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Jiranyakul, Komain

National Institute of Development Administration

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Are Thai Equity Index Returns Sensitive to Interest and Exchange Rate Risks?

Komain Jiranyakul

School of Development Economics
National Institute of Development Administration
Bangkok, Thailand
Email: komain_j@hotmail.com

Abstract

This study examines the sensitivity of the Thai stock market to nominal and real interest rate, and exchange rate risks during January 2004 and December 2015 using quantile regression. The analysis focuses on sectoral level and one main index in the stock market. The empirical results show that the stock market is more sensitive to exchange rate risk than interest rate risk. However, the impacts of these risks are different across equity index returns. The results from this study give implication for risk management of portfolio managers and investors.

Keywords: Equity index returns, interest rate risk, exchange rate risk, quantile regression
JEL Classification: C21, G12, G32

1. Introduction

The interest rate exposure of stock returns has become common in most empirical studies. In addition, stock returns can also be sensitive to inflation and exchange rate risk. Earlier study by Sweeney and Wargar (1986) that uses a two-factor arbitrage pricing theory to examine the impact of interest rate on the US stock market gives evidence that the stock market is sensitive to changes in the yields on long-term government bonds. The most interest-sensitive sector is utilities sector. Yourougou (1990) finds that interest rate risk has a significant impact on common stock returns of financial sector. Bae (1990) finds strong support for a negative impact of changes in interest rates on common stock returns of both depository and nondepository institutions. Isimbabi and Tucker (1997) employ principle component analysis to examine the market perception of the risk of US banking industry under a multifactor model. They find that the banking industry perceives the risk beyond the market and interest rate risk. Dinenis and Staikouras (1998) find a significantly negative relationship between interest rate changes and stock returns in banks, insurance companies, investment trust, property investment companies and finance firms. Fraser and Madura (2002) find that bank stock returns are sensitive to interest rate changes and the relationship is negative. Jareno (2008) finds that the Spanish stocks significantly respond to real interest rate and inflation. Jareno et al. (2016) examine the sensitivity of the US stock market to nominal and real interest rate and inflation. Their results show that the stock market is sensitive to changes in interest and inflation rates. The impacts of exchange rate on stock returns are also well documented. Jorion (1991) examines the impact of exchange rate on stock returns and finds that exchange rate exposure of non-financial firms is different across industries. Bodnar and Gentry (1993) examine exchange rate exposures at industry level in Canada, Japan and The US. They find that some industries in all the three countries display significant exposure to exchange rate risk. Chamberlain et al. (1997) examine the exchange rate exposure of a sample of US and Japanese banking firms using daily data. They find that the US stock returns are more prone to exchange rate than the Japanese stock returns. Muller and Verschoor (2006) find evidence suggesting that a depreciating euro against foreign currencies has a negative

impact on European stock returns while an appreciating euro has a positive impact. Jayasinghe and Tsui (2008) employ a bivariate generalized autoregressive conditional heteroskedastic (GARCH) model to examine exchange rate exposure of sectoral returns in fourteen Japanese industries. They find that many sector returns are correlated with exchange rate changes. Apergis et al. (2011) find that foreign exchange risk is priced in the cross-section of German stock returns over the period 2000-2008. In addition, the relationship between stock returns and foreign exchange sensitivity is non-linear. Inci and Lee (2014) find that there is a significant causal relationship running from exchange rate changes to stock returns in nine major industries in eight major countries.

Many previous studies focus on the impacts of both interest rate and exchange rates on stock returns. Choi et al. (1992) focus on the bank stock returns. They employ a multifactor model to examine the impact of interest rate and exchange rate risks on the returns. Their estimations of an autoregressive integrated moving average model give the results showing that exchange rate innovations significantly impose both negative and positive impacts on bank stock returns and these results depend on different time periods. Elyasiani and Mansure (2005) find that exchange rate variables are more important determinants of bank stock returns than interest rate variable. Hyde (2007) examines the sensitivity of stock return at industry level to market, exchange rate and interest rate risks in France, Germany, Italy and the UK. The main findings from this study show that the exposure to exchange rate risk is observed in all industries and countries, but the impact of interest rate risk is found only in Germany and France. Bredin and Hyde (2011) use monthly data to examine foreign exchange rate and interest rate exposure of industry level portfolios in the G7 countries. They find that there is little evidence of exchange rate exposure in most industries. However, the results for interest rate changes are mixed. The negative impacts of interest rate changes are observed only in Canada, Japan and the UK. Kasman et al. (2011) give the results from OLS estimations for the Turkish bank stock returns that stock returns are negatively related to interest rate and exchange rate changes. Olugdode et al. (2014) examine the sensitivity of 31 UK non-financial industries to exchange rate and interest rate exposure using a GARCH-in-mean approach. They find that stock returns in non-financial sectors are more affected by long-term interest rate risk than short-term interest and exchange rate risks.

