

The Inflation-Hedging Ability of Real Estate Thai Evidence: 1987-2011

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Abstract

This study examines whether Thai real estate can hedge against *ex post* and *ex ante* inflation during the 1987-2011 period. Using the Fama and Schwert framework, we find that real estate returns have a positive (albeit not strongly significant) relation with both *ex post* and unexpected inflation over the period. However, by focusing on various sub-periods in order to control for possible structural changes in the economy, we find that the relationship between inflation and real estate returns depends on the state of the economy. Real estate provided a super hedge against inflation, especially, in the recent financial crisis.

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1 Introduction

The aim of rational investors is not only to maximize returns but also to reduce investment risks. Among the risks investors face, inflation has become one of the predominant concerns because it erodes the real return on their investment. The fear of losing purchasing power urges investors to invest in assets that protect against the adverse effects of inflation. These assets are called inflation hedges [47]. Particularly when the erosion of purchasing power by inflation is partially or fully offset by the increase in the investment asset's return, this asset is said to hedge against inflation [12]. In his theory of interest rate, Fisher [13] posits that expected nominal interest rates should move on a one-for-one basis with expected inflation. This so-called Fisher hypothesis, generalized to

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other investment assets, implies that the expected nominal return on any investment asset should be equal to the expected inflation rate plus its expected real return, which is assumed to be independent from inflation [11].

Inflation-hedging assets are more attractive than others. Among alternative investment assets, real estate has historically been viewed as a good investment asset and a powerful inflation hedge. Investing in direct real estate serves both the need for housing and the wish to protect wealth against inflation. As mentioned by Le Moigne and La [21] real estate is ranked second, following Treasury Inflation Protected Securities (TIPS), among the best inflation hedges. For long-term investors such as pension funds, insurance companies, which are confronted with liabilities that are positively related to inflation, real estate has always been a preferred investment asset [15, 17, 20, 46]. Similarly, real estate is also a desirable choice for young investors seeking secured retirement [3]. However, in practice, whether or not real estate can provide a hedge against inflation is still a controversial issue [12].

Understanding the characteristics of real estate investments is particularly important for Thailand for several reasons. First, more than a third of Thai households' wealth is estimated to consist of residential and commercial real estate [41]. Second, the development of the real estate sector in Thailand has spurred as the country is transforming from an agriculture and trade-based economy into a tourism and manufacturing-based economy [37]. Consequently, the social, economic and cultural characteristics of its cities have also been transformed [9, 22]. Particularly, the dominant role of the traditional big family is increasingly being challenged by the single family's role and the young generation's need of their own house as a "nest-egg". Thirdly, Thai households are more likely to own more than one property than before, thanks to the growing affluence as well as easier access to funds and government support. More often than not, one property is bought as residence, while other properties are let out for rental income, i.e. for investment purposes. These three factors have contributed to a buoyant demand for real estate [48].

The benefits of including real estate in investment portfolios have been recognized by the financial literature (see e.g. MacGregor and Nanthakumaran [29]). These advantages encompass portfolio diversification, increasing investment income, and protecting the investment value against inflation [21]. Understanding the Thai real estate market's characteristics - such as its inflation-hedging ability - benefits domestic investors as well as international institutional investors [34]. This paper not only contributes to the literature by focusing on a developing country. In addition, Thailand was confronted with various economic and political environments. This allows us to show that the hedging ability of real estate depends on the state of the economy.

The remainder of this paper is structured as follows. Section 2 reviews the existing literature. Section 3 sets out a conceptual framework for inflation hedging. The methodology and data are considered in section 4. In section 5, the empirical findings are presented and analyzed. The final section concludes the study with a summary of the key findings.

