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The relationship between stock price index and exchange rate in Asian markets: A quantile regression approach

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ABSTRACT

This paper uses the data of six Asian countries to estimate the relationship between stock price index and exchange rate. According to the portfolio balance effect, these two variables should be negatively related. However, since the evidence from traditional ordinary least squares estimation is not favorable, the quantile regression model is adopted to observe the various relationships between stock and foreign exchange markets. The results show an interesting pattern in the relation of these two markets in Asia, which indicates that the negative relation between stock and foreign exchange markets is more obvious when exchange rates are extremely high or low.

1. Introduction

This paper analyzes the relationship between stock price index and exchange rate in Asian markets. These two variables are both important in determining the development of a country. However, previous related studies have shown contrasting empirical evidence. Some studies have stated there are long-term equilibrium relation between stock price index and exchange rate (Ibrahim and Aziz, 2003; Kim, 2003). Other studies have stated that the relationship is short-term (Bahmani-Oskooee and Sohrabian, 1992; Nieh and Lee, 2001; Smyth and Nandha, 2003). Still other studies were unable to find evidence showing these two variables are related (Solnik, 1984; Ozair, 2006). Moreover,

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there are conflicts even in the studies that agree stock and foreign exchange markets are interconnected. Some propose that stock price index and exchange rate are positively related (Sevuktekin and Nargelecekenler, 2007), while others think the relationship should be negative (Soenen and Hennigar, 1988; Kim, 2003).

On the whole, the related literature discussing the theoretical foundation of the relationship between stock and foreign exchange markets can be divided in two directions: the international trading effect (Aggarwal, 1981) and the portfolio balance effect (Bahmani-Oskooee and Sohrabian, 1992).

Aggarwal (1981) believed that the connection between these two markets results from the influence of international trading. A change in exchange rate cannot only directly influence the stock prices of multinational and export oriented firms; it can also indirectly affect domestic firms. For a multinational firm, the change of exchange rates immediately influences the value of its foreign operations and continuously affects the profitability of the firm. Domestic firms are also influenced by the change of exchange rates, since they still may import their input and export their output.

When exchange rate depreciates, the competitiveness of exports will increase, and the input cost of imports will increase (Joseph, 2002). Thus, generally speaking, depreciation will cause positive (negative) effect for export (import) firms and increase (decrease) their stock prices; however, appreciation will cause negative (positive) effect for export (import) firms and decrease (increase) their stock prices. Since there are relatively more export-oriented firms in Asian countries (in other words, Asian countries are more export-dominant), currency depreciation usually has a positive effect on the domestic stock market in these countries (Ma and Kao, 1990). Hence, stock prices and exchange rates should be positively correlated in Asian markets based on the international trading effect.

As opposed to the view of Aggarwal (1981) and Bahmani-Oskooee and Sohrabian (1992) used a portfolio balance approach to analyze the influence of stock prices on exchange rates. If the impact of an external parameter influences the stock market to go up, the domestic investors' wealth increases, raising the demand for the currency according to the investment portfolio equilibrium theory. The demand for money then increases and drives the interest rate to rise, consequently absorbing the inflow of foreign capital and causing the domestic currency to appreciate. Thus, if investors are more optimistic regarding the stock market of a country, foreign capital investors may then increase their investment to this country's stock market because of the speculative demand, and indirectly cause the appreciation of this country's currency. Stock markets and foreign exchange markets in Asian have become increasingly attractive to foreign capital in recent decades, causing the possibility of portfolio balance effect mentioned by Bahmani-Oskooee and Sohrabian (1992) to also exist in Asian markets. However, contrary to the international trading effect, the portfolio balance effect states that stock prices and exchange rates should be negatively correlated.

Although the international trading effect (Aggarwal, 1981) and the portfolio balance effect (Bahmani-Oskooee and Sohrabian, 1992) on the stock and foreign exchange markets could both exist in Asian countries, the directions of these two effects are different. As such, I endeavored to determine the "net" effect left in the relationship if I use data in Asian markets, as such situation may depend on market conditions. This paper proposes that the portfolio balance effect should not always exist. If the stock market of a country is not volatile, then foreign capital will not be absorbed in this market, and the indirect influence on exchange rate may be restrained. Only when the profit opportunity is obvious, then considerable quantities of foreign capital may enter or leave the stock market, creating obvious influence on exchange rate. Therefore, the goal of this paper is to observe the various relationships between the stock and foreign exchange markets in Asia, and to test whether or not the relationships can change depending on market conditions. The quantile regression model is used to estimate the relation of these two markets under different market conditions (different quantiles of exchange rates).