The main objective of this study is to investigate the impact of changes in interest and exchange rates on sectoral equity sectors and one main index in the Thai stock market. This research includes both financial and non-financial sectors in the analysis. The sectoral analysis allows for the identification of the sectors most affected by changes in interest and exchange rates. The quantile regression (QR) approach is used to examine the sensitivity of equity index returns to interest and exchange rate risks. The study contribute to the literature in that it provides evidence showing that exchange rate risk is more likely to affect equity index returns than interest rate risk in an emerging stock market. The remainder of the study is structured as follows. Section 2 provides the description of data and estimations. Section 3 presents empirical results. The last section summarizes the most relevant conclusions.

2. Analytical Framework

This section describes the data used in this study and the estimation method that is used to analyze the sensitivity of equity index returns to changes in interest and exchange rates in the Thai stock market.

2.1 Data

The stock exchange of Thailand (SET) website provides the SET index, which comprises stock price of companies listed in the stock market. In addition, the SET50 index is also used as an index portfolio of stock prices of large companies from various equity sectors. The

sector equity indices obtained from SETSMART website are the end of month series. The interest rate, consumer price index and the US dollar exchange rate series are obtained from the Bank of Thailand website. The interest rate used in this study is the 10-year government bond yield.¹ The monthly data covers the 2004-2015 period because the data for sectoral equity indexes are available from the year 2004. The sample has 144 observations. The return series and inflation rate are calculated as the percentage rate of change. Table 1 shows the sector classification in alphabetical order.

Table 1
Sector classification.

Number of sector	Sector name
Sector 1	Agro-industry
Sector 2	Consumption
Sector 3	Financials
Sector 4	Industrials
Sector 5	Property and construction
Sector 6	Resources
Sector 7	Services
Sector 8	Technology

Notes: Sector 3 includes banks and other financial institutions. Sector 6 includes energy firms.

Each sector portfolios are analyzed in accordance with the classification shown in Table 1. The sector analysis allows for investigating which sectors are sensitive to interest rate and exchange rate risks. The stationarity property of the variables used in this study is reported in Table 2.

Table 2
Stationarity and unit root tests of variables

Variables	PP (constant)	PP (constant+trend)
Nominal interest rate	-1.830	-3.746**
Real interest rate	-4.670***	-6.793***
Inflation rate	-8.560***	-8.698***
SET index return	-12.795***	-12.766***
SET50 index return	-10.297***	-10.262***
Agro-industry	-9.334***	-9.312***
Consumption	-10.540***	-10.545***
Financials	-9.334***	-9.301***
Industrials	-9.922***	-9.889***
Property and construction	-9.025***	-9.063***
Resources	-11.435***	-11.516***
Services	-9.753***	-9.751***
Technology	-10.150***	-10.120***

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

The PP tests proposed by Phillips and Perron (1988) are used to test for unit root of all series used in the analysis. The results show that inflation rate, the two index returns and all sector returns are stationary at the 1% level of significance. Nevertheless, nominal interest rate might not be stationary because the test with constant shows that it contains unit root. Therefore, the first difference of nominal interest rate should be used in the analysis.

¹ The long-term interest rate is believed to be a better proxy for stock interest rate risk (see Ballester et al., 2011, for example).

Table 3
Descriptive statistics of variables, 2004-2015.

