INFLATION HEDGING CHARACTERISTICS OF HOUSING MARKETS IN THAILAND

Annop Peungchuer
Department of Property Valuation, ABAC School of Management,
Assumption University

ABSTRACT

Property has been traditionally perceived as a good hedge against inflation. Extensive empirical researches have been undertaken to prove whether properties hedge against inflation in different countries. This paper explores the relationship between inflation and returns in the housing markets in Thailand. Only the appreciation component, not income, of housing market returns is taken into account due to the limitations of data. Inflation is decomposed into expected and unexpected inflation. As expected inflation is not directly observable, a proxy of expected inflation is required. This paper uses Treasury Bill rates and regression-generated time series, Autoregressive (AR) and Autoregressive Integrated Moving Average (ARIMA) modelling, to estimate expected inflation.

INTRODUCTION

Traditionally, property markets are widely believed to be a good hedge against inflation, in addition to their diversification benefits while having them in the investment portfolio. Irving Fisher (1930) who was the pioneer of inflation hedging concept proposed that the expected real rate of returns should be independent of the rate of inflation. Fisher hypothesized that expected nominal interest rates should move on the basis of one-for-one relationship with expected inflation. Fama and Schwert (1977) adapted the Fisher hypothesis to test whether assets had provided a hedge against inflation. This empirical study was based on a static regression model.

Consequently, many empirical studies have been undertaken to examine whether property effectively hedges against inflation adopting traditional static regression methodology and other more robust and vigorous methodologies. This relationship between property markets and inflation has been carried out in many countries; however, no paper has yet studied the hedging characteristics of property markets in Thailand. The continued concern about inflation in Thailand has led this paper to investigate and test if Thai property markets can protect investors from inflation.

LITERATURE REVIEW

One of the classic works on a hedge against inflation of an asset is Fama and Schwertis (1977) study. Fama and Schewert's examined a wide range of assets, US Treasury bills, Government bonds, common stocks, human capital, and residential real estate. The data of each asset class from 1953 - 1971 were analysed. The returns of three-month US Treasury Bills were used as a proxy for expected inflation because Fama (1975) had exhibited that they were a good proxy for expected inflation. Fama used the Ordinary Least Squares (OLS) model to investigate the issue. Fama and Schwert analysed the monthly, quarterly, and half-yearly returns of each asset class. The findings showed that the only asset that hedged against both expected and unexpected inflation was residential real estate.

Rubens, Bond, and Webb (1989) examined the inflation-hedging effectiveness of varieties of asset returns, both financial and real assets in US from 1960 - 1986. They argued that the measure of unexpected inflation suggested by Fama and Schwert (1977), the difference between actual inflation and the Treasury Bills rate, were *ex post*. In order to use as much ex-*ante* data as possible, they adopted the Livingston price expectations (LPE) series as a measure of expected inflation. The LPE series is a semiannual forecast by business economists that has been conducted since 1946 and is now handled by the Federal Reserve Bank of Philadelphia. Regression equations were estimated using the Cochran-Orcutt method to control for autoregressive disturbances. The findings showed that only residential real estate was a complete positive hedge against actual inflation whereas all other financial and real assets had standard errors so large that their hedging effectiveness was indeterminant. With regard to the expected inflation, Ruben *et al.* found that the results varied across asset types. However, only Treasury Bills and business real estate provided a complete positive hedge against expected inflation. Findings concerning the unexpected inflation showed that only farmland and residential estate provided complete positive hedges. As real estate was normally only a portion of an investor's portfolio, Ruben *et al.* also considered mixed-asset portfolios by using a Markowitz variance/covariance model to create four mean/variance efficient portfolios. The findings illustrated that the portfolio with business real estate was a complete positive hedge against expected inflation whereas the portfolio with residential real estate was only a partial positive hedge against actual inflation and a complete positive hedge against expected inflation. Nevertheless, none of the portfolios provided statistically significant protection against unexpected inflation.