With increasing international diversification taking place in recent years, cross-market return correlations, gradual abolishment of capital inflow barriers and foreign exchange restrictions, and the adoption of more flexible exchange rate arrangements in emerging and transition counties, stock and foreign exchange markets have become interdependent (Aydemir and Demirhan, 2009). However, previous related studies have shown highly differing empirical evidences of this interdependence. This paper provides a new explanation for the various relationships between these two markets.

The remainder of this paper is presented as follows: Section 2 reviews related literature; Section 3 provides a brief explanation of quantile regression; Section 4 illustrates data and reports the estimation results; and Section 5 summarizes the main conclusions of this paper.

2. Literature review

In recent decades, many countries have adopted a floating exchange rate system. According to traditional theory, the change of exchange rate is influenced by international trade. The performance of domestic stock market over the few decades has played important roles in influencing the capital inflow or outflow, indicating the significant impact of changes in stock prices on exchange rate movements. However, in empirical studies, the relationship between stock price index and exchange rate remains unresolved.

Some studies have found evidence supporting the different connections between stock and foreign exchange markets (Aggarwal, 1981; Soenen and Hennigar, 1988; Ajayi and Mougoue, 1996; Hatemi-J and Irandoust, 2002; Kim, 2003; Ibrahim and Aziz, 2003; Sevuktekin and Nargelecekenler, 2007; Oguzhan and Demirhan, 2009). Aggarwal (1981), using monthly data of U.S. stock prices from 1974 to 1978, found that stock prices and exchange rates are positively related. Hatemi-J and Irandoust (2002) also used monthly data from 1993 to 1998 in analyzing stock prices in Sweden. Their results showed that Grange causality is unidirectional from stock prices to exchange rates. Sevuktekin and Nargelecekenler (2007), using monthly data from 1986 to 2006, found positive and bidirectional causality between these two variables in Turkey.

Soenen and Hennigar (1988), using the data from 1980 to 1986, found that the influence of exchange rate on U.S. stock prices is negative. Kim (2003) adopted the multivariate cointegration and error correction model in analyzing the relationship between stock and foreign exchange markets in the U.S. from 1974 to 1998; results showed that stock prices and exchange rates, whether in the long or short run, are negatively correlated. Ibrahim and Aziz (2003) used monthly data of stock prices, exchange rates, and money supply in Malaysia from 1977 to 1998. They, too, concluded that the relation between stock and foreign exchange markets is negative; when domestic currency depreciates, the stock prices will also decrease.

Other studies have proposed that, in the long run, stock market and foreign exchange market are separate, since no evidence could be found showing that these two variables are related (Solnik, 1984; Ozair, 2006).

Although previous studies have properly documented the relationship between stock prices and exchange rates, the empirical results show conflicting evidence. As mentioned in introduction, two possible explanations can illustrate the adjusting mechanism in these two markets: the international trading effect and the portfolio balance effect. The international trading effect states that when the exchange rate depreciates, the competitiveness of exports and the input cost of imports will both increase. Thus, depreciation will make positive (negative) effect for export (import) firms and increase (decrease) their stock prices. The portfolio balance effect proposes that when the stock market of a country becomes more attractive, foreign capital flow into the country will cause the stock market to go up and cause the currency to appreciate.

There is a possible explanation for the different results of the relationship between stock price and exchange rate. The portfolio balance effect should not exist every time and everywhere, since foreign capital will not be absorbed in this market if the stock market of a country is not volatile; the indirect influence on exchange rate may then not exist. However, if the opportunity to profit is obvious and causes the considerable quantities of foreign capital to enter or leave the stock market, the obvious capital inflow or outflow will occur, and significant influence on exchange rate may be found. Therefore, during normal times when there are no obvious capital inflow or outflow, only the international trading effect will exist in the relationship between these two markets. However, during financial crises or bubbles in stock markets, profit opportunity occurs and causes considerable quantities of foreign capital to leave or enter the stock markets. This eventually causes the currencies to depreciate or appreciate. In such a case, the relationship between stock prices and exchange rates will be negative.

Hence, the goal of this paper is to emphasize on observing the various relationships between stock and foreign exchange markets. In recent decades, the data used for stock and foreign exchange markets in Asia have become increasingly attractive to foreign capital. In addition, most of Asian countries have become more export-dominant. Therefore, if the portfolio balance effect exists, the relationship (the estimated coefficients) between the stock price indices and exchange rates in Asian markets will be further negative; otherwise, they can be positive or not significant.