2 Literature Survey

Early research on the relationship between real estate and inflation focuses on the U.S. It uses ordinary least squares (OLS) to investigate the expected and unexpected inflation hedge of corporate bonds, government bonds, treasury bills, real estate returns, common

stock returns and wages (e.g., Fama and Schwert [11]). For real estate, they find significantly positive and close-to-unity coefficients during the period 1953-1971. Moreover, its results indicate that only residential real estate can provide a perfect hedge against both expected and unexpected inflation. These findings are also corroborated by other studies: for the U.S., e.g., Bond and Seiler [5], Rubens, et al. [39] and for other countries, e.g., Hong Kong (Ganesan and Chiang [15]) or Canada ([2], Le Moigne and La [21], Newell [33]).

Studies on the inflation-hedging capability of other types of real estate in different countries provide, however, mixed results [26, 30]. For example, Rubens, et al. [39] investigate the inflation hedging-ability of three types of U.S. real estate, i.e. residential, commercial and farmland. They find that only residential real estate can provide a perfect hedge against inflation. While commercial real estate can hedge against expected inflation, it cannot hedge against unexpected inflation. In contrast, farmland provides a hedge for unexpected inflation, but not for expected inflation. Zooming in on more specific property types such as apartments, office, retail, and warehouse property, Huang and Hudson-Wilson [20] find that offices are the best hedge against both expected and unexpected inflation. The next best hedges are apartments followed by warehouses. In contrast, retail does not provide a hedge against inflation. These empirical findings indicate that various property types may show a different sensitivity to the inflation due to differences in the renting contracts used. Retail leases e.g. may contain rent provisions specifying the rent as a percentage of gross sales, thus letting their revenue vary directly with the consumer price level. In addition, also other lease characteristics (typical term of lease, renewal options, etc.) may influence the relationship between inflation and real estate returns [21]. For instance, the terms of lease may impact the operating expenses that in turn influence rental income. If a lease allows for a pass-through of operating expenses to the tenant such as for office and retail leases, the rental incomes are unaffected by an increase in inflation [20]. In other words, real estate value may reflect increases in the general level price, and hence may provide an inflation hedge. Conversely, if it is a fixed-rent long-term lease such as customarily in Hong Kong, an increase in inflation may negatively influence rental income. In such a case, real estate is not a good hedge against inflation [15].

Real estate's inflation-hedging capacity may not only vary across property types, but may also be a function of the prevailing economic conditions [43]. Li [25] finds that the significant relationship between Canadian real estate and inflation found in a high inflation period (1974-1982) disappears in a low inflation period (1983-1994). Le Moigne and La [21] attribute this to the Bank of Canada following a strict inflation targeting framework in which inflation rates are always kept at low levels. Yet, these results contradict those of Önder [36]. He finds that real estate in Turkey does not provide an inflation hedge in a highly inflationary environment.

3 Methodology

3.1 The Fisher Hypothesis

Fisher [13] states that the expected nominal interest rate is equivalent to the sum of the expected real interest rate and the expected inflation rate, and also that the real and monetary sectors of the economy are largely independent. Therefore, the expected

inflation should be fully reflected into the expected nominal interest rate. The theory is generalized to nominal returns on any asset, which should move one-for-one with expected inflation [11]. Formally, the proposition can be represented by

$$[1 + E_{t-1}(R_t)] = [1 + E_{t-1}(r_t)][1 + E_{t-1}(\pi_t)] \quad (1)$$

where E_{t-1} is the conditional expectation operator at time $t - 1$, R_t denotes the nominal return on an asset from time $t - 1$ to t , r_t is the appropriate equilibrium real return on the asset from time $t - 1$ to t , and π_t represents the inflation rate from time $t - 1$ to t . Equation (1) can be equivalently reformulated as

$$E_{t-1}(R_t) = E_{t-1}(r_t) + E_{t-1}(\pi_t) + E_{t-1}(r_t)E_{t-1}(\pi_t) \quad (2)$$

In (2), the cross-product term $E_{t-1}(r_t)E_{t-1}(\pi_t)$ is usually negligible. Hence, the representation of (2) is routinely written as

$$E_{t-1}(R_{it}) = E_{t-1}(r_{it}) + E_{t-1}(\pi_t) \quad (3)$$

3.2 Empirical Model

We investigate the *ex post* relationship between the nominal asset return and inflation using the following regression:

$$R_t = \varphi + \omega\pi_t + \epsilon_t \quad (4)$$

where φ and ω are coefficients and ϵ_t is the error term.

