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The Integration of Residential Real Estate Market and Stock Market: Assessment Using the ARDL Approach[§]

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Abstract : This paper examines the long-run and short-run relationship between residential real estate market and stock market in Malaysia during the period 1988-2004. Using the autoregressive distributed lag (ARDL) cointegration procedure gave results that suggest that the residential real estate and stock market are segmented. This would indicate that investors could diversify their portfolio by investing in the residential real estate and the stock market.

Keywords: Residential real estate market, cointegration analysis, stock market, autoregressive distributed lag

1. Introduction

This paper reports the findings of an investigation into the integration between Malaysia's residential real estate market and stock market by using Pesaran and Shin's (1995) autoregressive distributed lag (ARDL) approach to cointegration. Prior studies by Quan and Titman (1999), Ting (2002) and Wan and Md (2002) on the determinants of house prices and rental index in Malaysia were conducted by employing ordinary least squares (OLS) method. It is well documented in econometric literature that an estimate of the OLS regression model can be spurious or dubious if regressed from a non-stationary series with no long run relationship or a cointegrating relationship (Engle and Granger, 1987). This study might well be a pioneer in addressing this matter by adopting an autoregressive distributed lag cointegration procedure.

In econometric studies, two markets are said to be integrated when there is a long-term equilibrium relationship between them. If the stock and real estate markets are segmented (not cointegrated), some stock market influence can be diversified away by investing some portion of the assets into real estate market. Conversely, if the stock market and real estate market are completely integrated, they should be systematically influenced by the same

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economic factors. In this case, diversification benefits, generated from constructing a portfolio comprising stocks and real estate, would be less attractive because the rate of returns from these markets is highly correlated with each other.

The rest of this paper consists of four sections. Section 2 reviews relevant literature. The data and ARDL cointegration approach are explained in Section 3 while the empirical results are presented in Section 4. Finally, Section 5 concludes this paper and highlights the limitations of this study.

2. Review of Literature

This paper is supported by two related bodies of empirical literature. The first group involves investigation into the integration of real estate with stock markets. An early study by Liu *et al.* (1990) found evidence to support the arguments that the commercial real estate market is segmented from the stock market. Fu *et al.* (1994) also supported the notion of market segmentation put forward by Liu *et al.* (1990). By applying the causality tests of Granger (1969) to quarterly data of residential property prices in Hong Kong and the Hang Seng Index of the Hong Kong stock market, Fu *et al.* (1994) found that changes in stock prices led to changes in property prices, but not vice-versa. This indicates that there still exists some degree of segmentation as the integration is only unidirectional.

In contrast to the above segmentation findings, Ullah and Zhou (2003) adopted the cointegration test to study three housing variables for US single family homes (sales, median sales price and mortgage rate) and the New York Stock Exchange market index during the 1972 to 1999 period. They found that real estate variables and stock returns variables tend to move together in the long-run (co-integrated). In Singapore, Liow (2004) detected a long-run equilibrium relationship between stock prices and real estate prices (residential and office prices). The error correction term derived from the error correction model (ECM) implies that approximately 62 per cent of the previous discrepancy between the actual and desired stock prices is corrected in each quarter.

The second group of studies is related to *price discovery theory* between direct and indirect real estate markets. Price discovery is expected to take place in a more efficient and liquid market, that is, in an indirect real estate market. In other words, an indirect real estate investment market, with less market friction, has price discovery over direct real estate investment from which the information is then transmitted to direct real estate market.

The empirical evidence on price discovery theory is not unanimous. By employing Granger causality test on securitised (indirect real estate market) and unsecuritised (direct real estate market) commercial property market returns for both the US and UK, Barkham and Geltner (1995) found that price discovery occurred in the securitised market structure which was then transmitted to the unsecuritised market. In Hong Kong, the OLS results of Tse and Web (2000) showed a different direction where changes in direct real estate prices (residential, industrial and office markets) tend to lead indirect real estate prices (property stock prices). In Singapore, the cointegration test results of both Ong (1994) and Liow (2004) support the hypothesis of integration between property stock prices (indirect real estate prices) and direct real estate prices.

There are also a group of researchers who found that direct and indirect real estate markets are segmented. Two studies in Singapore that support the notion are by Ong[1]

(1995) and Liow (1998). Wilson *et al.* (1996), He (1998), Wilson *et al.* (1998) and Chaudhry *et al.* (1999) also concluded that there is no price discovery activity in these markets.

