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A Cointegration Analysis of Business Real Estate Markets and Inflation

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Abstract. The impact of inflation on business real estate return has long been a primary financial concern of long-term investors. This study employ Johansen cointegration approach to investigates the long-term inflation hedging effectiveness of business real estate assets in Hong Kong over the period 1980-2008. The Johansen cointegration results provide strong evidence to support the hypothesis that inflation and the three types of business properties (commercial, retail and industrial property) are cointegrated, suggesting that the commercial, retail and industrial property provide a long-term hedge for inflation.

Keywords: Inflation hedging, business real estate, cointegration approach, Hong Kong.

1. Introduction

The impact of inflation on business real estate return has long been a primary financial concern of long-term investors, such as pension funds and life-insurance company. While inflation may have slowed in the 1990s, the global financial crisis in the 2008 and the recent anxiety of global inflation provide an opportunity to re-examine the relationship between inflation and business real estate returns. In particular, real estate investors wishing to conserve the value and purchasing power during the period of high inflation require an accurate assessment of the inflation hedging characteristics of various types of business real estate assets.

2. Related Literature

The effectiveness of real estate assets as an inflation hedge has been studied since the late 1970s. However, earlier studies on the inflation-hedging ability of real estate assets have traditionally used data from the United States (US) and the Europe because quality data are only available for relatively long periods in those developed economies. In a pioneer study, Fama and Schwert (1977) examined inflation hedging ability of residential properties, government bonds and common stock in the US using classical regression models. The authors utilised the work of Fisher (1930), breaking inflation into its expected and unexpected component parts. Fama and Schwert (1977) concluded that only residential real estate was a complete hedge against expected and unexpected inflation. In another study using Asian data, Sing and Low (2000) concluded that real estate provides a better hedge against inflation than does stock and securitized real estate for Singapore market based only on classical regression results. Among the various type of real estate, industrial property is the most effective hedge against both expected and unexpected inflation, whereas retail property offers only significant hedge against the expected inflation.

In fact, those regression results are not sufficient as a basis for concluding that the real estate assets have been hedged against inflation even though Fama and Schwert (1977) and Sing and Low (2000) had tried to apply a 'differenced variable' approach based on Fisher (1930) hypothesis instead of the 'level variable' to tackle the spurious regression problem suggested by Granger and Newbold (1974). While the method of 'differencing' satisfies the stationary condition, the economic inferences derived from such estimated parameters have limited significance in the short-run. The criticism of spurious regression is still serious if the regression model's underlying variables exhibit a long-run equilibrium relationship as the relevant long-run information may be lost after the differencing procedures have been completed. To tackle this problem, the Engle-Granger (1987) cointergration approach has been applied to examine the long-term inflation hedging effectiveness of real and financial assets returns since 1990's. Ganesan and Chiang (1998) found conflicting results between regression and Engle-Granger (1987) cointegration approaches. Based

upon a static regression model, retail properties offer a complete hedge against expected and unexpected inflation in the short-run. In contrast, there is no long-term relationship or equilibrium between inflation and all type of business real estate assets based on Engle and Granger (1987) cointegration approach and concluded that all type of residential and business real estate assets fail to provide a long-term inflation hedge in Hong Kong over the period 1984-1994. In contrast, Matysiak et al. (1996) conclude that commercial property provided a long-term hedge against inflation in United Kingdom over the period 1964-1993.

Due to the statistical uncertainties of previous results, this research aims to re-examine the inflation-hedging characteristics of three major real estate assets (residential, commercial, retail and industrial property) in Hong Kong over the period of 1980-2008. This paper aims to re-examine the long-term inflation hedging effectiveness of real estate and assets using Johansen (1988) full information maximum likelihood cointegration approach.

3. Research Methodology and Data

3.1 The Data

This research employed time-series quarterly and semi-annual data to investigate the inflation hedging effectiveness of business real estate in Hong Kong. The data series on inflation rate of Hong Kong were extracted from the Hong Kong monthly and Hong Kong annual digest of statistics, while the data series of real estate return were collected from the Hong Kong property review and the Hong Kong monthly digest of statistics. The estimation period covers a period of 29 years from 1980 to 2008. As Fama and Schwert (1977) concluded that the consumer price index (CPI) is an acceptable proxy for the price levels an investor faces, the consumer price index A (CPIA) will be employed as a reliably accepted measure of actual inflation because it consists of the smallest weight of private housing cost among all series of CPI. Given that the total return on commercial, retail and industrial property cannot be accurately measured and following Fama and Schwert (1977), we rely on capital gain return on commercial, retail, industrial property by means of the commercial, retail, industrial property price index as an adequate proxy for the variation of total return

3.2 Selection of Johansen cointegration approach

Although the Engle and Granger (1987) approach was used to test for the existence of long-run relationships between inflation and asset return for Hong Kong by Ganesan and Chiang (1998), there are disadvantages to this technique. Banerjee et al. (1986) ascertained that static OLS cointegrating regression might have substantial bias in some small sample estimations, while Philips (1991) proved that the Johansen maximum likelihood estimator was highly consistent, symmetrically distributed, and asymptotically median-unbiased. Subsequently, Gonzalo (1994) found that the Johansen maximum likelihood procedure performed better than other estimators, including the Engle-Granger (1987) ordinary least square procedure. Due to the statistical uncertainties of the Engle-Granger approach, we employ the Johansen (1988) cointegration approach instead of Engle and Granger (1987) approach to analyse the long-run relationship between inflation and business real estate return in this study.