Following Fama and Schwert [11], we also estimate the following *ex ante* model in the second step:

$$R_t = \alpha + \beta E_{t-1}(\pi_t) + \gamma U E_{t-1}(\pi_t) + n_t \quad (5)$$

where n_t is the error term.

Since both explanatory variables are orthogonal, consistent estimates of β and γ can be obtained as long as expected inflation is observable. In equation (5), Fama and Schwert [11] indicate three cases for the hedging potential of an asset:

- (a) If the tests indicate that $\beta = 1.0$, the asset is said to be *a complete hedge against expected inflation*: there exist a one-to-one relationship between the nominal return on asset and the expected inflation rate, and also the expected real return on the asset varies independently to the expected inflation rate.
- (b) If the tests show that $\gamma = 1.0$, the asset is *a complete hedge against unexpected inflation*.
- (c) If the tests point out that $\beta = \gamma = 1.0$, the asset is considered as *a complete hedge against inflation*: the nominal return on asset has a one-to-one relationship with both the expected and unexpected inflation rate, and the *ex post* real return on the asset varies independently to the *ex post* inflation rate.

It should be noted that the approach by Fama and Schwert [11] requires a suitable measure for the expected and unexpected inflation rates. Since the use of the treasury bill rate as a proxy for expected inflation by Fama and Schwert [11] cannot be reliably applied due to lack of openly traded short-term risk-free monetary instruments in Thailand, another expected inflation measure must be used. Comparing the performance of four main methods to forecast inflation, i.e., time series-based models, a Phillips curve-based model, a term structure-based model, and survey-based measures such as survey forecasts by Livingston, SPF show that surveys outperform the other ones and that ARIMA models perform decently out-of-sample. Given the unavailability of survey-based measures for the country, we therefore use ARIMA models (Box and Jenkins [6]) to estimate the expected and unexpected inflation for this study. This approach is also commonly employed by other studies, e.g., Gultekin [16], Li, et al. [23] and Wahlroos and Berglund [44]. We estimate all regressions by OLS (Ordinary Least Squares), since our focus is to examine the short-run influence of inflation on the asset returns, and not the feedback from returns to inflation. We use the Newey-West corrected covariance matrix when computing the test statistics in order to account for heteroskedasticity and residual autocorrelation [35].

4 Data and Summary Statistics

4.1 Data

The consumer price index (CPI) in Thailand is used as a proxy for actual inflation. We decompose actual inflation rate into expected inflation and unexpected inflation. Among others, Nelson [32] and Gultekin [16] point out a few technical issues with the use of a monthly Consumer Price Index (CPI) as a measurement of inflation regarding to the timing of CPI measurement, their public announcement and the actual rate of information flow to the market.⁴ Hence, we follow Fama and Schwert [11], Cohn [8] and Bodie [4] and use quarterly data aggregated from monthly data to avoid the inherent technical issues of monthly CPI data.⁵ CPI is obtained from the DataStream.

We measure real estate performance by considering two available housing indices, i.e. the index for single detached houses with land and the index for town houses with land. Ideally, total returns should be used for our analysis and not just the price appreciation. Unfortunately, only price indices are available for both housing types. Data of both indices

⁴Particularly, CPI is not the end-of-the-month measurement, but various measurements of components over the month instead. Its public announcement is usually made later than the measured month or even often with long delays, for which these announcements may convey little additional information to the market beyond what the market participants directly observed or obtained from other sources. These suggest that lagged and lead inflation rates may convey more information, which should be taken into account by regressing the returns on the individual lagged and leads in the inflation rates as well as other distributed lag and lead models to capture their importance.

