Analysis for the Reality of the CPI when Ignoring Some Financial Assets - Evidence from Taiwan

Chien-Chung Nieh[1], Tsui-Huang Wu[1], Kuang-Cheng Cheng[1] and Joyce Hsieh[2]

[1]Department of Banking and Finance, Tamkang University
[2]Department of International Business, Tamkang University
No. 151 Ying-chuan Rd., Tamsui Dist., New Taipei City 251, Taiwan
Email: niehcc@mail.tku.edu.tw

ABSTRACT

This research attempts to judge the reality of the price index without incorporating the prices of stock and real estate and to analyze the efficiency of the diversification when investing in both assets of stock and real estate over the period of 1986Q1 to 2002Q3 in Taiwan by employing various multivariate VAR models. The empirical results first indicate that diversification by investing in both assets of stock and real estate is fruitless since the market is efficient. Granger causality tests provide us perceptual information that the price index without incorporating the prices of stock and real estate is spurious. Nonetheless, the formulating of a STECM is not necessary since the linear functional form is not violated in our examination.

Key Words: Stock price, Real Estate Price, Consumer Price Index, ARDL, STECM

1. INTRODUCTION

Without considering the asset prices of stock and real estate, the consumer price index (CPI) in Taiwan seems not appropriate one to reflect the real price level. There is probably another type of inflation latent if the asset prices of stock and real estate are incorporated into the price index. Moreover, the interrelationships between real estate price and stock price are generally acknowledged strong (e.g., Gyourko and Keim, 1992 [15], Goldstein and Nelling, 1999 [13], and Fu and Ng, 2001 [11]). The up-and-down of the stock trend drives the fluctuation of a country's economy, which in turn causes a strong impact on the price of the real estate market. Testing for the causal relation between stock and real estate markets can be found in Liu *et al.* (1990), Eichholtz(1997) [8], Okunev and Wilson(1997) [26], and He(2000). Therefore, this study tries to employ various time-series methodologies, using Taiwan as the sample base, to investigate the long-run equilibrium and the short-run dynamic relationship among CPI, stock price and real estate price. The findings of this study are used to (1) judge the reality of the price index without incorporating the prices of stock and real estate and (2) analyze the efficiency of the diversification when investors decide to invest in both assets of stock and real estate.

The remainder of this paper is organized as follows: Section II describes the data. Section III introduces the methodologies and presents the empirical results. Section V concludes this paper.

2. DATA

The data sets used here consist of quarterly time series on stock price index, real estate price index and consumer price index covering the period of 1986Q1 to 2002Q3. Stock price index and consumer price index were obtained from the AREMOS database of the Ministry of Education of Taiwan. Real estate price index was collected and constructed by Hsin-Yi Real Estate Inc. Examination of the individual data series makes it clear that the logarithmic transformations were required to achieve stationarity in variance; therefore, all the data series were transformed to logarithmic form. Figure 1 to Figure 3 exhibit the plots of the three variables considered in this paper.

<Insert Figure 1 to Figure 3 about here>

3. METHODOLOGIES AND EMPIRICAL RESULTS

A. Unit Root Tests

In this study we apply several conventional unit root tests, such as ADF, PP, KPSS, DF-GLS, ERS, and NP, to test for the ‘stationarity’ for each of three variables considered.[1] Empirical results indicate that stock price (LST) is integrated of order one, I(1), whereas mixed results of I(0) and I(1) are come out for both series of consumer price index (LP) and real estate price (LRE).

<Insert Table 1 about here>

B. ARDL Bounding Test

ARDL bound test has been widely employed since Pesaran, Shin and Smith(2001) [24], e.g., Abbot, Darnell and Evans (2001, exchange rate for the UK) [1], Bentzen and Engsted (2001, energy for Denmark) [5], Ghatak and Siddiki (2001, exchange rate for India), Atkins and Coe (2002, Fisher effect for the US and Canada) [2], Bahmani-Oskooee and Ng (2002, money demand for HK) [4], Fedderke and Liu (2002, capital flow for South Africa) [10], Tang and Nair (2002, import demand for Malaysia) [27], Vita and Abbott (2002, saving and investment for the US) [30], and Bahmani-Oskooee and Goswami(2003, J curve for Taiwan) [3]).

Since the result of our unit root tests found that the cointegrating vector incorporates both I(0) and I(1) series, the ARDL-UECM bounding test developed by Pesaran et al. (2001) [24] is thus an appropriate method to examine the long-run relationship between the three variables considered in this paper.

