6. DOES WEALTH OR CREDIT EFFECT EXIST IN CHINA?[1]

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Abstract

Using the non-parametric rank tests proposed by Breitung (2001), we set out in this study to determine whether any non-linear long-run equilibrium relationship exists between the stock and real estate markets of China. We go on to adopt the threshold error-correction model (TECM) to determine whether a similar relationship is discernible, possibly non-linear functions of the log-price of these two markets. Our results indicate the existence of a long-run non-linear relationship between the Shenzhen composite index and the real estate price index. In the short run, the Granger causality test favors the 'wealth effect' hypothesis; conversely, in the long run, the existence of the 'credit-price' effect is discernible above a certain threshold value, whilst the 'wealth effect' is apparent below this threshold value, which implies a bi-directional feedback causal relationship. Our empirical results demonstrate that in the long run, the price transmissions between these two markets are non-linear and asymmetric.

Keywords: rank test, Granger causality test, wealth effect, credit-price effect
JEL Classification: C22, E44, G11

1. Introduction

China has experienced spectacular growth in its economy over recent years, and, as a result, has become an extremely popular target for investment, leading to both its stock index and real estate prices reaching record high levels. Between 2001 and 2005, the rising trend in global housing prices was also clearly discernible in China,

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where housing prices had soared by 68 per cent; however, at the same time, the stock markets experienced an opposing trend, with the monumental slides leading to losses in excess of 50 per cent of the stock index value during that period. To some experts, such irrational exuberance in the housing market provided a clear signal of a bubble that was ultimately destined to burst. Surprisingly, despite the fact that China had achieved a GDP growth rate of 9.5 per cent in 2004, the country's two stock exchanges (the Shanghai and Shenzhen stock exchanges) have turned out to be the worst performing markets in Asia. Although these markets did experience a welcome surge as a result of the staging of the Beijing Olympic Games during 2007-2008, once the games were over, the markets once again experienced further slides.

Numerous studies have been carried out by researchers over recent decades in attempts to determine the relationship between the stock market and real estate market. Identifying this relationship is crucial to investors within these two markets, and particularly to policymakers who require such information to support their efforts in the design of appropriate national growth strategies. Any disturbances in market fundamentals within a given market will generate movements of capital into and out of the affected market (Okunev and Wilson, 1997). On the one hand, if there is substantial integration of the stock and real estate markets, then a high degree of asset substitution is expected to take place, with such substitution ultimately having a significant impact on price fluctuations within the relevant markets. On the other hand, however, if the two markets are not integrated, then this will have significant implications for portfolio investment, particularly for managers seeking to achieve widely diversified portfolios.

This gives rise to three specific areas of interest which would appear to warrant further examination: (i) whether these two markets were systematically linked; (ii) whether the significant falls in stock prices led to the surge in the real estate market; and (iii) whether the development of the real estate market actually led to further falls in the stock markets. We set out in this study to examine these issues in the stock and real estate markets of China using correlation analysis. The use of such an approach to explain the relationship between the stock and real estate markets has already been firmly established in numerous previous studies; for example, Gyourko and Keim (1992) note that S&P 500 returns have significant explanatory power in predicting equity REIT returns. Fu and Ng (1997) concluded that in Hong Kong a low contemporaneous relationship exists between stocks and the transaction-based real estate index, whereas Quan and Titman (1999) report that for most countries no statistically significant relationship was discernible between stock returns and real estate price changes. Based upon the use of Granger causality tests to examine the wealth effect in California, Green (2002) found that this wealth effect was only discernible in those regions characterized by high housing prices. Finally, using the 'arbitrage pricing model' to explore the relationship between stock and real estate markets in the US, Ling and Naranjo (1999) demonstrate the existence of a cointergration relationship between equity REITs and the stock market.