Hoesli (1994) employed Swiss real estate mutual funds as a proxy to determine if real estate provides an effective hedge against inflation. However, Hamelink and Hoesli (1996) argued that the data used in the study of Hoesli (1994) pertained to Swiss real estate mutual funds and not to real estate. Hence, the conclusion might hold only for securitised real estate, not all types of real estate. Hoesli (1994) argued that the results of many studies, for instance, Fama and Schwert (1977), Brueggeman et al. (1984), Hartzell *et al.* (1987), on the inflation hedging ability of real estate were flawed. Fama and Schwert measured the return on real estate as the rate of inflation of the Home Purchase Price component of the CPI. When part of the CPI was regressed on the CPI, the results would necessarily be positive. Following Fama (1975), Hoesli used the nominal interest rate on a risk-free asset as a proxy for anticipated inflation when assuming constant real interest rates. In the case that real interest rates were hypothesised to follow a random walk, non-constant over time, Hoesli proposed to derive the expected real interest rates by using the ARIMA model. No significant relationship between the return on the mutual funds and the actual inflation was found when monthly, quarterly, and annual data were tested. Nevertheless, real estate seemed to provide a positive hedge against inflation in the long run as the coefficient was positive and marginally significant when five-year data were investigated. However, the tests for a hedge against expected and unexpected inflation assuming constant real interest rates as well as assuming that real interest rates follow a random walk were somewhat inconclusive.

Hamelink and Hoesli (1996) argued that the two types of indices, appraisal-base indices and indices of securitised real estate, which were frequently used as the price appreciation of the real estate markets, had serious limitations. Thus, they constructed a hedonic price index for apartment buildings in Geneva for the 1978 - 1992 period to examine the inflation hedging effectiveness of Swiss real estate. Four approaches were employed to estimate expected inflation. Following Gültekin (1983), the contemporaneous inflation rates were used as proxies in the first approach. This implied that expectations were perfect; therefore, there would be no unexpected inflation. The second model specified the inflation rate at time *t* as a linear function of the inflation rate at time *t-1*. The third and fourth models employed QTARCH model and ARCH-M respectively. The results of AR(1) model revealed that this year's inflation was a good indicator for next year's inflation while the QTARCH was found to be the most highly correlated with the observed inflation rate. Real estate did not appear to enhance the ability of portfolio to hedge against inflation when *ex post* inflation rates were used as estimators of inflation. Hamelink and Hoesli concluded that Swiss stocks, bonds, real estate, and real estate mutual funds were usually positively related to expected inflation and negatively related to unexpected inflation.

Sing and Low (2000) tested the inflation hedging characteristics of real estate and financial assets in Singapore. A wide range of real estate, all-property, shop, office, residential, and industrial real estate were examined over a twenty-one-year period from 1978 to 1998. They also divided sample periods into four five-yearly subperiods to explore the inter-temporal changes of the inflation hedging characteristics of the assets. They further sorted the sample periods into low and high inflation regimes to test the inflation effectiveness of assets in the period of high and low inflation. The periods of high and low inflation were divided at the median of the inflation rates from 1978 to 1998. The high inflation group were the sample periods with inflation above the median while the low inflation group were the sample periods with inflation below the median. Sing and Low used the CPI as a proxy of the inflation rate. A one-period lagged three-month Treasury Bill rate was adopted as the expected inflation in this paper. The unexpected inflation was determined by the approach of Fama and Schwert (1977), the difference between the actual inflation and expected inflation. Since the presence of auto-correlations in the model was indicated by the Dubin-Watson statistics, Sing and Low corrected the auto-correlations in the error terms by including k-lagged autoregressive error terms. The number of lag used for the autoregressive error terms was three. The regression results rejected the inflation-hedging hypothesis for all assets except for shop and industrial property in the case of hedging against actual inflation. Additionally, shop and industrial property were the only two assets that hedged against expected inflation. The only coefficient that was significant, at 10% level, concerning the unexpected inflation was industrial property. Furthermore, the findings of five-yearly subperiod analysis showed that industrial property was the only asset that offered consistent positive hedges against both expected and unexpected inflation. Finally yet importantly, the empirical studies revealed that industrial property was the best choice for investors during the high inflation period.

Chu and Sing (2004) undertook an examination on the inflation hedging characteristics of the Chinese real estate market. Chu and Sing tested the short-term inflation hedging characteristics, using the conventional ordinary least squares (OLS) methodology, in four major cities in China, Beijing, Chengdu, Shanghai, and Shenzhen. They represent the northern, southern, eastern, and western parts of China. Residential, commercial, and office buildings were examined for each city. Chu and Sing added a lagged dependent variable in the regression equation to correct the auto-correlated residuals, as they argued that Fama and Schwert (1977) failed to take into account the stationarity problem in time series data. Following Gatzlaff (1994) and Barkham, Ward, and Henry (1996), ARIMA was used to estimate the expected inflation rates. Since the Chinese Treasury Bill rate was highly regulated and illiquid, it did not appear to be a good proxy of the expected inflation. The findings of the serial correlation adjusted OLS model revealed that real estate of all types in the four Chinese cities were poor hedges against both expected and unexpected inflation with the exception of Chengdu. Real estate in Chengdu was a significant negative hedge against expected inflation. In addition, Chu and Sing examined the long-term relationship between real estate returns and inflation using cointegration analysis. With regard to the cointegration tests, the country-level data were used. The findings showed no significant positive long-term relationship between real estate returns and inflation in Chinese real estate markets.

