality. This paper will structure an alternative approach of cointegration and causality analysis by incorporating the Pesaran *et al*. (2001) [2] Autoregressive Distributed Lag (ARDL) bounds testing approach and Granger *et al*. (2000) [3] causality approach. The selection of Pesaran cointegration approaches instead of Johansen (1988) [4] approaches address the problem of how to use a relatively small sample data to estimate the long-term relationship and

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the direction of causality between gross domestic product and property price that faced by many researchers in estimating the cointegrating relationships between gross domestic product and property price.

II. Literature Review

To evaluate the causal relationship between economic growth and property price, previous empirical research on this topic can be classified into two major categories: (1) Those studies focus on examining the key driving factors that cause the appreciation of residential property price. (2) Those studies focus on the study whether the economic growth and property prices are cointegrated and the predictive power (lead-lag relationships) between economic growth and property prices. Earlier studies such as Peng (2002) [5], Tsatsaronis and Zhu (2004) [1], Lorenz and Truck (2008) [6], Hoskins *et al*. (2004) [7] and Lung *et al*. (2008) [8] attempt to investigate the effect of macroeconomic factors, such as Gross domestic product, real interest rate, on the property market price. Those earlier studies focus on examining the key driving factors that cause the appreciation of residential property price. However, only a few studies exist concerning on the causal relationships and the predictive power between economic growth and property price. Until more recently, Hui and Shen (2006) [9], Hui and Ng (2009) [10], Miller *et al*. (2011) [11] and Chan and Woo (2013) [12] aim to investigate at an aggregate level, whether property prices have predictive value for economic growth or vice versa. Hoskins *et al*. (2004) [7] employed correlation models to investigate the relationship between macroeconomic factors and major international property markets. They found that the inflation, unemployment rate and GDP were considered as leading economic determinants for U.K, U.S, Australian and Canadian property markets during 1985-1999. In another study, Lorenz and Truck (2008) [6] investigated the effect of a set of macro-economic factors on various property markets in Europe. The results indicate that there are different set of significant variables affecting different markets. They found that the GDP and population growth are the most significant variables in France but for Germany the population growth and unemployment growth are the most significant variables. Turing to studies based on Hong Kong, Peng (2002) [5] investigate the effect of macroeconomic factors and other factors of supply on the change in property price in Hong Kong and found that macroeconomic factors contributed to the variation of property price. In particular, income growth and unemployment rate are the major factors affecting residential property price in Hong Kong. In another study, Lung *et al*. (2008) [8] examine the major factors that cause the appreciation of residential property price in Hong Kong in late 2007 and early 2008. The empirical results indicate that real interest rate was a key factor that affecting the property price during 1997-2003 and 2003-2005. However, the upsurge of residential property price between 2005 and 2007 was mainly affected by stock market rally and strong income growth.

Evidenced by cross-country analysis, Tsatsaronis and Zhu (2004) [1] point out that GDP could summarize the information contained in other factors which affect home buyers' purchasing power, such as unemployment rate and household income. Under China's bureaucratic system, the central leaders relate sub-national leader's political promotion to their economic performance. This incentive requires local officials to focus on boosting GDP. More capitals from financial institutions are encouraged by local governments to stimulate economic growth. Increasing economic output enhances market demand and hence property price. This imply that GDP could be the proxy for macroeconomic factors affect purchasing power of the property buyers. Regard studies on whether property prices have predictive value for economic growth or vice versa, Hui and Shen (2006) [9] compare the housing price bubbles in Beijing and Shanghai with that of Hong Kong. The results of cointegration analysis and Granger causality tests show that disposable income Granger causes housing price in Shanghai and Hong Kong, but not in Beijing. In another study, Hui and Ng (2009) [10] find that property prices in Shenzhen are mainly explained by previous property prices and personal income. One-way Granger causality from GDP to property price is found in Shenzhen. However, a bilateral causal relationship between property prices and GDP is found in Hong Kong. Moreover, Miller *et al*. (2011) [11] employ quarterly data for all 379 metropolitan areas in the U.S. from 1980:1 to 2008:2, to study the effect of local Gross Metropolitan Product (GMP) on property price. The authors compared the effects of predictable and unpredictable property price changes, which they use to capture the credit price and wealth effects of property price respectively. The estimation results found that house price changes have significant effects on GMP growth and the effect of predictable changes (the credit price effect) is about three times stronger than the effect of unpredictable changes (the wealth effect). Chan and Woo (2013) [12] examine the dynamic relationships between property prices, stock prices, and GDP in Hong Kong. The estimation results indicate that these three variables have long-run, bi-directional casual relationships and perform an error-correcting role in the system. In particular, the causality test results show the GDP growth causes long-run rises in the prices of houses and stocks. On the other hand, the results also indicate the property prices cause long-run growth in GDP. Motivated by the conflicting results of previous studies, this research aims to examine causal relationship between the gross domestic product and transaction price of commercial and residential properties in Hong Kong over the period of 1980-2016.