Previous studies focusing on this subject using data in Asian markets have obtained highly differing results. For example, Granger et al. (2000) investigated the relationship between stock and foreign exchange markets of nine Asian countries during the Asian financial crisis. They found that foreign exchange market takes the lead and has an impact on the stock market in Japan and Thailand; stock market takes the lead in Taiwan; the relationship is bidirectional in Indonesia, South Korea, Malaysia, and the Philippines; and that no such relation exists in Singapore. Doong et al. (2005) used the data in six Asian countries and found there is no long-term cointegration in these markets. Pan et al. (2007) found that the relationship between stock and foreign exchange markets in Asian differs depending on countries and time (before or after the Asian financial crisis).

To completely understand the relation between these two markets, this paper attempts to propose an explanation for the different empirical results of the relationship between stock and foreign exchange markets, and to use empirical models to support the explanation.

3. Empirical models

To avoid the problem of spurious regression, this paper performs unit root tests for the stock price index and exchange rate. Augmented Dickey–Fuller (Said and Dickey, 1984) test as well as Phillips–Perron (1988) test are adopted. The methodologies of these two tests are shown in the following.

Suppose Y_t denotes the variable (stock price index or exchange rate) for the test of stationarity. Then there are three models for obtaining the statistics of Augmented Dickey–Fuller test:

$$\Delta Y_t = a_0 + a_1 t + a_2 Y_{t-1} + \sum_{s=1}^{k} b_s (\Delta Y)_{t-s} + u_t \tag{1}$$

$$\Delta Y_t = a_0 + a_2 Y_{t-1} + \sum_{s=1}^{k} b_s (\Delta Y)_{t-s} + u_t \tag{2}$$

$$\Delta Y_t = a_2 Y_{t-1} + \sum_{s=1}^{k} b_s (\Delta Y)_{t-s} + u_t \tag{3}$$

where $\Delta Y_t = Y_t - Y_{t-1}$, t is time trend. The null hypothesis is $H_0 : a_2 = 0$, that is, the series contain a unit root. Phillips and Perron (1988) propose an alternative method of controlling for serial correlation when testing for a unit root. The method estimates the non-augmented Dickey–Fuller test equation:

$$\Delta Y_t = \alpha Y_{t-1} + X_t' \delta + \varepsilon_t$$

where X_t are optional exogenous regressors which may consist of constant, or a constant and trend. The null hypothesis is $H_0 : \alpha = 0$, that is, the series contain a unit root. Phillips and Perron modified the t-ratio of the α coefficient so that serial correlation does not affect the asymptotic distribution of the test statistic.

If the variables are all non-stationary, then the cointegration test proposed by Engle and Granger (1987) would be performed to test the linear long-run relationship between stock price index and exchange rate. According to Engle and Granger (1987), two series integrated in the order d, $I(d)$, are cointegrated, if the linear combination of the two series, $[Y_t = \beta X_t + u_t]$, results in a residual, u_t, that is stationary in less than order d.

In addition, as documented in Enders and Siklos (2001), the Engle–Granger testing strategy can be biased towards the acceptance of no cointegration if the adjustment processes of the two markets are asymmetric. If this long-run equilibrium relationship does not exist, then we further examine the short-run relationship changes using traditional ordinary least squares estimation and quantile regression. The quantile regression model is used to estimate the relation of these two markets under different market conditions.

After Koenker and Bassett (1978) proposed the approach of quantile regression, several papers used this method to analyze different subjects. For example, Deaton (1997) applied quantile regression for demand analysis; Buchinsky (2001) used it to estimate a woman's return to education in the United States; and Bassett and Chen (2001) adopted this method's index models to characterize mutual fund investment styles.

The advantage of this approach is its capacity to permit estimation of various quantile functions in a conditional distribution. Empirical studies have been interested in analyzing the behavior of a dependent variable given the information contained in a set of explanatory variables. The traditional approach uses the ordinary least squares to estimate a linear regression model; however, this method only provides the estimation of median (0.5th quantile) function. By using quantile regression, each quantile regression characterizes a particular point of the conditional distribution. Putting different quantile regressions together will be further useful, especially when the conditional distribution is heterogeneous. Since the goal of this paper is to emphasize on observing the various relationships between stock and foreign exchange markets in Asia, a quantile regression model is used to provide more details of the relationship. The model is briefly illustrated as follows.

Suppose there is a linear specification for the conditional quantiles of E,

$$E_t = X_t\beta + u_t \tag{4}$$

where E_t is the exchange rate of a country; X_t is $k \times 1$ regressors, which is constant, and the stock price index used in this paper; β is the coefficients the model wants to estimate, and the goal of the quantile regression model is to estimate β for different conditional quantile functions; and u_t is error term.