The last and the most recent study to be discussed in this paper is Hoesli, Lizieri, and MacGregor (2006). They explored the relationship between commercial real estate returns and economic, fiscal, and monetary factors, including inflation, for US and UK markets. Hoesli *et al.* used four-quarter moving averages of inflation rates as the measure for expected inflation. They employed error correction models (ECM) to examine long run integration and dynamic adjustments between asset returns, and real and monetary variables, including inflation. Four asset classes, stocks, small cap stocks, securitised real estate, and real estate, were examined. A wide range of explanatory variables were tested for each country. The findings of Hoesli *et al.* (2006) revealed that expected inflation was a significant variable with a positive coefficient for all asset classes in the case of US long-run model. With regard to direct property, its coefficient was significantly less than 1.0 whereas in the case of REIT it was not significantly different. This implied that direct property is a partial hedge against expected inflation and a complete hedge in the case of securitised real estate. The coefficient on unexpected inflation was always negative and significantly greater than unity. Conversely, there was very limited evidence of inflation hedging for US short-run models, although the resulted suggested real estate was better than other asset classes at hedging against expected inflation. The UK long-run models showed that all asset classes partially hedged against expected inflation although the coefficient of direct property was significantly less than unity and others were significantly higher. The coefficient on unexpected inflation was significantly positive for private real estate. With regard to UK short-run models, only direct real estate exhibited inflation, both expected and unexpected hedging characteristics, although the coefficients were significantly less than unity. This implied that real estate was only a partial hedge against inflation.

EMPIRICAL METHODOLOGIES

Theoretical Framework

This paper attempts to examine the inflation-hedging characteristics of Housing Markets in Thailand. Therefore a clear definition of inflation and inflation hedging needs to be addressed. Fisher (1930) defined inflation as a phenomenon whereby there is a sustained and inordinate increase in the general price level. The observed inflation can be decomposed into two components, expected inflation and unexpected inflation. Adopting Fisher interest rate theorem, Fama and Schwert (1977) proposed the most widely used definition in the empirical studies that an asset is considered to be a complete hedge against inflation, if and only if the nominal return of the asset varies in a one-to-one relationship with both expected and unexpected inflation. Barkham, Ward, and Henry (1996) provided analogous definition that the property of an efficient hedge against inflation is to provide investors with compensation, not only for expected inflation, but also for the inflation that is not foreseen at the time at which prices are set. Following Fisher (1930), Fama and Schwert (1977) formalized the regression model to investigate relationship between asset returns and inflation as follows:

$$r_{jt} = \alpha_j + \beta_j E(\Delta_t) + \gamma_j[\Delta_t - E(\Delta_t)] + \mu_{jt}$$

where

r_{jt} = expected nominal rate of return of asset j at period t

α_j = expected real rate of return of asset j

β_j, γ_j = regression coefficients

$E(\Delta_t)$ = expected inflation rate at period t

(Δ_t) = actual inflation or observed inflation rate at period t

μ_{jt} = random error term

According to the above regression model, since the observed inflation can be split into expected and unexpected inflation, $[\Delta_t - E(\Delta_t)]$ represents unexpected inflation. An asset is said to be a perfect hedge against expected inflation when $\beta_j = 1$, and to be a perfect hedge against unexpected inflation when $\gamma_j = 1$. When $\beta_j = \gamma_j = 1$ the asset is considered to offer a complete hedge against inflation. The signs of the regression coefficient indicate whether an asset is a positive hedge or a negative hedge against inflation. In addition, it suggests that an asset provides a partial hedge against the respective inflation if the coefficient, in absolute term, is less than unity but statistically distinguishable from zero.

Measures of Inflation Rates

The percentage change of the Consumer Price Index (CPI) is the most commonly used by a number of empirical studies as a measure of actual, *ex post*, inflation. On the other hand, as the expected inflation rate is not directly observable, there is yet no consensus on the best method to estimate expected inflation. The proxy utilised by previous empirical studies to create an expected inflation time series can be classified into three categories.