⁵However, our empirical findings do not significantly change when monthly data are used.

are provided by Bank of Thailand.⁶ Both single house and town house returns are defined as log index changes.

4.2 Data Motivation

Direct real estate in general serves two needs: it can be held to shelter people and/or goods, or it can be used as an investment asset [24]. Depending on the type of real estate, one dimension might be more essential than the other, which in turn may impact its inflation-hedging properties [14]. Therefore, it is worth discussing here the differences in characteristics between the two types of real estate investigated in this study.

Single houses are large ones located at the ring of cities and towns, which are essentially used for dwelling purposes. Hence, the single house index essentially represents residential real estate, and its price is determined mainly by the households' residential demand. Based on Fama and Schwert [11] we expect that the relationship between single houses and inflation (both expected and unexpected) is positive.

In contrast, town houses are one to two-storey barrack-typed or row houses [37], located in the central district of cities or towns with an easy access to public transportation, e.g., BTS Skyway Train or subway MRT. These houses are popular, not only for dwelling purposes but also the renting purposes. This type of houses thus tends to be more hybrid in nature, i.e., combining residential and commercial real estate characteristics, and may behave differently from pure residential real estate. E.g., Hoesli, MacGregor, Matysiak and Nanthakumaran [19] show that the renting rates on commercial real estate are able to compensate for both expected and unexpected inflation due to their being determined by the market. Nevertheless, if rents are set in advance and cannot be reviewed in the short run, commercial real estate can provide a hedge against expected inflation but not against unexpected inflation. This is supported by Le Moigne and La [21] who find income-generating real estate providing a perverse hedge against inflation. In addition, Huang and Hudson-Wilson [20] claim that a negative relation between commercial real estate returns and expected inflation is possible if the monetary authorities attempt to combat inflation via interest rate policy. Particularly, an increase in the policy interest rate to reduce inflation may raise the borrowing cost for businesses, which in turn reduces the demand for housing leases and therefore commercial real estate returns. Therefore, we expect that the relationship between town house returns and inflation (expected and unexpected) can be either positive or negative.

4.3 Summary Statistics

Table 1 reports the summary statistics for single house and town house returns, as well as for inflation rates. Both kinds of real estate have a positive average return with a relatively high standard deviation over the sample period. The inflation rate exhibits a high autocorrelation coefficient⁷ at the fourth lag. Given these results, we use an AR(4) model to decompose the inflation rates into expected and unexpected inflation rates. The portmanteau test [28] fails to find any remaining significant residual serial correlation, indicating no misspecification of the filter.

⁶The Bank of Thailand uses a hedonic regression methodology to construct these indices.

⁷The coefficients are statistically significant at the 5% level.

Table 1: Summary statistics

	Mean	Median	Min	Max	Std	Skewness	Kurtosis	<i>N</i>
R_{SH} (%)	0.40	0.75	-23.26	19.94	4.51	-4.49	32.23	75
R_{TH} (%)	0.44	0.59	-21.72	18.05	3.90	-4.34	30.74	75
π_t (%)	0.91	0.90	-4.13	4.98	1.16	-0.46	7.04	100
$E(\pi_t)$ (%)	0.91	0.90	-0.37	1.93	0.30	-0.46	7.01	96
$UE(\pi_t)$ (%)	0.00	0.05	-5.15	3.85	1.14	-0.67	7.52	96

5 Empirical Results

5.1 Regression Results

This section presents the empirical findings of the inflation hedging tests for two kinds of Thai real estate, single houses and town houses. These tests examine the inflation hedging ability of each type first against actual inflation (equation 4) and then also against both expected and unexpected inflations (equation 5).

The results in Table 2 (panel A) show a positive but not statistically significant relationship between both single house and town house returns and actual inflation, indicating that these two types of housing possibly provide a hedge against *ex post* inflation. Furthermore, given the large standard errors, both coefficients are not statistically different from neither one nor zero as can be seen from the table. Hence, we can also not reject the fact that real estate returns may move in one-to-one correspondence with *ex post* inflation.