Two mechanisms are proposed in this study to interpret this relationship, the first of which is the well-established 'wealth effect', which claims that households with unanticipated gains in share prices will tend to increase their housing stock. Evidence of the wealth effect, based upon the vector autoregressive (VAR) model, is provided by Kakes and van den End (2004), who demonstrate that within the Dutch housing market stock price fluctuations have distributional effects across different segments. The second mechanism is the ‘credit-price effect’, which claims that a rise in real estate prices can stimulate economic activity, the future profitability of firms, and, as a consequence, stock market prices, as a result of raising the value of collateral and reducing the cost of borrowing for both firms and households. It is, however, suggested by Granger and Terasvrita (1993) that the majority of the economic variables are non-linear in nature, and as such, if the resultant relationship between the variables is also non-linear, any analysis using a linear model may lead to specification error. In contrast to the earlier studies, their general conclusion was that the relationship between stock prices and real estate prices is negative and low; hence, they consider only the linear relationships between the variables whilst ignoring any potential long-run economic effects. Subsequent research nevertheless argues that the relationship between stocks and real estate can be characterized by using a non-linear model (Okunev and Wilson, 1997).

In contrast to the assumed linear relationships associated with the above studies, Ambrose *et al.* (1992) employ a rescaled range analysis to test for non-linear trends in the returns series for different classes of assets, with their results revealing that mortgage and equity REITs display similar return-generating characteristics to the stock market; thus, they conclude that the real estate and stock markets are integrated. From their use of a non-linear model to investigate the level of integration between the real estate and security markets in US, Okunev and Wilson (1997) found that securitized REITs were fractionally cointegrated with the Standard&Poor’s (S&P) stock index, but that movements in the real estate market towards the stock market were quite slow, and that divergence between the two markets could therefore be quite prolonged. Further non-linear causality tests were carried out by Okunev *et al.* (2000) to examine the dynamic relationship between the US real estate and S&P 500 stock markets; they found a strong unidirectional relationship running from the stock market to the real estate market. More recently, using both cointegration and error-correction model methodologies, Apergis and Lambrinidis (2007) provided further confirmation that the real estate and stock market in both the US and the UK were highly integrated.

Conventional cointegration methods are inappropriate, essentially because they assume a unit as the null hypothesis, and a linear process under the alternative. It is, nevertheless, clear that the theory is not always capable of providing any precise specification of the functional form, such that non-parametric tools for use in estimation and inference are clearly desirable. The majority of the models adopted in the previous empirical studies addressing the issue of equilibrium have generally failed to take into account the non-linear properties of the adjustment process; however, as noted by Laxton *et al.* (1993) both bias and mistakes are increasingly likely when a linear and symmetrical methodology is adopted to test economic variables that are non-linear and asymmetric. It is worth noting that in the non-linear evidence referred to in the above studies the tendency has been to adopt parametric residual-based tests in a cointegrational approach to the testing of the relationship between stock and real estate markets. The present study differs from these earlier examples by providing non-linear cointegrational evidence on China based on the non-parametric rank tests developed by Breitung (2001), which demonstrate power in both linear and non-linear frameworks, and which are also applicable to whatever the data generating process of the variables under examination. In contrast, parametric testing procedures assume that the data generating process is already known in advance; and thus, there is some danger of misspecification if the wrong parametric models are used to characterize the variables of interest.

There are, therefore, several important issues that are of particular interest to this study. Firstly, our primary objective in this study is to ascertain whether there is indeed any significant non-linear relationship between the real estate and stock markets in China using rank tests proposed by Breitung (2001). Secondly, we go on to apply asymmetric error-correction models to describe the short-term dynamic adjustments with the asymmetric price transmissions between the stock and real estate markets. Our results should facilitate an investigation into the causal relationships between the real estate markets and stock markets of China. Finally, Granger causality will enable us to determine whether the 'wealth effect' or the 'credit price effect' exists within any of the China that are either above or below the threshold. We aim to facilitate the forecasting of future performance between one market and the other, thereby providing important and significant insights for investors and speculators.

The remainder of this study is organized as follows. A description of the methodology adopted for this study is provided in Section 2. This is followed in Section 3 by the presentation of our empirical results. Finally, the conclusions drawn from this study are presented in Section 4.