Variables	Mean	Median	S. D.	Skewness	Kurtosis	JB
Nominal interest rate change	-0.0165	-0.0400	0.2713	0.1285	5.1663	28.3534
Real interest rate	3.8853	3.6833	0.9338	1.1811	5.0828	59.0957
Inflation rate	0.2124	0.1997	0.5807	-1.0778	10.3365	348.385
SET index return	0.7054	1.3159	7.5032	0.8084	16.1124	1039.85
SET50 index return	0.5930	1.3009	6.1593	-0.9984	6.9073	113.721
Agro-industry	1.1119	1.2721	5.4071	-0.6999	5.3977	46.9280
Consumption	0.3650	0.4165	3.6417	-0.6129	5.7803	55.5934
Financials	0.6105	1.5358	6.4023	-0.6839	5.1112	37.9811
Industrials	0.3149	0.6708	8.1439	-0.6760	6.8055	97.1772
Property and construction	0.5565	1.1370	7.0172	-0.5631	5.1254	34.4722
Resources	0.5411	0.8056	7.3359	-0.5072	5.7507	51.2156
Services	1.1192	1.1918	5.5995	-1.4798	10.0904	351.739
Technology	0.5241	0.7062	0.3453	-0.3030	3.8034	6.3042

Note: JB denotes the Jarque-Bera statistics.

The average sector returns are positive and vary among sectors. The standard deviation is quite high, except for technology sector. All sector returns are negatively skewed and exhibit excess kurtosis. Furthermore, the Jarque-Bera statistics reject normality of returns. Therefore, it can be concluded that the dependent variables have fat tails compared with the Gaussian distribution. In other words, they exhibit leptokurtic distributions.

2.2 Estimation method

The empirical models used in this research are the two-factor models of Stone (1974) and Jorion (1990).² The model that can examine the impact of interest rate can be expressed as:

$$R_{it} = \alpha_i + \beta_{1i}R_{mt} + \beta_{2i}r_t + \varepsilon_{it} \quad (1)$$

where R_i is the nominal rate of return of equity index i , R_m is the overall market rate of return, r is the long-term interest rate (nominal or real) and ε_i is the random error. The second model used to examine the impact of exchange rate is expressed as:

$$R_{it} = \alpha_i + \beta_{1i}R_{mt} + \beta_{2i}r_t + \beta_{3i}\Delta EX_t + \varepsilon_{it} \quad (2)$$

where EX is the nominal US dollar exchange rate expressed as the ratio of domestic currency (baht) and dollar. The impact of explanatory variables should be different between quantiles that occurs between the central region and the tails of the distributions of equity index returns. The two models allow for estimations of the impact of stationary variables on all equity index returns.

Even though the OLS regression is popular for economic analysis, the non-normal distribution of variables causes the estimation by OLS method to be inefficient and unreliable. The principal statistics reported in Table 3 show that dependent variables have skewness, kurtosis and non-normal distribution. Therefore, the quantile regression or QR proposed by Koenker and Basset (1978) is used to uncover differences in the response of the dependent variables across their different quantiles. This method is employed by Jareno et al. (2016).

² These models adds additional explanatory variable to the market model.

Buchinsky (1998) gives a practical guideline for an application of quantile regression for empirical research.

3. Empirical Results

This section reports the estimated results for the whole sample period from January 2004 to December 2015. In addition, the impact of the US subprime crisis occurred in early August 2007 is also taken into account. According to Dooley and Hutchison (2009), this crisis can exert the impact on international stock markets, especially emerging stock markets.³ Therefore, the estimations for two sub-periods are also conducted. The first sub-period or the pre-crisis period ranges from January 2004 to August 2007, and the second sub-period or the crisis and post-crisis period ranges from September 2007 to December 2015. If the US subprime crisis imposes a significant impact on the Thai stock market, different results regarding the whole sample period should be observed.

3.1 Results for the whole sample period

The changes in nominal interest rate are a proxy of interest rest risk. Since the level of nominal exchange rate is non-stationary, its first difference is used instead. The results of models 1 and 2 for the SET50 index and sectoral returns estimated from Eqs. (1) and (2) using QR method with the range from 0.1 to 0.9 are reported. Table 4 shows how sectoral and the SET50 index returns are exposed to the stock market.

Table 4
Estimated coefficients of stock market return. 2004-2015.

Sector	Model 1	Model 2
Agro	0.61	0.60
Consumption	0.29	0.25
Financials	0.96	0.92
Industrials	1.11	1.07
Prop & cons.	1.04	1.00
Resources	1.01	1.06
Services	0.76	0.73
Technology	0.71	0.70
SET50	1.03	1.04

Note: The estimated median β_{1i} for each equity index return is highly significant.