III. Data and Methodology

A. Data and ARDL Cointegration

This research employed time-series annual data to investigate the cointegration relationships between GDP and commercial and residential property price in Hong Kong. The data series on gross domestic product have been extracted from the estimates of gross domestic product, while the data series of residential and office property price have been collected from the property Review and the Hong Kong monthly digest of statistics. The estimation period

covers a period of 37 years from 1980 to 2016. The two categories of business and residential property markets are classified as commercial (office) and residential (apartment) markets. In contrast to the traditional Engle-Granger (1986) [13] approach and Johansen (1988) [4] cointegration approach which have been widely applied in the empirical literature, the Pesaran *et al*. (2001) [2] ARDL cointegration approach has not been applied in any causal study between economic growth and property price for Hong Kong. Since this research select annual frequency data to avoid the noise in more frequent return, the bounds testing approach is very useful in this annual data study as it cannot employ any traditional cointegration approaches due to a small sample size. 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, K is the number of lags, D represents the differences and all variables in logarithm. The intercept and time trend may be added to UECM based on the empirical results in equation

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

The maximum number of lags (k) is 3 due to the limited sample size of 37 in this study. We then use bounds testing approach to examine for the presence of a long-run cointegrating relationship between property price and economic growth using two separate statistics. Firstly, we use the F-statistics to determine the joint 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). In the first stage of the Pesaran cointegration analysis, the null hypothesis of the non-existence of a long-run relationship is investigated by testing the Equation 1 without lagged level variables. Next, a variable addition test with both differenced and level variables is performed to test the joint significance of the lagged level variables in the equation 1. In the second stage of the ARDL estimation procedures, a further two-step method is applied to estimate the relationship between economic growth and property price. In the first step, the orders of the lags for all level variables in the ARDL model are selected, using SBC or AIC criteria while ensuring there was no problem of serial correlation. In the second step, we derived the short run estimates and error correction tern (ECT) from the associated error correction models derived from the selected ARDL model. The Pesaran ECM is then estimated to perform conventional Granger non-causality test for any models with cointegration relationship

B. Estimation Procedures of Granger Et Al. (2000) [3] Non-Causality Tests

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) [3]. 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 Y1t and Y2t denote gross domestic product and residential property price or office 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 Y1t and Y2t, an error correction term is required in testing Granger causality as shown below in equation 2 and 3. According to Engle and Granger (1987) [13], 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. A Wald test will be applied to test for the joint significance of independent variables in equation 2 and 3.

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

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

IV. Empirical Results

A. 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. The results of ADF statistics indicate that all the variables under investigation are I (1) variables at 95% level. The ADF unit root tests results necessitated the use of the ARDL approach to cointegration. The ADF test results are not reported here but available on request. When the causal relationship is running from residential property price to gross domestic product, the results in Table I indicates that the F-statistics and t-statistics of residential properties (with 2 lags and 3 lags) are higher than their respective upper bound critical values of 5.73 (F-statistics) and 3.22 (t-statistics) at 95% level. Likewise, when the causal relationship is running from office property price to gross domestic product, the results in Table I indicates that the F-statistics of office properties (with 2 lags and 3 lags) are higher than their respective upper bound critical values of 5.73 (F-statistics).When the causal relationship is running from gross domestic product to residential property price and office property price, the results in Table II indicates that the F-statistics and t-statistics of residential properties (with 2 lags) are higher than their respective upper bound critical values of 5.73 (F-statistics) at 95% level. This suggests that the gross domestic product is cointegrated with residential property price and office property price, the bivariate causality tests from gross domestic product to residential property price and office price will be tested for long-run and short-run causality on residential and office market.