- Firstly, the use of an economic variable, namely Treasury Bill rates, employed by, for example, Fama and Schwert (1977); Brown (1991); Hoesli (1994); Barkman, Ward, and Henry (1996). This proxy is subject to the ex-ante argument of Rebens et al. (1989).
- Secondly, survey-based inflation forecasts by business economists, such as Livingston price expectation series in US, Westpac inflationary expectations series in Australia, and Money Markets International (MMI) in UK, see for example; Rubens, Bond, and Webb (1989); Newell (1996); Barkman, Ward, and Henry (1996).
- Finally yet importantly, regression-generated time series, such as, Autoregressive Integrated Moving Average (ARIMA) model, Vector Autoregression (VAR) model, Autoregressive (AR) model, Autoregressive Conditional Heteroskedasticity (ARCH) model. This robust regression approach has been extensively used by recent empirical researches, see for example; Hoesli, Lizieri, and MacGregor (2006); Goetzmann (2006); Chu and Sing (2004).

Owing to the unavailability of survey-based inflation forecasts in Thailand, the expected inflation rate will be proxied by only two approaches in this empirical study. First, implementing the approach proposed by Fama and Schwert (1977), the expected inflation will be represented by a one-period lagged three-month Treasury Bill rates. In addition, a regression model, AR(1), will be employed to create an expected inflation time series, see Hamelink and Hoesli (1996). The AR(1) model is formalised as follows:

$$\pi_t = \alpha + \beta\pi_{t-1} + \varepsilon_{jt}$$

Having estimated expected inflation, Fama and Schwert (1977) proposed that unexpected inflation or inflation shock is the difference between actual (ex post) inflation and expected inflation, $[\Delta_t - E(\Delta_t)]$.

Data Description

All time series data employed in this study are obtained from CEIC database. The sample period under examination spans from April 1998 - December 2004 on quarterly, half-yearly and annual basis. The Consumer Price Index is obtained and transformed to natural logarithmic value, as suggested by Fama and Schwert (1977), to attain continuous compounding. The actual (*ex post*) rate of inflation, Δ_t, is then computed as the first difference, *i.e.* $\Delta_t = 1n\,(CPI_t/CPIt\text{-}1)$. Unfortunately, the indices that represent the entire Housing markets in Thailand are not available. Thus, two House Price indices and one Land Price index which comprises Bangkok and its vicinity; Nonthaburi, Samutprakarn and Patumthani, are obtained as the surrogate time series for Thai Housing Markets. The two House Price indices are the Single-Detached House Price (excluding land) and Town House Price index (excluding land). Furthermore, they do not take account of income but they only present price appreciation. The Bank of Thailand, to construct these indices, uses a hedonic methodology. Thus, they do not possess the same serious limitations that are inherent in most of the appraisal-based indices. The main problem with appraisal-based series is that they are smoothed, leading to downwards biased standard deviations, see Hamelink and Hoesli (1996), Barkham, Ward and Henry (1996). The last time series obtained is one-period lagged values of three-month Treasury Bill rates, to proxy expected inflation. The first difference of the log-returns of Treasury Bill is then computed to transform nominal returns into continuous returns.

Model Specifications

To test the hedging ability of Housing Markets against actual (ex post) inflation, the market returns are regressed on the actual inflation without decomposing it into expected and unexpected components by the following regression equation.

$$r_{jt} = \alpha_j + \delta_j\Delta_t + \varepsilon_{jt}$$

If the regression coefficient, δ_j, is (statistically) significantly different from zero and indistinguishable from unity, it suggests that the Housing Markets completely hedge against *ex post* inflation. However, if it is statistically significant but distinguishable from unity, it implies that the housing markets provide only a partial hedge against ex post inflation.

Subsequently, the conventional OLS model, proposed by Fama and Schwert (1977), in the following equation is applied to test the efficiency of Housing Markets in hedging against expected and unexpected inflation.

$$r_{jt} = \alpha_j + \beta_j E(\Delta_t) + \gamma_j[\Delta_t - E(\Delta_t)] + \mu_{jt}$$

The hypothesis testing is the Housing Markets are not a perfect hedge against both expected and unexpected inflation. The null hypothesis cannot be rejected if, and only if, both coefficients are statistically indistinguishable from one. However, many recent empirical studies argued that crucial limitations are inherent in the Fama and Schwert (1977) methodology. It failed to take into account the stationarity problem in time series data. Failure to correct the stationarity in the dataset could result in spurious regression, see Tarbert (1996), Matysiak *et al.* (1996), Sing and Low (2000), Chu and Sing (2004). The Durbin-Watson statistic tests show no presence of positive and negative serial correlation, as indicated by figures relatively close to two, in the residual errors from the preliminary estimation regression. The serial correlation may affect the robustness of the models. Sing and Low (2000) corrected the serial correlation in the error terms by including 3-lagged autoregressive error term in the regression model. The third order autoregressive process then reduced the error term to a white-noise process, uncorrelated random error term with zero mean and constant variance (Gujarati 2003). However, this process is not required in this study. Finally, the issue of cointegration, approach employed to investigate any long-run equilibrium relationship of time series, is not addressed in this study. The cointegration tests require long length of time series under examination (Talbert 1996, Chu and Sing 2004), which is not the case of current house price indices available in Thailand at the present time.