3. Data

The data utilised in this paper are the National Property Information Centre (NAPIC)[2] annual terraced house (TERR) and high-rise unit price (HIGH) indexes, Kuala Lumpur Composite Index (KLCI) and Kuala Lumpur Property Index (KLPI). The study period is from 1988 to 2004. The main attributes of the data are briefly described as follows:

(a) Annual data from 1988 to 2004 (17 observations) used in this study for all time series variables were adjusted to common base year of 2000. Terraced (TERR) and high-rise unit (HIGH) price indexes were obtained from *The Malaysian House Price Index* (MHPI) bulletin published by NAPIC.[3] The selection of landed and high-rise properties was based on the trade-off nature between these two types of properties in relation to investment decisions. High-rise properties generally provide investors with high rental yield but low capital appreciation, the reverse is true for landed properties. Terraced houses were used as a proxy for landed properties by virtue of the popularity of this type of property among the Malaysian house buyers. TERR represents townhouses, low-and medium-cost for one, one and a half, two-to three-storey terraced houses. HIGH, on the other hand, represents flats, apartments and condominiums.

(b) Kuala Lumpur Composite Index (KLCI), a value-weighted market-based index of 100 Malaysian companies listed on the Bursa Malaysia was used as a proxy for the local stock market. Kuala Lumpur Property Index (KLPI) that tracks the share price performance of all listed property investment and development companies on the Bursa Malaysia was used as a proxy for property stocks.

4. Method

The ARDL or bounds test approach proposed by Pesaran and Shin (1995) was employed in this paper by virtue of some of its advantages over the conventional cointegration methods (Engle-Granger 1987; Johansen and Juselius 1990). First, the ARDL approach can be applied irrespective of whether the variables are I(0) or I(1) (Pesaran and Pesaran, 1997:304). Second, given the small sample size in this study (17 observations), the Johansen-Juselius (1990) approach is not appropriate. Kremer *et al.*(1992) argued that for data with small sample size, no cointegration relation could be established among variables that are integrated to order one I(1). The ARDL has been recently applied to small sample size studies by Pattichis

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[1] By employing a structural vector autoregressive model, Ong (1994) found a long-run relationship between property stock prices and direct real estate prices. However, this result contradicted his subsequent findings in 1995, which revealed that property stock and direct real estate prices have no long-run relationships.

[2] NAPIC is under the purview of Valuation and Property Services Department of the Ministry of Finance Malaysia.

[3] The annual terraced and high-rise indexes employed in this study are weighted averages computed from the respective terraced and high-rise unit from the 14 states in Malaysia.

(1999), Mah (2000) and Tang (2001) with observations of 20, 18 and 25 respectively. Third, this approach takes a sufficient number of lags to capture the data generating process in a general-to-specific modeling framework (Laurenceson and Chai 2003).

4.1 ARDL Model Testing Procedure

The first stage of ARDL involves testing for the existence of a long-run relationship among variables in the model.

$$LNKLCI_t = \alpha + bLNTERR_t + cLNHIGH_t + \varepsilon_t \tag{1}$$

$$LNKLPI_t = \alpha + bLNTERR_t + cLNHIGH_t + \varepsilon_t \tag{2}$$

where LNKLCI, LNKLPI, LNTERR, LNHIGH are four different time series; å is a vector of stochastic error terms; and á, b and c are the parameters. For the above equation, the error correction versions of ARDL model are given as follows:

For Equation (1)

$$\begin{aligned} DKLCI_t = {} & \alpha_0 + \sum_{j=1}^{1} b_j * DKLCI_{t-j} + \sum_{j=1}^{1} c_j * DTERR_{t-j} + \sum_{j=1}^{1} d_j * DHIGH_{t-j} \\ & + z_1 * LNKLCI_{t-1} + z_2 * LNTERR_{t-1} + z_3 * LNHIGH_{t-1} + z_4 * DUMMY97 \\ & + error_t \end{aligned} \tag{3}$$

For Equation (2)

$$\begin{aligned} DKLPI_t = {} & \alpha_0 + \sum_{j=1}^{1} b_j * DKLPI_{t-j} + \sum_{j=1} c_j * DTERR_{t-j} + \sum_{j=1} d_j * DHIGH_{t-j} \\ & + z_1 * LNKLPI_{t-1} + z_2 * LNTERR_{t-1} + z_3 * LNHIGH_{t-1} + z_4 * DUMMY97 \\ & + error_t \end{aligned} \tag{4}$$

The *LN*-prefix and *D*-prefix denotes the log-transformed series and the first difference series respectively. The maximum lag numbers are set equal to one, considering the small sample size (17 observations). *DUMMY97* for equation (3) and (4) represents the structural change in the Malaysian stock market following the outbreak of 1997 financial crisis. This dummy variable takes the value of 1 during the years 1997, 1998 and 1999 and 0 otherwise.