Table 2: Regression results of real estate returns on actual inflation rates, expected inflation and unexpected inflation.

In the table, the hypothesis $H_0: \omega_i = 1$ or $H_0: \beta_i = 1$ or $H_0: \gamma_i = 1$ are shown in the brackets next to the coefficients, and the robust t -values for testing the hypothesis $H_0: \varphi_i = 0$ or $H_0: \omega_i = 0$ or $H_0: \alpha_i = 0$ or $H_0: \beta_i = 0$ or $H_0: \gamma_i = 0$ are reported in the parentheses below the coefficients.

Panel A: real estate returns on actual inflation rates.

$$R_{it} = \varphi_i + \omega_i \pi_t + \varepsilon_t$$

	φ_i	ω_i	N	\bar{R}^2	F
R_{SH}	-0.01 (-0.68)	0.63 [-0.66] (1.15)	75	0.01	1.33
R_{TH}	-0.01 (-0.61)	0.56 [-0.88] (1.10)	75	0.01	1.20

Panel B: real estate returns on expected and unexpected inflation rates.

$$R_{it} = \alpha_i + \beta_i E(\pi_t) + \gamma_i UE(\pi_t) + n_t$$

	α_i	β_i	γ_i	N	\bar{R}^2	F
R_{SH}	-0.00 (-0.26)	0.40 [-0.39] (0.26)	0.65 [-0.60] (1.11)	75	0.01	0.66
R_{TH}	0.00 (0.03)	-0.11 [-0.79] (-0.08)	0.60 [-0.73] (1.09)	75	0.01	0.60

F -value for testing the null hypothesis that $\beta = \gamma = 1$: 0.27 and $\beta = \gamma = 0$: 0.66 (R_{SH})

F -value for testing the null hypothesis that $\beta = \gamma = 1$: 0.67 and $\beta = \gamma = 0$: 0.60 (R_{TH})

Table 2 (panel B) presents the regression coefficients of real estate returns on expected and unexpected inflation. While single house returns have a positive relationship with both expected and unexpected inflation, town house returns have a negative relationship with expected inflation. However, because of the relatively large standard errors, not a single coefficient is significantly different from neither zero nor one. In other words, the results cannot reject the Fisher hypothesis of a one-to-one relationship between real estate returns and the *ex-ante* inflation. Moreover, both coefficients on expected and unexpected inflation are found to be statistically jointly indistinguishable from zero and unity using an F-test ($H_0: \beta = \gamma = 0$; $H_0: \beta = \gamma = 1$). These findings seem to confirm our conjecture about the impact of this real estate type's dimension, (i.e., an income-generating investment asset) on its inflation-hedging ability.

5.1 Stability Analyses

Structural changes may occur in many time series due to economic shocks, market crises and various institutional reforms. Such episodes, if not taken into account, may induce structural shifts and bias the estimated results [1, 45].

Given the significant changes in the Thai economy, we divide our sample into four sub-periods. During the first period, running from 1987Q1 to 1997Q2, Thailand achieved strong economic growth and was recognized as one of the world's fastest growing economies (see, e.g., Endo [10] and Morrison [31]). The second period (1997Q3-2003Q3) covers the Asian financial crisis and was characterized by severe economic conditions. By the end of June 1997, net official foreign reserves had fallen to only US\$ 2.9 billion. Floating the Baht and seeking assistance from the IMF was unavoidable [42]. Even after July 1998, Thai macroeconomic policy was still under tight supervision of the International Monetary Fund (IMF). The Thai government's loan commitments created serious concerns for investors' confidence about the extent to which the Thai government was free to conduct its macroeconomic policy. In fact, prominent economists such as Joseph E. Stiglitz claimed that the involvement of IMF did have a negative impact on the Thai economy: "All the IMF did was make East Asia's recession deeper, longer, and harder" [40]. The impact on real estate markets also was severe. In 1998, 350,000 housing units were unoccupied. The number of housing projects also significantly dropped from 79,824 units in 1995 to 4,469 units in 1999. These facts evidence the seriousness of the strains put on the Thai housing market. From July 2003 onwards, Thailand was completely free from its financial obligations to the IMF and hence from its restrictions in implementing economic policies. Finally, we separate the effects of natural and political shocks to the Thai economy from Q4 2003 to Q4 2008. This period witnessed severely unstable Thai politics: during this period one military coup and about three political demonstrations by opposition parties immobilized the country. As an illustration, no less than four prime ministers alternatively came into office in 2008. These shocks may have influenced the real estate-inflation relation since real estate markets are very sensitive to the economic shocks and political news [27].