ANALYSIS OF EMPIRICAL EVIDENCES

Correlation

Prior to other statistical tests, simple correlation statistics between actual (*ex post*) inflation and returns of housing market, are computed to investigate any connection inflation and housing market returns. In addition, the correlation of Treasury Bills rates and contemporaneous inflation is presented in Table I as well. The results of correlations between actual inflation and returns of housing market, as indicated by Table I, are somewhat inconsistent. Quarterly and half-yearly series show low, some are negative, correlations. However, annual series indicate a moderate correlation between inflation and housing market returns. Further statistical tests need to be carried out to examine the relationship between them. Equally importantly, correlations reveal that relationship between actual (*ex post*) inflation and Treasury Bill rates, a proxy for expected inflation, are mixed. Half-yearly and annual series indicate negatively moderate correlations; conversely, quarterly series show a low but positive correlation. Hence, assessment of Treasury Bill rates as a proxy of expected inflation is required before proceeding to econometric modelling.

Table I: Correlations between actual inflation and returns of housing markets

	Detached House	Town House	Land	Treasury Bills
Quarterly	-0.24	0.24	0.21	0.23
Half-Yearly	-0.13	0.11	0.43	-0.54
Annual	0.63	0.64	0.62	-0.65

Sample period is from 1998 - 2004

Assessing proxies for expected inflation

The Treasury Bill rates were extensively used as the proxy of expected inflation rate in several studies. Nonetheless, the use of Treasury Bills as a proxy for expected inflation was subject to critique by numerous successive empirical evidences. Following Fama (1975), this paper tests whether Treasury Bills is a good proxy for expected inflation rate in Thailand by running the following regression:

$$\Delta_t = \alpha + \beta r_{bt} + e_t$$

If β is statistically indistinguishable from one then Treasury Bill rates can be used as a good proxy for expected inflation. The intercept term, α, represents the real rate of return. The results obtained from the regression estimation are shown in Table II.

Table II: Treasury Bill rates as proxies for expected inflation, 1998 - 2004

	Sample size	α	β	Adjusted R^2	DW	Serial correlation in residual for following lags: 1	2
Quarterly	25	1.121	-0.358	0.1527	2.083	-0.206	-0.016
		(0.3156)	(0.1326)				
Half-yearly	11	1.312	-0.216	0.1638	1.915	-0.637	-0.180
		(0.7507)	(0.3609)				
Annual	6	3.145	-0.798	0.2839	1.731	N/A	N/A
		(0.9861)	(0.4620)				

DW is the Durbin-Watson statistic for serial correlation

Standard errors are shown in the brackets.

N/A indicates that the length of sample period is not sufficient for lagging of residual

Only slope coefficient of quarterly series that are statistically different from zero and statistically indistinguishable from one. The serial correlation coefficients are not statistically different from zero. Furthermore, the Durbin-Watson statistical test of quarterly series reveals no presence of serial correlation in the residual errors from the regression estimation. These findings imply that Treasury Bill rates act as an efficient proxy of expected inflation rate. However, the slope coefficients of half-yearly and annual series are not significantly different from zero. This means that Treasury Bill rates do not act as a good proxy of expected inflation in the case of half-yearly and annual series. The inconsistent findings suggest that the use of Treasury Bill rates as a proxy of expected inflation is inconclusive and still open to debate.

The second proxy of expected inflation rate used in this study is a regression-generated time series. The expected inflation rate will be proxied by first-order autoregressive, AR(1). The AR(1) is a dynamic econometric model. In sharp contrast to the model proposed by Fama where real interest rates are assumed to be constant, the real interest rates are hypothesised as being non-constant over time in AR(1), see Hamelink and Hoesli (1996). The AR(1) includes one-period lagged value of the observed inflation as the explanatory variable and allows real interest rates to vary over time. The regression model of AR(1) used in this paper is formalised as follows:

$$\pi_t = \alpha + \beta\pi_{t-1} + \varepsilon_{jt}$$

Table III: AR(1) as proxies for expected inflation, 1998 - 2004

	Sample size	α	β	Adjusted R^2	DW
Quarterly	26	0.3545 (0.1429)	-0.0712 (0.1883)	-0.0354	1.988
Half-yearly	12	0.8341 (0.3150)	-0.1202 (0.2844)	-0.0806	2.217
Annual	5	0.6027 (1.0091)	0.8637 (0.7696)	0.0609	2.373

DW denotes the Durbin-Watson statistic for serial correlation
Standard errors are shown in the brackets.