2. Rank Test for Nonlinear Cointegration

In order to test for cointegration between two time series, y_t and x_t, consider y_t as a function of x_t, which may be represented by:

$$y_t = f(x_t) + u_t , \qquad (1)$$

where: y_t and $f(x_t)$ are both integrated of order one, that is, $y_t \sim I(1)$ and $f(x_t) \sim I(1)$, and u_t stands for the stochastic disturbances. The cointegration tests in the past have been developed on the assumption that $f(x_t)$ is a linear function of x_t. Brietung (2001) showed that residual-based linear cointegration tests are inconsistent for some classes of nonlinear functions (see Sargan and Bhargava, 1983; Phillips and Oularis, 1990). To overcome this problem, he thus proposed cointegration test based on rank transformation of the time series. The rank test exploits the property that a sequence of ranks is invariant to monotonic transformation of the data. In other words, if x_t is a random walk then the ranked series of x_t behaves like a random walk as well. Similarly, if two series are cointegrated, possibly nonlinearly, then the ranked series are cointegrated as well. The rank transformation therefore allows for getting away from specific functional forms of the cointegrating relation. An advantage of rank tests is that one does not have to be explicit about the exact functional form of the nonlinear cointegrating relationship.

The rank test is based on a measure of the squared distance between the ranked series. When the test statistic takes on a value smaller than the appropriate critical value, this is evidence against the null hypothesis of no cointegration in favor of the alternative hypothesis of cointegration, because in this case the variables move closely together over time and do not drift too far apart. Such a test checks whether the ranked series move together over time towards a long-run cointegrating equilibrium that may be linear or nonlinear. Following the Brietung (2001), we can define a ranked series as $R(w_t) =$ rank of w_t among $(w_1, w_2,..., w_T)$, where $w = \{y, x\}$.The basic idea behind these rank tests is that if there is cointegration between the two series, y_t and x_t, the rank sequences tend to have similar evolutionary paths; otherwise the sequences of the ranks will tend to be divergent. The null hypothesis of no (non-linear) cointegration between y_t and x_t is rejected if these tests statistics are found to be smaller than their respective critical values.

Breitung (2001) developed the following test statistics, in which y_t and x_t are considered to be mutually series-correlated random walks:

$$\psi_T = \frac{\sum_{t=1}^{T} d_t^2}{T^3 \hat{\sigma}_{\Delta d}^2} \quad (2)$$

where: dt = R(yt) – R(xt), for R (wt) = rank of wt among (w1 , w2 ,…, wT), where w = {y, x}.

Meanwhile, $\hat{\sigma}_{\Delta d}^2 = T^{-2}\sum_{t=1}^{T}(d_t - d_{t-1})^2$ are used to adjust for the potential correlation between the two series under examination.

To assess whether the cointegration is linear or nonlinear found by the rank test, Breitung (2001) suggests the score test statistic $T \cdot R^2$ as:

$$\tilde{u}_t = c_0 + c_1 x_t + c_2 R(x_t) + e_t \quad (3)$$

where: T is the sample size, R^2 is the coefficient of determination of regression (3), and $\tilde{u}_t = y_t - (\tilde{a}_0 + \tilde{a}_1 x_t)$, where $\tilde{a}_0$ and $\tilde{a}_1$ in turn, are the least squares estimates from a regression of y_t on a constant and x_t. Under the assumptions of u_t is a zero-mean white noise and that x_t is exogenous, the score test statistic $T \cdot R^2$ is asymptotically Chi-squared (χ^2) distributed with one degree of freedom. The null hypothesis of linear cointegration, $c_2 = 0$, may be rejected in favor of nonlinear cointegration when $T \cdot R^2$ exceeds the χ^2 critical value. However, Brietung (2001) points out that in many cases, x_t is endogenous. Brietung (2001) proposes to adopt the cointegration regression due to Stock and Watson (1993) for adjustment, by truncating the infinite sums in the following specification appropriately:

$$y_t = \alpha_0 + \sum_{j=1}^{\infty} \alpha_j y_{t-j} + \beta_1 x_t + \sum_{j=-\infty}^{\infty} \gamma_j \Delta x_{t-j} + \varepsilon_t \quad (4)$$