TABLE I: RESULTS OF ARDL COINTEGRATION TESTS (PROPERTY PRICE TO GDP GROWTH)

Asset type	F-Statistics	t- Statistics
Residential (2 lag/3lag)	12.9**/15.5**	-3.87**/-3.85**
Office (2lag/3lag)	10.52**/7.75**	-3.67**/-2.84

TABLE II: RESULTS OF ARDL COINTEGRATION TESTS (GDP GROWTH TO PROPERTY PRICE)

Asset type	F-Statistics	t- Statistics
Residential (2 lag/3lag)	8.15**/5.81**	-3.11**/-2.88
Office (2lag/3lag)	14.2**/4.61	-4.04**/-2.96*

Notes 1.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.

TABLE III: GRANGER NON-CAUSALITY APPROACH (PROPERTY PRICE TO ECONOMIC GROWTH)

Asset type	**ECT (coefficients)**	**ECT (t-statistics)**	**Wald test (W)/t tests(t)**	$\overline{R}^2$	**LM**
Residential	-0.115	**-4.59** **	6.88 ** (t test)	0.757	0.13
Offices	-0.205	**-6.979** **	2.29 (W)	0.824	0.087

TABLE IV: ECONOMIC GROWTH TO PROPERTY PRICE

Asset type	**ECT (coefficients)**	**ECT (t-statistics)**	**Wald (W)**	$\overline{R}^2$	**LM**
Residential	-0.193	-2.664**	6.887**	0.591	0.126
Offices	-0.518	-5.293 **	4.392**	0.632	0.134

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 IV. 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.

B. Causality Test Results

Although gross domestic product is found to be the long-run forcing variable to property price for residential and office market, this is only a necessary but not sufficient condition for rejecting Granger non-causality. We then conduct Granger conventional non-causality tests as noted by Granger *et al*. (2000) [3]. 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) for long-run causality, the significance of lagged differences of single explanatory variable using a t test for short-run causality, if only one lagged difference explanatory variable is selected in the final ECM model. If the ECM model select more than one lagged difference explanatory variables, the joint significance of the lagged differences of the multiple explanatory variables will be tested by a Wald test for short-run causality. When causal relationship for residential and office market is running from gross domestic product to property price for residential and office property market, the t-tests result of the error correction terms (ECT) for residential property equation and office property equation, shown in Table IV, are significant at 95% level. As Granger *et al*. (2000) [3] suggests that a significant error correction term is an indication of long-run causality. In addition, as shown from the results of Wald test in Table IV, the joint significance of the lagged differences of explanatory variables are significant at 95% level for office property market, indicating evidence of short-run causality from gross domestic product to office property. Likewise, as shown from the results of t test in Table IV, the significance of the lagged differences of explanatory variable are significant at 95% level for residential property, indicating evidence of short-run causality running from gross domestic product to residential property.

When causality is running from either residential property price to gross domestic product or office property price to gross domestic product , the coefficients on the error correction terms (ECT) shown in Table III are significant for residential and office properties at 95% level, indicating a long-run casuality. In addition, the significance of first difference of explanatory variable (t test,-6.88) for residential property are significant at 95% level, indicating evidence of short-run causality from residential property price to gross domestic product. Overall, the Granger conventional non- causality test results suggest that there is evidence of long-run causality, running from gross domestic product to residential and office property markets and the models running form sale price for residential and office property markets to gross domestic market. Further, there is evidence of long-run and short run causality running from either gross domestic market to sale price of residential or gross domestic market to office property are found at 95%. The Granger conventional non- causality test results suggest that there is evidence of long-run causality, running from either sale price for residential to gross domestic market or office property markets to gross domestic market. However, short run causality is only found on the non- causality test running from sale price for residential property to economic growth only.

V. CONCLUSION

In this study, we examine the causal relationships between gross domestic product and property price in Hong Kong. The results of ARDL cointegration (bounds testing) tests running from residential and office property price to

gross domestic product provide strong evidence to support the wealth and collateral effect hypothesis that the relationships between residential properties and gross domestic product and the office properties and the gross domestic product are cointegrated. This suggests that the residential property and office price could be a forcing variable to affect economic growth over the long run. In addition, the cointegration results running from gross domestic product to residential and office properties also suggest there is cointegration relationship between economic growth and property price. Hence, the results confirm the bilateral causal relationship between property prices and GDP in Hong Kong. The Granger non- causality results indicate there is strong evidence that grosss domestic product has a lead effect on residential and office property price in the long run and vice versa. The empirical findings of the cointegration and causality models may have strong implications for predicting residential and office property price; results from cointegration and causality tests suggest that the residential property price and office property price are better predicted by including the difference and lagged difference values of gross domestic product and the gross domestic product in Hong Kong is better predicted by including the difference of residential property price

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