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[1] Various unit root tests of ADF, DF-GLS, ERS, PP, NP, and KPSS are developed by Dickey and Fuller(1981) [6], Elliot, Rothenberg, and Stock(1996) [9], Philips and Perron (1988) [25], Ng and Perron(2001) [22], and Kwiatkowski, et al.(1992) [18], respectively.

The uni-equation of the ARDL-UECM model in our study is expressed as the following form:

$$\Delta p_t = \sum_{j=1}^{n_1} b_j \Delta p_{t-j} + \sum_{j=0}^{n_2} c_j \Delta s_{t-j} + \sum_{j=0}^{n_3} d_j \Delta r_{t-j} + \phi_1 p_{t-1} + \phi_2 s_{t-1} + \phi_3 r_{t-1} + \varepsilon_t \quad (1)$$

where p, s, and r represent CPI, stock price, and real estate price, respectively. All these variables are taken into a logarithm form.

Since the appropriate lag length is crucial for the credibility of the VAR's result, we adopted the MAIC suggested by Ng and Perron (2001) [22] to select the lag length and found that lags of 5, 0, and 7 (n1, n2, and n3) for CPI, stock price, and real estate price, respectively, are most appropriate for our model speciation.[2] That is, an ARDL-UECM-MAIC(5, 0, 7) is constructed.

<Insert Table 2 about here>

Table 2 shows the result of ARDL bounding test that the F-statistic is larger than the critical value of the upper bound, boundary for I(1), which indicates that there exists a long-run level relationship among these three variables.[3] This long-run relationship in turn connotes the existence of a efficiency market hypothesis (EMH). Thus, diversification by investing in both assets of stock and real estate is fruitless.

Our ARDL model specification also examines the short-run impact of the real estate price and stock price on the CPI. The short-run impacts are shown in Table 3.

<Insert Table 3 about here>

C. Granger Causality Test

Nonetheless, Granger causality test is applied for the lead-lag examination among our three variables. The results based on multivariate VAR model significantly show that there exists unidirectional causal relation running from each of the real estate price index and the stock price index to consumer price index.[4] This empirical finding provides us perceptual information that the price index constructed without incorporating the prices of stock and real estate might be spurious. This 'spurious price index' contains an important policy implication in constructing consumer price index in Taiwan.

D. Stability Test

We apply the CUSUM (cumulative sum) plots to test for the stability of the residual

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[2] We employ Ng and Perron(2001) [22] unit root test to select the appropriate lag lengths for our model specification.

[3] Testing for the existence of level relationship, the asymptotic critical value bounds of the F-statistic are from Pesaran, Shin and Smith(2001) [24] p.301 Table CI.(v) CaseV.

[4] For saving the space, we omit the table to show all the numbers. However, the results will be available upon request.

of the linear combination (error correction term) of our sample variables. Figure 2 shows the result that our test is stable since the CUSUM plots are within the critical bound of 5% significant level.

<Insert Figure 2 about here>

E. Nonlinear Test

This paper further employs smooth transition error correction model (STECM) proposed by Granger and Teräsvirta(1993) [14] and Teräsvirta(1994) to examine the linear vs. nonlinear adjustment of the ECM by looking at different non-linear functional forms of the disequilibrium error. Van Dijk and Teräsvirta(2000) [29] has a good survey for the recent developments of smooth transition autogressive (STAR) models and some good applications of STECM can be found in Huang, Lin and Cheng(2001) [17] and Milas and Otero(2002) [20], among others.

The STECM is formulated as following form:

$$\Delta y_t = \pi_0 + \pi_1' W_t + (\theta_0 + \theta_1' W_t) F(z_{t-d}; r, c) + \mu_t$$

where $W_t = (Z_{t-1}, \Delta y_{t-1}, ..., \Delta y_{t-p}, \Delta X_t', ..., \Delta X_{t-p}')'$ and $\mu_t \sim NID(0, \sigma^2)$. The coefficient vector π_1 has a dimension of $m \times 1$ and $m = (p+1)(k+1)$. The function $F(z_{t-d}; r, c)$ is a continuous transition function with the transition variable z_{t-d} and parameter (r, c) that provides a variety of nonlinear models, e.g., logistic, exponential or quadratic logistic functions.

In this paper, the error correction for our sample variables (residlp) is used as a transition variable. From Table 4, we see that the lag indication of d is selected to be 4 since the p-value of H_0 reaches the lowest one (0.238) when d=4 and the logistic function is adopted for our STECM because of that H_{03} has the lowest p-value of 0.0328 comparing with H_{02} and H_{01} (0.763 and 0.777) under d=4. Though we construct a nonlinear form for our examination, the result shows that the linear functional form is not mis-specified, which indicates that no nonlinear effect exists in the model.