The least squares estimated residual $\tilde{\varepsilon}_t$ is then regressed on the regressors of equation (4) and $R(x_t)$. Under the null hypothesis of a linear cointegration relationship, the resulting $T \cdot R^2$, where R^2 is the coefficient of determination of regression (4), is also asymptotically Chi-squared (χ^2) distributed with one degree of freedom. The Monte Carlo simulations by Brietung (2001) show that for a wide range of nonlinear models the rank tests perform better than their parametric competitors.

3. Empirical Analysis

The real estate price index (*RES*) is obtained from the DATASTREAM database, compiled by the China National Bureau of Statistics, whilst the Shenzhen composite index (*SZ*) is obtained from the Taiwan Economic Journal (TEJ). The monthly data span the period from 1998 to 2011, and as a result of the significant swings in the data series, all of the data series are transformed to logarithmic form in order to achieve stationarity.

3.1 Cointegration and Non-linear Tests

The results of the rank and non-linear tests estimated in this study are summarized in Table 1.

Table 1

Results of the Cointegration and Non-Linearity Rank Tests

China	Rank Test[a]		Linearity Test[b]	
	ψ^*		$T \cdot R^2$	
	0.0069	***	10.25	***
Critical Value (%)				
10	0.0232		2.71	
5	0.0188		3.84	
1	0.0130		6.63	

Notes: a. The rank test is adjusted for autocorrelation. The null hypothesis of the rank test is that no cointegration exists between the stock and real estate markets; the alternative hypothesis is that cointegration does exist between the two assets. The null hypothesis is rejected when the critical value exceeds the test statistic.

b. The null hypothesis of the linearity test is that a linear relationship exists with no cointegration between the stock and real estate markets; the alternative hypothesis is that a linear relationship does not exist and cointegration does exist between the two assets. The null hypothesis is rejected when the computed $T \cdot R^2$ value exceeds the critical value.

c. *** denotes significance at the 1% levels.

For the case of the rank test, we compute the autocorrelation adjusted test statistics, ψ^*. The null hypothesis of this rank test is that the stock and real estate markets are cointegrated, as compared to the alternative hypothesis of no cointegration between the two variables. The null hypothesis is rejected in favor of the alternative hypothesis when the critical value is smaller than the test statistic; otherwise, the null hypothesis is supported.

As is clearly shown by the ψ^* statistic in Table 1, the null hypothesis is rejected for China in this study, since the test statistic is smaller than the conventional critical values at the 1 per cent level of significance. As such, according to the ψ^* statistic, we observe cointegration relationships between the stock and real estate markets for China. This therefore indicates that the rank test employed in this study provides some evidence of the existence of long-run relationships between the stock and real estate markets of China.

Based upon the cointegration relationships previously identified above, it is possible to go on to distinguish between non-linear and linear cointegration using the rank sum linearity test of Breitung (2001). It is clearly evident from Table 1 that the null hypothesis of linear cointegration is rejected at all conventional levels; thus, the rank sum linearity test results also clearly indicate that the cointegration relationships can be said to be non-linear.

3.2 Granger-Causality Results Based on TECM

Based upon the nonlinear cointegration identified in the previous section, we now go on to test the transmissions using the threshold error-correction model (TECM) with consistent estimated thresholds, using AIC to select the most appropriate lag length for the model. Following the positive finding of a non-linear equilibrium relationship, we use the asymmetric TECM with consistent nonlinear estimates (Enders and Granger, 1998; Enders and Siklos, 2001) to capture the short-run and long-run dynamic adjustment process with regard to the stock and real estate markets of China. We examine the transmissions by TECM as following:

$$\Delta LRES_t = \alpha - 0.035Z^{+}_{t-1} - 0.044Z^{-}_{t-1} + \sum_{i=1}^{n_1}\delta_i \Delta LRES_{t-i} + \sum_{i=1}^{n_2}\theta_i \Delta LSZ_{t-i} + c_t \quad (6)$$

$$\Delta LSZ_t = \alpha - 0.072Z^{+}_{t-1} + 0.034Z^{-}_{t-1} + \sum_{i=1}^{n_1}\delta_i \Delta LRES_{t-i} + \sum_{i=1}^{n_2}\theta_i \Delta LSZ_{t-i} + c_t \quad (7)$$