All intercept terms are insignificant and none of the slope coefficients is statistically different from zero. In addition, the adjusted R^2 values are extremely low. This implies that the expected inflation rate should not be proxied by the AR(1) modelling because one period lagged value of the observed inflation is not an explanatory variable of the contemporaneous inflation.

Since the AR(1) model is invalid, a new regression-generated time series is required in order to compare the inflation hedging between Treasury Bill rates and econometric modelling as proxies for expected inflation. The visual inspection of the autocorrelations and partial autocorrelations of the series of the observed inflation using the correlograms indicate ARIMA(1,2,0) modelling only for quarterly series, not half-yearly and annual series. The results of the regression estimation are shown in table IV.

Table IV: ARIMA(1,2,0) as proxies for expected inflation, 1998 - 2004

	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.760750	0.205162	3.708038	0.0012
Δ_t-1	-2.129213	0.299473	-7.109865	0.0000*
Adjusted R^2	0.673692			
Durbin-Watson	2.180911			

* indicates that the coefficient is very significant

Both constant and slope coefficients are highly significant. In addition, the slope coefficient is statistically indistinguishable from one. This suggests that ARIMA(1, 2, 0) acts as a good proxy for expected inflation. The goodness of fit of the regression model as indicated by R^2 value, over 60 per cent, is relatively high. According to the assessment of proxies for expected inflation, the expected inflation rate will be proxied by Treasury Bill and ARIMA(1, 2, 0) on a quarterly basis only.

Hedging Against Actual Inflation

None of the regression coefficients is statistically indistinguishable from zero. The regression coefficients of town house and land are positive but that of detached house is negative. The goodness of fit of the regression models is extremely low. These findings suggest that the regression results reject inflation-hedging hypothesis for all housing markets. In other words, housing markets are not good hedges against actual inflation. This result contradicts the findings of many earlier studies in other countries, which revealed that real estate hedges against inflation. Interestingly, none of the regression coefficients of constant, which represent real rate of interest, is significant. This implies that housing markets do not appear to provide a positive real rate of interest.

Table V: Inflation-hedging of Housing market against actual inflation, 1998 - 2004

	α_j	β_j	Adjusted R^2	Durbin-Watson Statistics
Detached House	1.1074 (0.9071)	-1.5426 (1.2125)	0.0232	1.829
Town House	-0.1262 (0.7790)	1.3365 (1.0413)	0.0242	2.799
Land	-1.5925 (2.0663)	3.0254 (2.7619)	0.0076	2.791

Standard errors are shown in the brackets.

Hedging Against Expected and Unexpected Inflation

The examinations of inflation hedging against expected and unexpected inflation are conducted by the conventional OLS model, proposed by Fama and Schwert (1977). The results of the regressions with the application of three-month Treasury Bill rates to proxy the expected inflation rate are summarised in Table VI. The results are in marked contrast to most previous empirical studies in other countries. Housing markets do not appear to provide any hedging relationship against expected inflation and unexpected inflation. The β_j and γ_j coefficients of detached house are negative while those of town house and land are positive but all of the regression coefficients are insignificantly different from zero. Moreover, the findings imply that housing markets do not appear to offer positive real rate of return since the constant coefficients, which represent real rate of return, are all not significantly different from zero. These empirical evidences are unfavourable to real estate, particularly housing sectors, in Thailand.

Table VI: Hedging against expected and unexpected inflation, T-Bill as a proxy

	α_j	β_j	γ_j	Adjusted R^2	Durbin-Watson Statistics
Detached House	1.9379 (1.1499)	-1.5276 (1.2041)	-1.1988 (1.2399)	0.0367	1.942
Town House	-0.0713 (1.0148)	1.3374 (1.0626)	1.3592 (1.0942)	-0.0160	2.801
Land	0.4521 (2.6069)	3.0623 (2.7299)	3.8717 (2.8109)	0.0306	2.863

Standard errors are shown in the brackets.