Basically, the lagged level terms are added to an error correction form of the underlying (ARDL) model and the *F*-statistic is computed. The first part of Equations (3) and (4) with b_j, c_j and d_j represents the short-run dynamics of the model whereas the second part with z_1, z_2, z_3 and z_4 represents the long-run relationship. Pesaran *et al.*(2001) have tabulated the appropriate critical values for different numbers of regressors (*k*), and whether the ARDL model contains an intercept and/or trend. They gave two sets of critical values. One set assuming that all the variables in the ARDL model are I(0) and another set of data assuming all variables in the ARDL model are I(1). The asymptotic distribution of the *F*-statistic is non-standard under the null hypothesis of no cointegrating relationship between the examined variables, irrespective of whether the explanatory variable are purely I(0) or I(1).

The test was conducted in the following manner. The null hypothesis was tested by considering the ARDL models (Equations 3 and 4) excluding the lagged variables *LNKLCI, LNKLPI, LNTERR, LNHIGH* and *DUMMY97*. More formally, a joint significance test was performed where the null and alternative hypotheses are

$H_0: z_1 = z_2 = z_3 = z_4 = 0$
= non-existence of a long-term relationship among all variables in the ARDL model.

$H_A: z_1 \neq z_2 \neq z_3 \neq z_4 \neq 0$
= existence of a long-term relationship among all variables in the ARDL model.

If the computed F-statistic falls outside the critical value band, a conclusive decision can be made without needing to know whether the underlying variables are I(0) or I(1), or fractionally integrated. That is, if the test statistic exceeds the upper critical value, the null hypothesis of no long-run relationship can be rejected regardless of whether the underlying order of integration of variables is zero or one. Similarly, if the test statistic falls below these two bounds, the null hypothesis is accepted. If the computed statistic falls within the critical value band, the result of the inference is inconclusive and depends on whether the underlying variables are I(0) or I(1). It is at this stage that unit root tests on the variables need to be carried out.

The second stage of this analysis is to estimate long-run coefficients by using the ARDL model. This could only be executed if a long-run relationship between the variables in the model is satisfied where the F-statistic is found to be significant. The long-run co-integrating regression for Equation (1) is

$$LNKLCI_t = x_0 + y_1 * LNTERR_t + y_2 * LNHIGH_t + e_t \tag{5}$$

and for Equation (2)

$$LNKLPI_t = x_0 + y_1 * LNTERR_t + y_2 * LNHIGH_t + e_t \tag{6}$$

The lagged error correction term (e_{t-1}) derived from the error correction model (ECM) as shown below is an important element in the dynamics of cointegration systems in that it allows for an adjustment to the long-term equilibrium relationship, given a deviation in the last year. It is an estimation of the speed of convergence to long-run equilibrium.

From Equation (1)

$$DKLCI_t = \alpha_0 + \sum_{j=1}^{1} \beta_j * DTERR_{t-1} + \sum_{j=1}^{1} \delta_j * DHIGH_{t-1} + \alpha * e_{t-1} + (error)_t \tag{7}$$

From Equation (2)

$$DKLPI_t = \alpha_0 + \sum_{j=1}^{1} \beta_j * DTERR_{t-1} + \sum_{j=1}^{1} \delta_j * DHIGH_{t-1} + \alpha * e_{t-1} + (error)_t \tag{8}$$

5. Empirical Results

All the ARDL models studied in this paper passed the diagnostic tests that were automatically computed by *Microfit* except for *Jarque-Bera* test of normality. Table 1 shows the *F*-statistic results to test for the existence of a long-run relationship between variables in Equations (1) and (2). The computed *F*-statistics are in the range of 1.3282 to 1.7589 which is well below the lower bound of the critical value band of 3.219-4.378 (5 per cent significant level). Thus, we accept the H_0 that there is no long-run relationship between stock prices (KLCI and KLPI) and residential real estate prices (TERR and HIGH).

Table 1. F-Statistics for testing the existence of a long-run relationship

ARDL Model (dependent variable)	Maximum order of the lags in the ARDL Model of 1
DKLCI	1.7589
DKLPI	1.3282

We had also used All Houses Price Index (ALL) instead of TERR and HIGH as a proxy for the residential real estate market. ALL is a weighted average of the state-terraced, state high-rise, state semi-detached and state detached indexes. As in the case of results obtained by using TERR and HIGH as a proxy for residential market, the findings suggest that there is no long-run relationship between the stock market and the residential real estate market. Table 2 shows that all the *F*-statistics computed from Equations (3) and (4) are below their respective critical value band (3.793- 4.855). As there were no equations in this study with significant *F*-statistics, the second stage of the ARDL test to estimate the long and short-run coefficients and their corresponding ECM could not be executed.