Since Granger causality tests are very sensitive to the selection of lag length, the lag lengths are determined using the sequential procedures of Hsiao (1979); these are, nevertheless, also based on the Granger definition of causality; as a result of the application of this procedure we find that the lag lengths of both n_1 and n_2 are equal to 2 ($n_1 = n_2 = 2$). The results of our Granger causality tests – based on the corresponding TECM – are presented in Table 2, from which we can see that, in the short run, unidirectional causality is found to run from the stock market to the real estate market (i.e., significant H_0: $\theta_1 = \theta_2 = 0$).

Table 2

Estimates of the Error-Correction Models

	Asymmetric		Symmetric	
	LRES	LSZ	LRES	LSZ
Z – plus$_{t-1}$	-0.035(-0.306)	-0.072(-3.401) ***		
Z – minus$_{t-1}$	-0.044(-3.340) ***	0.034(0.862)		
ECT_{t-1}			-0.024(-3.362) ***	-0.047(-2.546) **
$H_0:\delta_1=\delta_2=0$		1.135		1.769
$H_0:\theta_1=\theta_2=0$	1.946*		1.959*	
$H_0:\delta_1=\delta_2=k=0$				2.849**
$H_0:\theta_1=\theta_2=k=0$			2.826**	
$H_0:\delta_1=\delta_2=k_1=0$		3.746***		
$H_0:\delta_1=\delta_2=k_2=0$		1.226		
$H_0:\theta_1=\theta_2=k_1=0$	1.629			
$H_0:\theta_1=\theta_2=k_2=0$	2.800**			
$H_0:k_1=k_2$	5.615***	6.037***		
Q(12)	12.532	14.558	12.478	12.869
in the short-run	wealth effect			
above the threshold		credit-price effect		
below the threshold	wealth effect			

Notes: a. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively

b. *t*-statistics are in parentheses.

c. Threshold Error-Correction Model:

$$\Delta Y_{it}=\alpha+K_1Z_{t-1}^{+}+K_2Z_{t-1}^{-}+\sum_{i=1}^{n_1}\delta_i\Delta Y_{1t-i}+\sum_{i=1}^{n_2}\theta_i\Delta Y_{2t-i}+c_t$$

where $Y_{it}=(LSZ_t,\ LRES_t)$, $Z_{t-1}^{+}=I_t\hat{\varepsilon}_{t-1}$, $Z_{t-1}^{-}=(1-I_t)\hat{\varepsilon}_{t-1}$ such that $I_t=1$ if $\varepsilon_{t-1}\geq-0.0855$, $I_t=0$ if $\varepsilon_{t-1}\leq-0.0855$ and c_t is a white-noise disturbance.

d. Symmetric Error-Correction Model:

$$\Delta Y_{it}=\alpha+K\hat{\varepsilon}_{t-1}+\sum_{i=1}^{k_1}\delta_i\Delta Y_{1t-i}+\sum_{i=1}^{k_2}\theta_i\Delta Y_{2t-i}+c_t$$

The short-run outcome favors the wealth effect hypothesis, which implies that those households in China accruing unanticipated gains in share prices will tend to increase their amount of housing. This is consistent with the results reported by Green (2002), Edelstein *et al*. (2004) and Kapopoulos and Siokis (2005). In the long run, however, the existence of a bidirectional feedback causality relationship is discernible between the two markets. The results show unidirectional causality running from the real estate market to the stock market when the threshold variable is above –0.0855 (i.e., significant H_0: $\delta_1 = \delta_2 = k_1 = 0$), thereby providing support for the credit-price effect hypothesis when the threshold variable value is above the threshold level. Conversely, when the threshold variable value is below the threshold level, we find that unidirectional causality runs from the stock market to the real estate market (i.e., significant H_0: $\theta_1 = \theta_2 = k_2 = 0$); that is, the wealth effect is discernible when the threshold variable is below the threshold level. These empirical results indicate the existence of interactions between the stock and real estate markets and suggest that in the long run the price transmissions between the two markets are asymmetric.