Table VII: Hedging against expected and unexpected inflation, ARIMA as a proxy

	α_j	β_j	γ_j	Adjusted R^2	Durbin-Watson Statistics
Detached House	0.7357 (0.9374)	-0.3547 (1.4496)	-1.5187 (1.3734)	0.0304	1.620
Town House	-0.3855 (0.8159)	1.7844 (1.2617)	0.8415 (1.1954)	0.0306	2.559
Land	-1.4083 (1.9773)	3.6023 (3.0574)	6.4852* (2.8968)	0.1609	3.007

Standard errors are shown in the brackets.

* Statistically significant at a 5% level

Table VII shows the regression results of inflation hedging performance against expected and unexpected inflation of housing markets using ARIMA modelling as proxies of expected inflation. The results are closely aligned with the regression estimation using Treasury Bill rates as a proxy of expected inflation except in the case of land. None of the regression coefficients of detached house and town house is statistically significant. These empirical evidences indicate that detached houses and town house do not appear to hedge against both expected and unexpected inflation. Furthermore, they do not offer positive real rate of return since their constant coefficients, α_j, are indistinguishable from zero. However, the regression results do not reject the hypothesis that land is a good hedge against unexpected inflation. The γ_j coefficient of land, 6.4852, is significantly different from zero. Land provides more than a one-to-one hedging characteristic against the variation in the unexpected inflation. On the contrary, it does not provide an efficient hedge against expected inflation as its β_j is not significant. The goodness of fit of the land model using ARIMA as a proxy of expected inflation is somewhat higher than those of detached house and town house. However, the Adjusted R^2 of 16.09% indicates that there are other independent variables explaining the variation of the land price.

It should be pointed out that the period under examination is the period after a bust of property markets and economic crisis in Thailand. It is the period when one would logically expect a sharp slump in income and price of property. Hence, the available data set limit the study of inflation hedging characteristics of housing markets at other stages of property markets and economy. Additionally, the results of this study are yet inconclusive as to whether Thai property markets hedge against inflation due to the short timeframe of the period under study.

IMPLICATIONS AND CONCLUSION

This paper provides empirical evidences to verify conventional beliefs regarding proxies of expected inflation and inflation hedging characteristics of housing markets in Thailand. Treasury Bill rates and regression-generated time series are tested whether they constitute good proxies of expected inflation. The results of the analyses of different frequency time series are conflicting. Treasury Bill rates only act as a good proxy of expected inflation for the quarterly time series but not for half-yearly and annual data set. When the ARIMA modelling, which is the more robust approach that allow real rate of return to vary overtime, is employed, the results completely coincide with the Treasury Bill rates. Thus, the assumption, which hypothesizes that the real rate of returns are constant, yet requires further careful scrutiny and critique. The appropriate approach to estimate the expected inflation rate is inconclusive and the debate on the subject remains open.

The regression results of hedging against actual (*ex post*) inflation reject the inflation-hedging hypothesis of Thai housing markets. This finding is not in line with empirical evidence found in extensive number of literatures in other countries. Interestingly, there is no strong evidence to indicate that housing markets provide positive real rate of return. However, the state of the property markets under the examination period must be taken into account. The sample period is the period following a big crash in property markets and economic slump in Thailand. The extreme state of property markets may have distorted the inflation hedging characteristics. When the availability of data allows, further investigation on other market scenarios should be carried out.

The regression results of hedging against expected and unexpected inflation using Treasury Bill rates and ARIMA modelling as proxies of expected inflation closely coincide with the exception of land segment. In the case of land segment, when the ARIMA model is used as a proxy of expected inflation, the regression coefficient of unexpected inflation is statistically significant. This finding implies that land segment hedges against inflation shock or unexpected inflation. Moreover, the evidence reveals that the relationship between returns of land segment and unexpected inflation is more than a one-to-one relationship, returns increase at a rate that is faster than the increase in unexpected inflation. Therefore, the implication is that the inclusion of land in an investor's portfolio would provide a hedge against inflation risks of other assets in the portfolio, in addition to its own inflation risks. Nonetheless, its adjusted R^2 value of the ARIMA modelling is only 16.09 per cent. This suggests that inflation, expected and unexpected, is not the only factor contributing to returns on land segment.