Table 2. F-statistics for testing the existence of a long-run relationship (ALL as a proxy for Residential Market)

ARDL Model (dependent variable)	Maximum order of the lags in the ARDL Model of 1
DKLCI	2.1722
DKLPI	1.2777

6. Conclusion

The finding of no cointegration between real estate market and stock market is in line with Glascock *et al.* (1997), Okunev and Wilson (1997), and Wilson *et al.* (1998) who found that the real estate market is segmented from the stock market. Market segmentation would suggest that the substitution hypothesis is not applicable to Malaysia. Residential real estate is not a good substitute to the listed companies' shares which are more liquid in nature. In tandem with Ong (1995), Wilson *et al.* (1996), He (1998), Liow (1998) and Chaudhry *et al.*(1999), this study found no long-run relationship between the direct and indirect real estate markets in Malaysia. The weak relationship between house prices and property companies' shares may be due to the reason that not all property companies have their core business in developing residential houses. Some of them may have a higher interest in the commercial or industrial property sectors compared to residential houses. Other implications that can be inferred from this study is that, since real estate and the stock market are not cointegrated, investors should be able to diversify their portfolio by holding both assets.

6.1 *Limitation of this Study*

This study is largely constrained by the lack of observations found in the *Malaysia House Price Index* (MHPI). The use of annual data could be biased due to the high volatile nature of this data. Nevertheless, as noted by Hakkio and Rush (1991), an increasing number of observations by using monthly or quarterly data do not add any robustness to the cointegration test as the main concern is the length of the period under consideration. In this study, annual data span from 1988 to 2004, coinciding with a full property cycle in Malaysia (Ting 2002). In addition, it would be ideal to include commercial property into the model to see the combined impact of real estate on the stock market. The office space market (commercial property) has always been an important sector of the property market and had become the preferred real estate class among institutional investors (Liow 2004). This would probably have caused the weak relationship between house prices and property companies' shares. Furthermore, not all property companies have their core business in developing residential houses. Some of them might be involved in the commercial or industrial property sectors. Hence, the two proxies used in this study probably could not capture the relationship between the stock market and real estate market.

Finally, this study did not investigate the impact of macroeconomic variables, such as gross domestic product (GDP), inflation and interest rate, that were found to be significant in previous studies. This shortcoming is due to the limited number of observations in the annual data. Nevertheless, we did perform ARDL tests on quarterly data during the period 1999 to 2004 (24 observations) with the incorporation of macroeconomic factors such as real GDP, interest rate (base lending rate) and inflation (consumer price index). The results obtained were similar to those reported earlier where residential real estate market is segmented from the stock market (refer to Appendix II for the details).

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Appendix I. The database for years 1988-2004

YEAR	TERR	HIGH	KLCI	KLPI
1988	49.6	76.9	261.19	734.27
1989	50.5	91.2	357.38	897.87
1990	53.1	98.5	562.28	1545.36
1991	60.3	105.6	505.92	1155.05
1992	65.6	105.7	556.22	1110.76
1993	68.5	104.2	643.96	1139.79
1994	74.4	110.5	1288.85	3438.04
1995	84.1	115.1	971.21	2559.99
1996	92.7	114	995.17	2103.72
1997	102	108.5	1237.96	2538.8
1998	97	101.8	594.44	760.9
1999	93.7	98.1	586.13	781.42
2000	100	100	833.89	1079.37
2001	100	102.8	679.64	632.54
2002	104.7	96.7	696.09	599.64
2003	107.7	111.3	646.32	540.91
2004	111.7	113.5	793.94	750.7

Appendix II. F-Statistics for testing the existence of a long-run relationship (Quarterly Data from 1999-2004)

ARDL Model (dependent variable)	Maximum order of the lags in the ARDL Model	
	1	2
Model 1 (DKLCI) (without macroeconomic factors)	3.2302	1.8662
Model 2 (DKLPI) (without macroeconomic factors)	3.0363	2.9405
Model 3 (DKLCI) (with macroeconomic factors)	1.1652	1.5826
Model 4 (DKLPI) (with macroeconomic factors)	1.7926	1.5421

Critical value band (5 per cent significant level) for Models 1 & 2 is 3.793-4.855.
Critical value band (5 per cent significant level) for Models 3 & 4 is 2.649-3.805.