Taking these structural changes into account, we incorporate three dummies for four sub-periods at three break points, i.e., July 1997, October 2003 and January 2009, to check the stability of the real estate return-inflation relationship. Dividing sub-periods in such a way can therefore provide a robustness check of the real estate-inflation relationship across different inflationary regimes.

Table 3 presents the regression results of equation (6) and (7). Considering the results for single houses and town houses in equation (6), the *ex post* real estate return-inflation relationship is consistently positive for all sub-samples that were characterized by financial or political turmoil. It is only for the last period spanning the latest financial crisis, that we find positive coefficients that are significantly greater than zero.

For the period with spectacular growth (the first sub-period: 1987Q1-1997Q2), we find that the coefficients for both types of housing are significantly smaller than one at the 1% level, but are insignificantly different from zero. This implies that both single house and town house do not provide a complete hedge against *ex post* inflation in the prosperous growth period. There are two possible explanations. First, before the 1997 Asian financial crisis, the Bank of Thailand followed a fixed exchange rate regime, in which the Thai Baht was pegged to a currency basket (in which the USD accounted for 80%). Therefore, inflation was effectively anchored at a level comparable with low inflation rates in the

U.S. over this period. Second, the real estate prices rose rapidly during this period because of a large influx of foreign capital into the market. During the Asian financial crisis, the results are inconclusive. The estimated standard errors are so large that the coefficients are not statistically significantly different from neither zero nor one. Due to this lack of precision, we cannot reject the Fisher hypothesis.

In the Asian financial crisis (the second sub-period: 1997Q3-2003Q3) the regression coefficients of both types of housing are positive, however, because of the relatively large standard errors, not a single coefficient is significantly different from neither zero nor one. For the third sub-period (the political crisis period: 2003Q4-2008Q4) the coefficients on *ex post* inflation for both housing returns are relatively small and significantly different from one at the 1% level (single house: 0.08, town house: 0.04), whereas in the last sub-period (the current financial crisis: 2009Q1-2011Q4) the coefficients are positive and significantly greater than either unity or zero at the 5% level (single house: 11.04, town house: 8.66). From these results, we can conclude that both single house and town house provide a “super-hedge” against *ex post* inflation in the last sub-period. A number of reasons may explain for the “super-hedge” against *ex post* and *ex ante* inflation of both single house and town house in last sub-period. The real estate sector grew significantly in the last sub-period,⁸ thanks to many positive factors [7]. For example, Thailand's political and economic activity was gradually returning to normal. Moreover, the government realized the important role of real estate as an economic driving force. Thus, the real estate stimulus measure was conducted, and was one of contributing factors for the remarkable real estate growth.⁹ Specifically, the government reduced the registration fees in real estate: e.g. the registration fees were reduced from 2 percent to 0.01 percent (except mortgage registration fees, which were reduced from 1.1 percent to 0.01 percent). Furthermore, the government also launched a 25-billion Baht¹⁰ loan package with favorable repayment terms and conditions for the first-time home-buyers.¹¹

Regarding regression (7), the regression coefficients on expected inflation for both types of housing are relatively large (single house: 8.04, town house: 5.78) and statistically significantly different from zero at the 5% level in the last sub-period. These coefficients are also statistically different from unity at the 10% level. These results indicate that both single house and town house provided a super-hedge against expected inflation in the recent financial crisis. For the other sub-periods, the coefficients are neither significantly different from zero nor one.