<Insert Table 4 about here>

4. CONCLUSION

Employing various multivariate VAR models over the period of 1986Q1 to 2002Q3, this research attempts to (1) judge the reality of the price index without incorporating the prices of stock and real estate and (2) analyze the efficiency of the diversification when investing in both assets of stock and real estate, by investigating, linearly and nonlinearly, the long-run and short-run interrelation among consumer price index, stock price and real estate in Taiwan. Our empirical results indicate that there exists a long-rung level relation among these variables. Diversification by investing in both assets of stock and real estate is thus fruitless since the market is efficient. Granger causality tests show a unidirectional causality relation running from each of the stock price index and the real estate price index to consumer price index. This empirical finding provides us perceptual information that the price index without incorporating the prices of stock and real estate might be spurious. This 'spurious price index' contains an important policy implication in constructing consumer price index in Taiwan. Nonetheless, both the stability test and the linearity test show that the formulating of a STECM is not necessary since our estimated model is stable and the linear functional form is not violated in our examination.

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Table 1 The Results of Various Unit Root Test Based on MAIC(NP, 2001)

		LP		LRE		LS	
ADF	Level	1.238	(2)	-4.457 **	(3)	-2.922	(0)
	difference	-8.962 ***	(0)	-3.072	(2)	-9.517 ***	(0)
DF-GLS	Level	-1.471	(5)	-1.693	(3)	-1.802	(0)
	difference	-1.518	(8)	-2.783	(2)	-9.584 ***	(0)
ERS	Level	127.296	(2)	104.973	(3)	21.796	(0)
	difference	2.762 ***	(0)	6.326 *	(2)	2.707 ***	(0)
PP	Level	0.583	(6)	-2.531	(4)	-2.819	(4)
	difference	-9.046 ***	(4)	-5.051 ***	(3)	-9.605 ***	(3)
NP	Level	-3.537 ***	(5)	-1.932	(3)	-1.585	(0)
	difference	-1.123	(8)	-2.657 *	(2)	-4.121 ***	(0)
KPSS	Level	0.255 ***	(6)	0.215 **	(6)	0.126 *	(6)
	difference	0.180 **	(5)	0.119	(5)	0.074	(6)

Notes: 1. LP, LRE, and LS are the symbols for the logarithm of consumer price index, real estate price, and stock price, respectively.
2. ***, **, and * denote significant at the 1%, 5%, and 10% levels, respectively.
3. The critical values for 1%, 5%, and 10% levels of ADF, DF-GLS, ERS, PP, NP, and KPSS are (-4.010, -3.478, and -3.167), (-3.717, -3.145, and -2.848), (4.236, 5.668, and 6.778), (-4.097, -3.476, and -3.166), (-3.42, -2.91, and -2.62), and (0.216; 0.146; 0.119), respectively.
4. The test statistic for NP test is MZ_t.
5. The number in the parentheses of ADF, ADF-GLS, ERS, and NP are the appropriate lag lengths selected by MAIC (Modified Akaike information criterion) suggested by Ng and Perron (2001), whereas the number in the parentheses of PP and KPSS are the optimal bandwidth decided by Bartlett kernel of Newey and West (1994) [21].
6. The null of KPSS test is testing for I(0), the null of the rest five tests are testing for I(1).
7. Based on the decision procedure suggested by Dolado, Jenkinson, and Sosvilla-Rivero(1990) [7], the appropriate models for the level and the first difference are both with trend and intercept and model with intercept, respectively.

Table 2. ARDL Bounds Testing for Cointegration Analysis

Computed F-statistic: 3.6531 (lag structure, k= 5, 3, 0)
Critical bound's value at 5%（Lower:4.87 and Upper:5.85）
Unrestricted intercept and no trend in the model
Pesaran, Shin and Smith(2001) [24] p.301 Table CI.(v) CaseV.

Table 3. ARDL Bounds Testing for Short-run Impacts of LRE and LST on CPI

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Dependent variable is DLP
62 observations used for estimation from 1988Q1 to 2003Q2
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Regressor	Coefficient	Standard Error	-Ratio[Prob]
CONS	.18381	.098089	1.8740[.068]
DLP(-1)	-.44950	.14652	-3.0679[.004]
DLP(-2)	-.44326	.15476	-2.8642[.006]
DLP(-3)	-.20523	.16753	-1.2250[.227]
DLP(-4)	.053995	.15552	.34718[.730]
DLP(-5)	.052507	.13986	.37544[.709]
DLS	-.0048481	.0064384	-.75299[.455]
DLRE	.010286	.031220	.32949[.743]
DLRE(-1)	-.018564	.027058	-.68608[.496]
DLRE(-2)	-.7082E-3	.021898	-.032342[.974]
DLRE(-3)	-.018427	.021573	-.85419[.398]
DLRE(-4)	.010479	.020440	.51268[.611]
DLRE(-5)	-.0042233	.020824	-.20281[.840]
DLRE(-6)	.0061100	.019684	.31040[.758]
DLRE(-7)	-.014534	.018650	-.77927[.440]
LP(-1)	-.068840	.024793	-2.7766[.008]
LS(-1)	-.1289E-3	.0048602	-.026516[.979]
LRE(-1)	.030051	.013411	2.2408[.030]