The estimated median beta coefficients indicate that all equity sector and the SET50 indexes are exposed to the stock market. However, the values of the estimated betas vary across sectors. The sectors that have the larger betas than the stock market beta are industrials, property and construction, and resources.

Table 5 show how sensitive each index return is to nominal interest rate changes. The results are obtained from the estimate of Model 1 in Eq. (1).

³ The first phase of the crisis indicated by Dooley and Hutchison (2009) runs from February 27, 2007 to May 18, 2008. The crisis lasts until February 2009. The impact of the crisis on emerging market stock prices might take some months to be realized. However, the countries in the sample do not include the Thai stock market. The data for the Thai stock market is the SET index seems to be more fluctuating around August 2007. Therefore, the Thai stock market is assumed to be affected by the crisis in September 2007.

Table 5

Estimated coefficients of nominal interest rate changes, 2004-2015.

Sector	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Agro	0.52	-0.36	0.33	0.64	0.43	0.42	1.50	2.33	2.81
Consumption	-1.90	-0.12	-1.70	-1.07	-0.19	-0.52	-0.45	0.34	0.45
Financials	2.07*	2.04	1.33	0.36	-0.16	-0.61	-0.57	0.02	1.05
Industrials	0.51	-0.19	0.13	0.42	1.82	2.43*	2.51*	0.43	-2.51
Prop & cons.	-0.06	-0.27**	-2.22**	-1.68	-1.59	-0.60	-1.37	-2.27**	-1.73*
Resources	1.25	0.13	-0.83	0.60	0.92	1.49	1.50	1.49	-1.19
Services	-0.34	-1.24	-0.49	-0.55	-0.75	-1.41	-0.58	0.28	-0.09
Technology	1.66	0.54	-0.48	-0.22	-0.44	0.04	-1.48	-1.64	-3.41
SET50	0.26	0.20	-0.26	-0.08	-0.47	-0.51*	-0.36	-0.09	0.05

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

The coefficients of nominal interest rate changes are significant in the first quantile for the financial sector. For the industrial sector, the coefficients are significant only in two quantiles while the property and construction sector has significantly negative impact of nominal interest rate changes in four quantiles. The significantly negative signs for property and construction sector indicate that firms in this sector have no ability to counteract the changes in interest rate. Furthermore, the negative coefficient for the SET50 index return is significant only in the sixth quantile. It should be noted that the significantly positive signs of the coefficients in the industrial and financial sector returns indicate that these sectors have the ability to counteract the changes in nominal interest rate. Overall, most sector returns do not respond to the changes in nominal interest rate.

Table 6 reports the sensitivity of returns to real interest rate while Table 7 reports the sensitivity of returns to exchange rate changes. These results are obtained from the estimate of Model 2 in Eq. (2).

Table 6

Estimated coefficients of real interest rate, 2004-2015.

Sector	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Agro	-0.13	-0.16	-0.05	-0.12	-0.37	-0.55	-0.72**	-0.94**	-0.52
Consumption	0.55	0.27	0.04	0.01	-0.10	-0.06	-0.11	-0.07	-0.17
Financials	-1.06	-0.35	0.18	0.30	0.31	0.22	0.08	-0.01	0.02
Industrials	-1.15	-0.24	0.01	-0.15	0.11	0.03	-0.35	-0.65	-1.12**
Prop & cons.	-0.16	-0.36	-0.31	-0.29	-0.52	-0.30	-0.35	-0.72**	-0.12
Resources	-0.40	0.32	0.61	0.46	0.17	0.23	0.10	0.87	0.72
Services	-0.73	-0.78*	-0.36	-0.19	-0.18	-0.32	-0.45*	-0.66**	-0.9***
Technology	0.32	-0.04	-0.41	-0.27	-0.45	-0.71*	-1.04*	-0.81	-1.8***
SET50	-0.3***	0.3***	0.19**	0.3***	0.3***	0.2***	0.18**	0.11	-0.02

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

The results of estimations of the model with the real interest rate variable are reported in Table 6. The impacts of real interest rate as a measure of interest rate risk seem to be more pronounced than those of changes in nominal interest rate. More sectors are affected by real interest rate. The exposures of stock returns to real interest rate can be different.⁴ It should be noted that the most affected by real interest rate risk is the SET50 index return. The sectors that are not affected are financials, property and construction and services. The positive signs of coefficients of the SET50 index return indicate that fifty large firms have the ability to

⁴ The level of real interest rate is used because its level is stationary. Real interest rate variable is calculated as the difference between the government bond yield and inflation rate. Therefore, the impact of inflation is implicit in the level of real interest rate.

counteract real interest rate risk. The impacts of real interest rate seem to be stronger than those of nominal interest rate.