For unexpected inflation, the coefficients for both types of housing returns are

⁸This can be seen from the increasing trend of the outstanding Property Credit comprising of Real Estate Development Credit and Personal Housing Credit during this period, which is 1,336,872.68; 1,448,306.24; 1,606,923.49; 1,795,475.56 (Millions of Baht) in 2009, 2010, 2011, 2012 and 2013, respectively - Report by Bank of Thailand (<http://www.bot.or.th/English/Statistics/EconomicAndFinancial/EconomicIndices/Pages/StatPropertyIndicators.aspx>).

⁹http://www.bot.or.th/English/MonetaryPolicy/Inflation/Documents/MPR_Jan2013.pdf

¹⁰The Government Housing Bank will offer a mortgage loan with zero interest rate in the first two years for the first-time homebuyers if the mortgage is less than three million Baht. (See, <http://www.thailand-business-news.com/banking/30222-0-mortgage-loans-to-help-first-time-homebuyers#.UVXOE47vbww>)

¹¹http://www.eria.org/publications/research_project_reports/images/pdf/y2010/no1/ch7Fiscal_issues_Thailand.pdf

consistently positive for all sub-samples but negative for the first one. In the third sub-period, the coefficients on unexpected inflation for both housing returns are relatively small (single house: 0.09, town house: 0.04) and significantly different from one at the 1% level while they are relatively large (single house: 13.21, town house: 10.74) in the last sub-period. Furthermore, in the last sub-period for both single house and town house are statistically distinguishable from unity and zero at the 5% and 1% level respectively. We therefore conclude that in this sub-period real estate provide a “super-hedge” against unexpected inflation.

However, the findings in the sub-period analysis prove that the relation between real estate returns and inflation is not stable over time. These findings corroborate other recent results [18, 38]. The reasons for the instability might be due to the other variables such as changes in global markets or changes in monetary policy [18]. Noticeably, our findings are not in line with Le Moigne and La [21] who found that ever since the Bank of Canada adopted inflation targeting in 1991, the Canadian real estate had ceased to be an inflation hedge. Particularly, although the inflation targeting policy was adopted by the Bank of Thailand since May 2000,¹² in which inflation has mostly been maintained within a narrow band between 1% and 3% per year, we still find significantly positive relations between returns on both types of house and actual as well as unexpected inflation for the third and last sub-period. As a robustness check, we also divide the sample and estimate the regressions for high and low inflation regimes separately. Quarters are assigned to the high inflation regime whenever the actual inflation is above its unconditional mean (0.91%), whereas they are classified into the low inflation regime when the actual inflation is equal or below its unconditional mean. The use of unconditional mean of actual inflation rates, instead of its median, is quite innocuous as both are very close. The coefficients in the two regimes are not significantly different from each other, corroborating our previous results.

Table 3: Stability analysis with dummy variable on actual, expected and unexpected inflation for single house and town house returns.

In the table, the t-values for testing the hypothesis $H_0: \omega = 1$ or $H_0: \beta = 1$ or $H_0: \gamma = 1$ are shown in the brackets next to the coefficients, and the robust t-values for testing the hypothesis $H_0: \varphi = 0$ or $H_0: \omega = 0$ or $H_0: \alpha = 0$ or $H_0: \beta = 0$ or $H_0: \gamma = 0$ are

¹²<http://www.bot.or.th/English/MonetaryPolicy/Target/Pages/Target.aspx>

reported in the parentheses below the coefficients. (***), (**) and (*) indicate significance at the 1%, 5% and 10% levels, respectively.