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Table 4. Smooth Transition Error Correction Model Tests for Nonlinearity

d	F num	F den	Ho F Stat	p. value
1	21	38	0.743695	0.762493
2	21	38	0.897883	0.594468
3	21	38	0.905141	0.586487
4	21	37	1.297807	0.238371
5	21	36	0.711666	0.793687
6	21	35	1.144457	0.353085

d	Ho4 F Stat	p. value	Ho3 F Stat	p. value	Ho2 F Stat	p. value
1	1.092297	0.387529	0.572793	0.774074	0.583429	0.766233
2	0.824164	0.573551	1.365152	0.243347	0.530815	0.807176
3	0.986017	0.455811	1.035439	0.420276	0.694425	0.676350
4	2.502435	0.032803	0.586124	0.763480	0.568837	0.777680
5	0.801572	0.591341	0.648775	0.713237	0.766870	0.617556
6	1.653267	0.153135	0.733609	0.644649	0.906198	0.509520

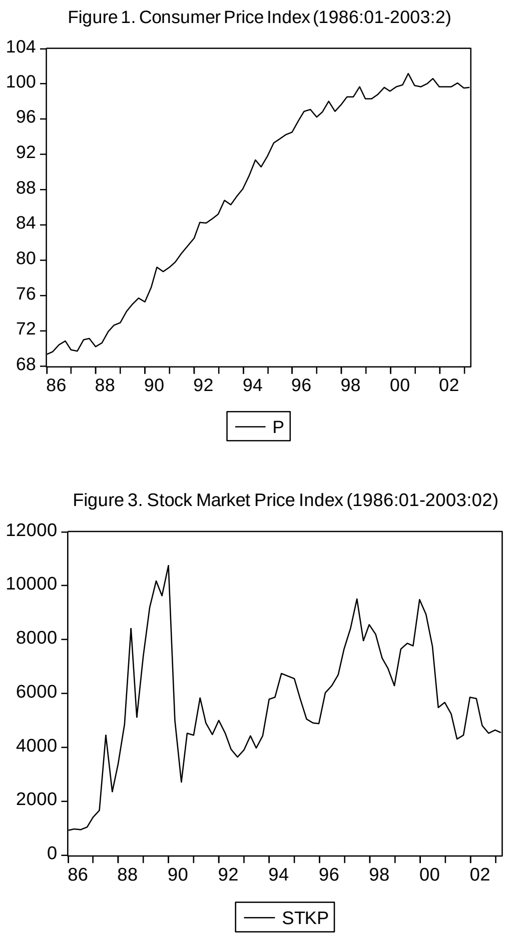

Figure 1 To Figure 3 Plots of the Three Variables Considered

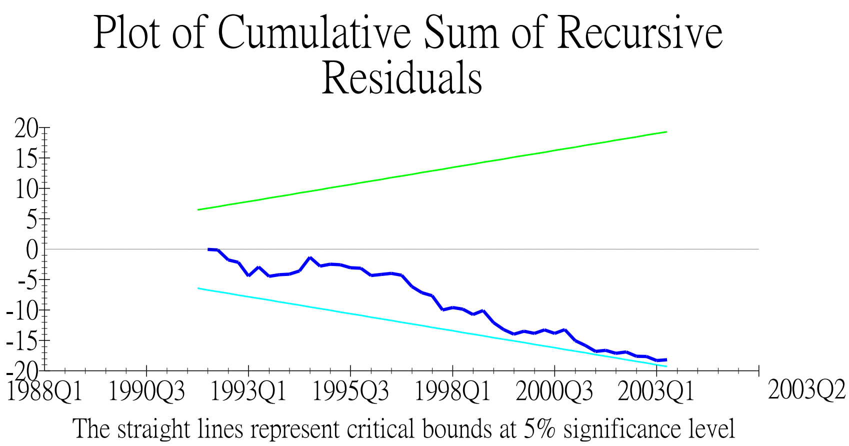

Figure 4. Plot of CUSUM