It should be noted that there are differences in the adjustment coefficients of Z^+ and Z^- for the two markets. Focusing on the adjustments in the stock market to restore equilibrium, the point estimates of the adjustment coefficients reveal that for a single unit negative change in the deviation from the equilibrium relationship created by changes in the real estate prices the stock prices adjust by 3.4 per cent. On the other hand, stock prices adjust so as to eliminate approximately 7.2 per cent of any positive change in the deviation from the equilibrium created by changes in the real estate prices. These findings indicate that adjustments between the real estate and stock markets towards a long-run equilibrium relationship are more rapid when the changes in the deviation are positive, than when they are negative.

As regards the real estate market, we find that the adjustment process is reversed, since real estate prices adjust so as to eliminate approximately 4.4 per cent (3.5 per cent) of a unit negative (positive) change in the deviation from the equilibrium relationship created by changes in the real estate prices. These findings indicate that adjustments between the real estate and stock markets towards a long-run equilibrium relationship are more rapid when the changes in the deviation are negative, than when they are positive. Indeed, the *F*-statistic also indicates that for both markets the null hypotheses of $k_1 = k_2$ (i.e., that the coefficients of Z^+ and Z^- are equal) are rejected. Furthermore, we find that the error-correction term is significant for the equation related to the stock market when the threshold variable value is above the threshold level; however, when the threshold variable value is below the threshold level, the error-correction term is found to be significant for the equation related to the real estate market. Our interpretation of this, as measured by the error-correction term, is that over time, in order to restore the long-run relationship within the system, when the threshold variable is below (above) the threshold value it is real estate (stock) prices that must bear the brunt of adjustment rather than the stock (real estate) prices. These empirical results further indicate that price transmissions between these two markets are asymmetric. By way of contrast, Table 2 also reports the estimates obtained from the symmetric error-correction model. In the case of symmetric adjustment, both of the error-correction terms on the stock and real estate markets are found to be significant at conventional levels, a result which implies not only that the stock prices bear the brunt of the adjustment process, but that this is also true for the real estate prices.

4. Conclusions

The primary aim of this study is to investigate empirically the long-run non-linear equilibrium relationship that exists within China using non-parametric rank test proposed by Breitung (2001). The rank tests cointegration method provides strong evidence of a long-run equilibrium relationship characterized by non-linear adjustment. Furthermore, the Granger causality test results from the corresponding TECM clearly indicate the existence of short-run unidirectional causality running from the stock market to the real estate market. Such an outcome, in the short run favors the wealth effect hypothesis; this could, however, be more appropriately interpreted as the result of a portfolio adjustment mechanism. It would seem reasonable to argue that higher stock prices will have the effect of raising the share of households' portfolios within the stock market, thereby ultimately leading to such households rebalancing their portfolios by selling stocks and purchasing other assets, such as houses; this will, in turn, lead to a natural surge in the housing market (Kapopoulos and Siokis, 2005). Furthermore, we find the existence of a long-run bidirectional feedback causality relationship between the two markets, which points to the occurrence of interactions between the stock and real estate markets.

Findings of particular notice in this study are the existence of a credit-price effect above the threshold value, as compared to the existence of a wealth effect below the threshold value. These empirical results demonstrate that in the long run the price transmissions between the two markets are asymmetric. Thus, in terms of risk diversification, it seems clear that the two assets should not be included in the same portfolio in China. Consequently, we suggest that these findings ought to be made readily available to individual investors, as well as financial institutions, which hold long-term investment portfolios in these two asset markets for their consideration of the implications.

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