Table 7

Estimated coefficients of nominal exchange rate changes, 2004-2015.

Sector	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Agro	-1.02	-0.49	-1.61*	-1.62*	-1.31	-1.28	-2.06**	-1.50	-1.70
Consumption	-1.01*	-1.20**	-1.05	-0.82	-0.80	-0.59	-0.35	-0.49	-4.4***
Financials	-0.69	-1.07	-0.86	-0.66	-1.04	-1.23	-1.48*	-0.63	-0.25
Industrials	-0.76	-0.20	-0.68	-0.85	-0.87	-0.16	-1.49	-2.32	-2.87
Prop & cons.	-3.11**	-1.57**	-1.9***	-1.5**	-1.4**	-0.91	-1.43	-2.28***	-1.54*
Resources	-0.50	0.04	1.16	0.11	0.84	1.36	0.86	0.94	1.26
Services	-1.9***	-1.37**	-1.34*	-0.36	-0.80	-0.98	-1.12	-1.43	-2.07**
Technology	0.56	0.67	0.15	0.49	0.63	1.14	-0.76	-0.79	-2.05
SET50	0.14	0.31	0.14	0.32*	0.28	0.35*	0.32*	0.23	0.22

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

The results of estimated coefficients of the model expressed in Eq. (2) for the sensitivity of equity index return to exchange rate risk are reported in Table 7. The response of equity index returns to exchange rate risk measured by changes in nominal exchange rate is slightly different from the response to real exchange rate shown in Table 6. Three sector returns affected by exchange rate risk are property and construction, resources and services. Only resources sector is shielded from exchange rate risk because the negative sign is insignificant for each quantile. The reason is that resources sector comprises large energy corporations, especially large oil companies. These firms sell their products in domestic currency. Therefore, their profits will not be affected by changes in exchange rate. This is also true for SET50 index returns, which comprises the returns of large corporations from various sectors. It should be noted that the signs of coefficients of changes in exchange rate cannot be exactly interpreted using equity index returns. The signs of the coefficients depend on the types of firms included in each equity index. Importing firms can benefit from negative changes in foreign exchange (appreciation) while exporting firms benefit from positive changes in foreign exchange (depreciation). This kind of benefits can cause stock prices of companies to rise or fall. Furthermore, the role of foreign investors is also important. The appreciation of Thai baht, domestic currency, will encourage more investment from foreign investors and vice versa. Overall, exchange rate exposures of firms are different across equity sectors.

3.2 Results for sub-sample periods

For the pre-subprime crisis period, the sensitivity of equity index returns to interest rate and exchange rate risks should be different from the sensitivity during the crisis and post-crisis period if the stock market is affected by the crisis.

Table 8

Estimated coefficients of nominal interest rate changes, 2004M1-2007M8.

Sector	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Agro	0.82	0.70	0.44	0.99	2.18	3.80	3.20	3.25	0.93
Consumption	-1.76	-0.81	-0.35	0.19	0.59	0.47	-0.25	0.53	3.11
Financials	2.11	1.94	1.50	1.51	1.03	-0.33	-1.01	0.22	-0.14
Industrials	0.56	-0.13	1.24	-0.67	1.80	2.58	4.87	4.92	6.95
Prop & cons.	-0.41	-0.97	-2.84	-2.42	-0.29	0.29	0.08	-0.43	-1.92
Resources	-0.28	-0.04	1.39	0.53	4.04	3.82	2.19	-0.90	-3.53
Services	1.51	1.02	0.05	-0.32	-0.29	-0.66	-0.39	0.10	-0.08
Technology	-1.77	-0.94	-0.97	-0.90	-2.92	-1.27	-1.51	-4.63*	-4.84**
SET50	0.03	-0.45	-0.56	-0.59	0.01	0.09	0.05	-0.02	0.61

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

The results in Table 8 show that the technology sector is affected by nominal interest rate risk in the last two quantiles, just before the occurrence of the crisis. Other sectors are shielded from nominal interest rate risk. Therefore, it can be argued that equity index returns are not affected by changes in nominal interest rate during the pre-crisis period.