Lastly yet importantly, Tarbert (1996) argued that the property markets are extremely unlikely to adjust instantaneously to changes in inflation and it would seem unlikely that a static regressions method would capture adequately any responses from inflation to property markets. Consequently, the static regressions employed in this study may be inappropriate because it is unable to differentiate between adjustments to a long-run equilibrium and short-run dynamic movement. Nevertheless, the limitations of data availability, only from 1998 to 2004, prohibit the use of cointegration approach in this paper to obtain an estimate of any long-run equilibrium relationship. Thus, the findings of this paper regarding proxies of expected inflation and inflation hedging characteristics of housing markets in Thailand is yet far from definitive and remain open to further investigation.

REFERENCES

Benjamin, J.D., Sirmans, G.S. and Zietz, E.N. (2001), "Returns and Risk on Real Estate and Other Investments: Moer Evidence", *Journal of Real Estate Portfolio Management*, Vol. 7, No. 3, pp. 183-214.

Brown, G.R. and Matysiak, G.A., *Real Estate Investment: A Capital Market Approach*, FT Prentice-Hall, 2000.

Barkham, R.J., Ward, C.W.R. and Henry, O.T. (1996), "The inflation-hedging characteristics of UK property", *Journal of property Finance*, Vol. 7, No. 1, pp. 62-76.

Chu, Y. and Sing, T.F. (2004) "Inflation Hedging Characteristics of the Chinese Real Estate Market", *Journal of Real Estate Portfolio Management*, May - Aug.

Fama, E.F. (1975), "Short term interest rates as predictors of inflation", *American Economic Review*, Vol. 65, No. 3, pp. 269-82.

Fama, E.F. and Schwert, G.W. (1977), "Asset return and inflation", *Journal of Financial Economics*, Vol. 5, pp. 115-46.

Goetzman, W.N. (2006), "Simulating Real Estate in the Investment Portfolio: Model Uncertainty and Inflation Hedging", *Yale ICF Working Paper*, No. 06-04.

Gujarati, D.N., *Basic Econometrics*, 4th ed., McGraw-Hill, 2003.

Hoesli, M., Lizieri, C. and MacGregor, B. (2006), "The Inflation Hedging Characteristics of US and UK Investments: A Multi-Factor Error Correction Approach", *Working Papers in Real Estate & Planning*, University of Reading Business School.

Hamelink, F. and Hoesli, M. (1996), "Swiss real estate as a hedge against inflation - New evidence using hedonic and autoregressive models", *Journal of Property Finance*, Vol. 7, No. 1, pp. 33-49.

Hoesli, M. (1994), "Real Estate as a Hedge against Inflation - Learning from the Swiss Case", *Journal of Property Valuation & Investment*, Vol. 12, No. 3, pp. 51-59.

Li, V.W.K. (2001), "Canadian Real Estate and Inflation", *Canadian Investment Review*, Spring.

Miles, D. (1996), "Property and inflation", *Journal of Property Finance*, Vol. 7, No. 1, pp. 21-32.

Matysiak, G., Hoesli, M., MacGregor, B. and Nanthakumaran, N. (1996), "The long-term inflation-hedging characteristics of UK commercial property", *Journal of Property Finance*, Vol. 7, No. 1, pp. 50-61.

Newell, G (1996), "The inflation-hedging characteristics of Australian commercial property: 1984-1995", *Journal of Property Finance*, Vol. 7, No. 1, pp. 6-20.

Rubens, J.H., Bond, M.T. and Webb, J.R. (1989), "The Inflation-Hedging Effectiveness of Real Estate", *The Journal of Real Estate Research*, Vol. 4, No. 2, pp. 45-55.

Stevenson, S. and Murray, L. (1999), "An Examination of the Inflation Hedging Ability of Irish Real Estate", Journal of Real Estate Portfolio Management, Vol. 5, No. 1, pp. 59-69.

Schofield, J.A. (1996), "Inflation hedging and UK commercial property", *Journal of Property Finance*, Vol. 7, No. 1, pp. 99-117.

Stevenson, S. (1999), "The performance and inflation hedging ability of regional housing markets", *Journal of Property Investment & Finance*, Vol. 17, No. 3, pp. 239-60.

Sing, T.F. and Low, S.H. (2000), "The Inflation-Hedging Characteristics of Real Estate and Financial Asessts in Singapore", *Journal of Real Estate Portfolio Management*, Vol. 6, No. 4, pp. 373-85.

Tarbert, H. (1996), "Is commercial property a hedge against inflation? A cointegration approach", *Journal of Property Finance*, Vol. 7, No. 1, pp. 77-98.

Yobaccio, E., Rubens, J.H and Ketcham, D.C (1995), "The Inflation-Hedging Properties of Risk Assets: The Case of REITs", The Journal of Real Estate Research, Vol. 10, No. 3, pp. 279-96.