3.3 Estimation Procedures of Cointegration Analysis – Johansen Approach

If the results of the unit root tests suggest that the underlying variables are stationary, it implies that they are able to form a cointegrating vector. The equivalent to testing whether or not a particular economic time series (X_t) stationary is to test for the significance of β_2, i.e. $H_0 = \beta_2 = 0$ in the Augmented Dickey-Fuller regression in Equation 1. If the null hypothesis (H_0) is rejected, then the time series (X_t) is said to be stationary.

$$\Delta X_t = \beta_0 + \beta_{1time} + \beta_2 X_{t-1} + \sum_{i=1}^{k} \lambda_i \Delta X_{t-i} + e_t \quad \text{.....(1)}$$

After establishing the number of unit roots, the lag lengths of the underlying variables in the Vector Autoregressive (VAR) model must be determined to test for the existence of cointegration. As the Johnasen cointegration results are mostly sensitive to the number of lags used in the estimation, it is important to

examine for any results discrepancies over the different lags. In addition, it is necessary to determine whether the VAR model has included the intercepts only, trends only or both the intercepts and trends. Finally, we use the maximum eigenvalue and trace statistics to determine the number of statistically significant cointegrating vectors in the real estate return equation. Following Tarbert (1996) and Stevensons (2000), only actual inflation is examined for the cointegration analysis in this study. This is justified on the basis that the purpose of the cointegration analysis is to test for evidence of a long-run relationship, and therefore it is legitimate to assume that actual and expected rates of inflation are equal.

4. Empirical Results

4.1 Unit Root Tests Results

Before conducting the Johansen cointegration tests, the conventional ADF tests are carried out to determine the order of integration. The ADF unit root test results estimated from Eq. (1) shown in table 1 indicate that all of the variables under investigation are I(1) variables at 95% level. One exception is for industrial property (semi-annual), which is a I(1) variable at 85% level.

Table 1 Results of ADF statistics

Variables	Level $_{(Q)}$	1^{s}Diff$_{Q)}$	Level $_{sa}$	1^{s} Diff $_{sa}$
Inflation	1.1726(8)	8.5582(o)**	1.6612(4)	4.5621(0)**
Commercial property	2.111(3)	6.328(0) **	2.102(2)	4.032(0) **
Industrial property	2.797(3)	5.6546(0) **	2.535(1)	2.944(0)
Retail property	1.813(7)	5.978(0) **	1.7(4)	4.165(0) **

Notes 1. Maximum lag length is 8 and 4 for quarterly and 4 for semi-annual., **2**.* Significance at the 90% level**, Significance at the 95% level***, and Significance at the 99% level. 3. Figures in brackets [ ] are the preferred lag lengths used in the Augmented Dickey and Fuller (ADF) auxiliary regression., 4. MacKinnon's (1991) critical value are given as -3.54 (time trend and constant) at the 95% level.

4.2 Cointegration Results (Johansen Approach)

The Johansen vector autoregressive (VAR) models with 2, 4, 6 and 8 lags are estimated with unrestricted intercepts and no trend to examine for any results discrepancies over the different lag length in the VAR models. The Johansen cointegration results shown in Table 2 indicate strong evidence of a cointegrating relationship between inflation and the business real estate return. In all cases, with the exception of industrial property (Trace statistics only, 6 lags and quarterly data) and retail property (6 lags, quarterly data), the maximum eigenvalue and trace statistics are significant at a level of at least 95%. The cointegration results therefore suggest that the three types of business real estate (commercial, retail, industrial and residential) asset provide a long-term inflation hedge in Hong Kong over the period 1980-2008. The result is consistent to Matysiak et al. (1996) but contradict to Ganesan and Chiang (1998) and Tarbert (1996)

Table 2 Results of Johansen cointegration tests

Asset Type		**Quarterly Data**				**Semi-Annual Data**	
		Lag length				**Lag length**	
		2	**4**	**6**	**8**	**2**	**4**
Commercial property	(M)	69.33**	41.24**	19.27**	18.87**	41.93**	24.13**
	(T)	72.10**	40.47**	19.00**	20.83**	47.81**	23.86**
Industrial property	(M)	70.67**	35.77**	16.39**	17.21**	43.98**	20.76**
	(T)	54.28**	31.56**	14.36	20.76**	28.98**	20.74**
Retail property	(M)	51.55**	27.24**	11.46	17.18**	25.26**	18.06**
	(T)	54.28**	31.56**	14.36	20.76**	28.98**	20.74**

Notes 1. Critical value 95% level (M) = 14.88, 90% level = 12.98. 2. Critical value 95% level = 17.86, 90% level = 15.75 (T), 3. (T) = Trace statistics, and (M) = Maximum Eigenvalue statistics.4. VAR (2,4,6,8) models are estimated with unrestricted intercepts and no trends

5. Conclusion

This study use Johansen cointegration models to re-examine for the long term inflation-hedging effectiveness of real estate assets in Hong Kong. The results of Johansen cointegration tests running from inflation to asset returns provide strong evidence to support the cointegrating relationships between inflation and four types of properties. The results suggest that the four types of real estate provide a long-term effective hedge for inflation over the long run. This is contradict to the findings of Ganesan and Chiang (1998) and Tarbert (1996) but comply with Matysiak et al. (1996) In contrast to Ganesan and Chiang (1998), this study concludes that the business real estate assets appear to provide a long-term hedge against inflation in Hong Kong. The results imply that Hong Kong investor should overweight their investment to business real estate assets during the period of high inflation.

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