The sensitivity of equity index returns to real interest rate is reported in Table 9. The sector that is exposed to real interest rate risk is agro industry, just prior to the crisis. Other sectors have the ability to counteract real interest rate risk.

Table 9

Estimated coefficients of real interest rate, 2004M1-2007M8.

Sector	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Agro	-0.65	-0.51	0.03	-0.11	-0.37	-0.80	-1.34	-1.56	-1.95*
Consumption	1.01*	-0.13	0.08	0.29	0.28	0.23	0.73**	0.45	0.30
Financials	0.40	1.14**	0.74	0.90	0.80	0.45	0.18	0.18	-0.41
Industrials	1.10	2.06	0.87	1.73	0.75	0.93	0.88	1.62	1.70
Prop & cons.	1.33	1.60*	0.58	1.00*	0.71	0.70	0.56	0.36	1.58
Resources	-0.60	-0.56	-1.41	-0.62	-0.48	-0.64	0.16	-0.16	-0.37
Services	-1.04	-0.40	0.12	0.19	-0.19	-0.01	-0.42	-0.74	-0.66
Technology	-0.49	0.19	0.11	0.58	-0.55	-0.85	-0.96	-0.67	-0.95
SET50	0.27	0.21	0.02	0.02	-0.01	-0.08	-0.11	-0.11	-0.25

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

Table 10 reports the sensitivity of equity index returns to exchange rate risk. The most affected sector is consumption. The SET50 index return is also exposed to exchange rate risk in the third, fourth and fifth quantiles.

Table 10

Estimated coefficients of exchange rate changes, 2004M1-2007M8.

Sector	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Agro	-0.11	-0.80	-0.19	-0.11	-0.37	-0.80	-1.34	-1.56	-1.95*
Consumption	-1.51*	-1.62**	-1.69**	-1.26	-1.16	-0.98	-0.53	-0.12	0.24
Financials	0.29	0.82	1.09	-1.01	1.02	-0.35	-1.22	-1.53	1.05
Industrials	1.04	1.61	0.38	0.94	-0.17	0.20	0.24	-0.48	0.98
Prop & cons.	-2.36	-0.12	-1.46	-1.17	-0.82	-1.12	-0.14	-0.05	1.22
Resources	1.28	3.17	1.71	1.67	1.88	1.44	1.81	1.65	0.90
Services	-1.72	-1.85	-1.64	-1.75	-0.79	-0.98	-1.24	-1.59	-2.01*
Technology	1.84	1.02	0.80	1.92	0.26	0.44	0.59	0.66	-0.88
SET50	0.80	0.16	0.47*	0.53**	0.51**	0.34	0.28	0.19	-0.08

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

For the crisis and post-crisis period, the response of equity index returns to interest rate risk is reported in Table 11.

Table 11

Estimated coefficients of nominal interest rate changes, 2007M9-2015M12.

Sector	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Agro	-1.07	-0.66	0.53	0.41	-0.23	0.60	1.21	2.48	2.86
Consumption	-3.00	-2.72***	-2.62**	-2.43*	-1.07	-1.39	-0.22	0.21	0.08
Financials	1.86	1.70	0.11	-0.78	-1.27	-0.94	0.13	0.85	0.37
Industrials	0.87	-0.87	0.27	1.30	2.78*	1.46	1.37	-1.58	-2.19
Prop & cons.	-0.53	-1.75	-1.29	-2.21	-1.72	-2.20	-2.98**	-2.45**	-2.21
Resources	-0.97	0.01	-1.65	-0.98	0.43	1.53	1.33	-0.24	-3.09
Services	-2.54	-1.34	-0.30	-0.07	-0.25	0.21	-0.75	1.14	1.12
Technology	1.23	2.31	-0.57	0.68	0.38	-1.19	-0.08	0.21	-0.52
SET50	0.77	0.56	0.29	-0.14	-0.05	-0.41	-0.41	-0.46	-0.29

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

The results in Table 11 show that the sensitivity of equity index returns to nominal interest rate risk has slightly become more pronounced than the pre-crisis period. The sectors that have no ability to counteract this risk are consumption and property and construction. Other sectors are not affected by this type of risk.