	Equation (6)				Equation (7)				
	Single house		Town house		Single house		Town house		
ω_1	-0.74	[-3.66]**	-0.6	[-3.69]***	β_1	1.58	[0.17]	0.93	[-0.00]
		(-1.55)		(-1.49)			(0.48)		(0.47)
ω_2	0.80	[-0.14]	0.89	[-0.10]	β_2	-2.95	[-0.98]	-2.97	[-1.04]
		(0.55)		(0.61)			(-0.73)		(-0.78)
ω_3	0.08	[-10.12]*	0.04	[-15.37]**	β_3	-0.52	[-0.97]	0.06	[-0.9]
		**		*			(-0.33)		(0.00)
		(0.83)		(0.64)					
ω_4	11.04	[2.02]**	8.66	[1.91]*	β_4	8.04	[1.89]*	5.78	[1.71]*
		(2.22)**		(2.16)**			(2.16)**		(2.06)**
					γ_1	-1.29	[-2.67]*	-1.06	[-4.97]**
							(-1.50)		(-2.56)**
					γ_2	0.87	[-0.1]	0.97	[-0.00]
							(0.61)		(0.68)
					γ_3	0.09	[-7.12]*	0.04	[-11.05]*
							(0.72)		(0.46)
					γ_4	13.2	[2.51]**	10.74	[2.62]**
							(2.71)**		(2.89)***
N	75		75			75		75	
\bar{R}^2	0.15		0.15			0.17		0.18	
F	2.24**		2.21**			2.18**		3.18***	
F -test for	3.18***				$E(\pi_t)$	1.79		1.55	
coefficients	2.58*				$UE(\pi_t)$	3	3.41**	5.38***	

6 Conclusions

The ability of real estate to provide a hedge against inflation has been one of the primary arguments for investors. People buy real estate to protect their portfolio from a currency crisis, recession, and the fear of high inflation, since it is believed that its returns can compensate for the diminishing purchasing power and wealth due to increases in inflation [21]. In other words, real estate has long been held to be an inflation hedge. In this paper, a straightforward regression analysis is performed, with estimated coefficients indicating the magnitude and direction of the relationship between real estate returns and measures of inflation.

We examine the relationship between real estate returns and *ex post* and *ex ante* inflation in Thailand over the time period of 1987 through 2011. Real estate research in Thailand has been quite limited due to data availability. The results of our study are generally consistent with previous studies and have several implications for investors. We find that both single house and town house returns have a positive relationship with *ex post*

inflation. While single house returns also show a positive relation with *ex ante* inflation, town house returns indicate a negative one. However, no coefficients are significantly different from zero. Moreover, we also find that these coefficients are statistically indistinguishable from one, implying that the one-to-one relationship between the nominal real estate returns and inflation cannot be rejected. This holds both for *ex post* and *ex ante* inflation rates. Our results hence indicate we do not have sufficient evidence to reject the Fisher hypothesis. In addition, we also find that real estate returns have a positive, although not significant, relationship with unexpected inflation. Controlling for the possible structural changes in the economy, we find that when the sample is segmented into the sub-periods, somewhat different results arise. The hedging-ability of real estate relatively strongly depends on the economic environment, as the real estate returns-inflation relationship tends to vary over sub-periods.

This study has implications for investors in Thailand since the findings provide evidence not only on the inflation-hedging capacity of real estate in general, but also on the understanding of how these hedging properties may vary in different macro-economic circumstances. Such information can help investors in making appropriate decisions for protecting their investment portfolio against inflation using real estate.

To sum up, our results show that the inflation hedging ability of real estate is heavily dependent on the state of the economy. For neither single houses nor town houses, we can reject the hypothesis that real estate hedges against expected inflation. Real estate however, does seem to be less successful in hedging unexpected inflation. For the period of fast economic growth (1987-1997), and for the period of political instability (2003-2008), we find that real estate significantly under-hedges the unexpected inflation (and the ex-post inflation). For the most recent period, which was characterized by a worldwide financial crisis, real estate turned out to be a statistically significant "super-hedge" irrespective of the kind of real estate held. Nevertheless, we cannot warrant that in any financial crisis, real estate can be used as a good inflation hedge.

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