Regarding the real interest rate variable in the second sub-period, the results in Table 12 show that the most affected sector is property and construction, which has no ability to counteract real interest rate risk. However, the fifty large firms included in the SET50 index have the ability to counteract this type of risk.

Table 12

Estimated coefficients of real interest rate, 2007M9-2015M12.

Sector	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Agro	-2.11	0.41	0.06	-0.12	-0.13	-0.48	0.59	-0.75	-0.32
Consumption	0.54	-0.56	0.22	0.51	0.44	0.30	0.05	0.33	-0.10
Financials	-1.13	-0.79	-0.78	-0.38	-0.46	-0.08	0.65	0.34	0.26
Industrials	-2.39	-1.60	-0.65	-1.09	-0.37	-0.18	-0.37	-0.67	-0.92*
Prop & cons.	-1.32	-0.52	-0.04	-0.60	-0.75*	-0.86**	-0.9***	-1.1***	-0.18
Resources	-1.48	-0.22	0.52	0.50	0.22	-0.01	-0.17	0.33	0.81
Services	-2.78	-0.85	-0.62	-0.16	-0.18	-0.41	-0.28	0.70*	-0.61
Technology	-1.79	-0.91	-0.45	-0.45	-0.49	-0.70	-0.01	-1.13	0.46
SET50	-0.42	0.27	0.16	0.23*	0.3***	0.28***	0.22**	0.19**	0.11

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

The exposure to exchange rate risk during the crisis and post crisis period is reported in Table 13. The results reveal that exchange rate risk does not affect fifty large firms listed in the SET50 index compared to the pre-crisis period.

Table 13

Estimated coefficients of exchange rate changes, 2007M9-2015M12.

Sector	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Agro	-2.15	-2.86**	-2.11**	-2.15	-2.54*	-1.79	-1.74	-0.87	-3.03
Consumption	-1.12	-1.54*	-1.45*	-0.75	-0.77	-0.77	-1.14	-3.02	5.04***
Financials	-0.56	-2.13	-2.51***	-2.03*	-2.6**	-2.06	-1.41	-0.57	4.19
Industrials	-4.37	-0.71	-0.92	-1.23	-1.91	-0.98	-0.95	-3.49	-5.68*
Prop & cons.	-2.94*	-1.76*	-0.39	-1.55*	-1.23	-1.64*	-1.87**	-2.42***	-3.87
Resources	-1.48	-0.97	0.04	0.26	1.19	1.67	1.74	0.35	-0.34
Services	-3.0***	-1.00	-1.20	-0.71	-0.63	-0.72	-0.19	-1.79	-3.46
Technology	-0.49	-0.33	-0.26	0.06	0.19	0.10	-0.02	-3.66	-4.49**
SET50	-0.45	0.30	0.39	0.17	0.12	-0.10	0.02	-0.10	0.63

Note: ***, **, and * denote significance at the 1%, 5% and 10%, respectively.

For sectoral index return, more sectors are exposed to exchange rate risk compared to the pre-crisis period. The most affected sectors are agro industry, consumption, financials, and property and construction. Only the resource sector is not exposed to exchange rate risk. The impact of exchange rate risk is more pronounced than the impact of real interest rate risk.

The results from sub-period analysis show that the US subprime crisis exerts a moderate impact on the sensitivity of equity index return to interest rate and exchange rate risks.

4. Conclusions

This research analyzes the sensitivity of the Thai stock market to changes in interest and exchange rates. The quantile regression is used. This procedure should be superior to the ordinary least squared method because it provides estimations of different quantiles. The main equity index and sectoral equity indexes represent listed stock prices in the stock market. The

analysis of sector returns allows for identifying differences among sectors that respond to interest and exchange rate risks. The results from this study indicate that the degrees of exposure to risks are different across sectors. Furthermore, the exposure of sectoral and main index returns to exchange rate risk seems to be more pronounced than that of interest rate risk. The implication for investors and portfolio managers is that they should take into account of the impact of the two types of risk when they form portfolios by selecting stocks from different firms or equity indexes.

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