Suppose the conditional mean of E is $\mu(X) = X'\beta$, the approach of ordinary least squares is to estimate the mean,

$$\min_{\mu \in R} \sum_{t=1}^{n} (E_t - \mu)^2 \tag{5}$$

That is:

$$\min_{\beta \in R^p} \sum_{t=1}^{n} (E_t - X_t'\beta)^2 \tag{6}$$

Solving Eq. (6) will give the estimation of median (0.5th quantile) function. For the other quantiles, we let τ stand for quantile variable. The conditional quantile function can be written as

$$Q_E(\tau|X) = X'\beta(\tau) \tag{7}$$

To obtain estimation of the conditional quantile functions, we need to solve

$$\min_{\beta \in R^p} \sum_{t=1}^{n} \rho_\tau(E_t - X_t'\beta) \tag{8}$$

to minimize the following equation:

$$\min_{\hat{\beta}} \left[\tau \sum_{E_t \geq \hat{\beta}X_t} |E_t - \hat{\beta}X_t| + (1-\tau) \sum_{E_t < \hat{\beta}X_t} |E_t - \hat{\beta}X_t| \right] \tag{9}$$

where $X_t'\hat{\beta}_\tau$ is an approximation to the τth conditional quantile of E. When τ is close to zero (one), $X_t'\hat{\beta}_\tau$ characterizes the behavior of E at the left (right) tail of the conditional distribution.

Table 1
Descriptive statistics.

Variable	Country	Mean	Std. Dev.	Skewness	Kurtosis
Stock price index	Singapore	2056.69	552.65	0.77	3.71
	Thailand	700.81	334.96	0.78	2.77
	Malaysia	884.87	236.84	0.22	2.40
	The Philippines	2116.99	716.37	0.30	1.98
	South Korea	921.50	378.64	0.98	3.33
	Taiwan	6320.88	1514.06	0.26	2.33
Exchange rate	Singapore	1.60	0.13	−0.16	1.84
	Thailand	34.63	7.13	−0.16	1.68
	Malaysia	3.34	0.56	−0.58	1.61
	The Philippines	41.17	11.38	−0.29	1.54
	South Korea	1042.69	207.16	0.31	2.31
	Taiwan	30.85	3.15	−0.54	1.81

Koenker and d'Orey (1987) proposed that the minimization problems could be solved by linear programming methods.

4. Data and empirical results

This paper uses the monthly data of the stock and foreign exchange markets in Singapore, Thailand, Malaysia, the Philippines, South Korea, and Taiwan from January 1992 to December 2009. Major stock indices are used for the stock market data,[1] and the exchange rates of currencies of a country to U.S. dollar are likewise used for measuring the value of a currency. Thus, an increase in exchange rate means the value of this currency depreciates. The historical time series of stock price index and exchange rate of the six Asian markets are shown in Fig. 1. Although these two series seem to be negatively related, there are some periods wherein stock price index and exchange rate are show positive co-movement.

Table 1 shows the descriptive statistics of data. To eliminate spurious regression problems, it is prerequisite to ensure that the series are stationary prior to estimating the empirical model. In this paper, unit root tests are conducted for level and first-order difference of the stock price indices and exchange rates using the Augmented Dickey–Fuller and the Phillips–Perron tests. The test results shown in Table 2 both confirm that all the variables are $I(1)$. After obtaining the difference, all variables are confirmed to be $I(0)$.

Then, the linear cointegration test of Engle and Granger (1987) is used to investigate if the deviations from the long-run equilibrium exhibit a mean-reverting behavior, that is, whether long-run equilibrium relationships between stock price index and exchange rate exist or not. Evidence in Table 3 indicates that the Engle–Granger tests fail to reject the null hypothesis of no cointegration at the 5% significance level. These results seem to suggest that stock price index and exchange rate are not cointegrated. Therefore, this paper uses the returns of stock price index and exchange rate in the following regression to avoid the non-stationary problem.

To observe the dynamic relationships between the stock and foreign exchange markets, this paper applies ordinary least squares method to estimate the relationship between the returns of stock price index and exchange rate. To emphasize on observing the portfolio balance effect on the capital side, which shows that the stock market leads the foreign exchange market in a negative way, this paper uses the returns of stock price index as the explanatory variable, and that of exchange rate as the dependent variable that needs to be estimated. The results are summarized in Table 4. The coefficients that stand for the relationship between two variables in six countries (α_1) are all significantly negative. This means the increase (decrease) of the returns of stock price index will decrease (increase) the exchange rate, causing the domestic currency to appreciate (depreciate). These results support the

[1] The FTSE Straits Times Index, the Bangkok Set Stock Index, the Kuala Lumpur Stock Index, the Manila Stock Index, the South Korea KOSPI Index, and the TSE Weight Stock Index are used for the stock price index in Singapore, Thailand, Malaysia, the Philippines, South Korea and Taiwan, respectively.

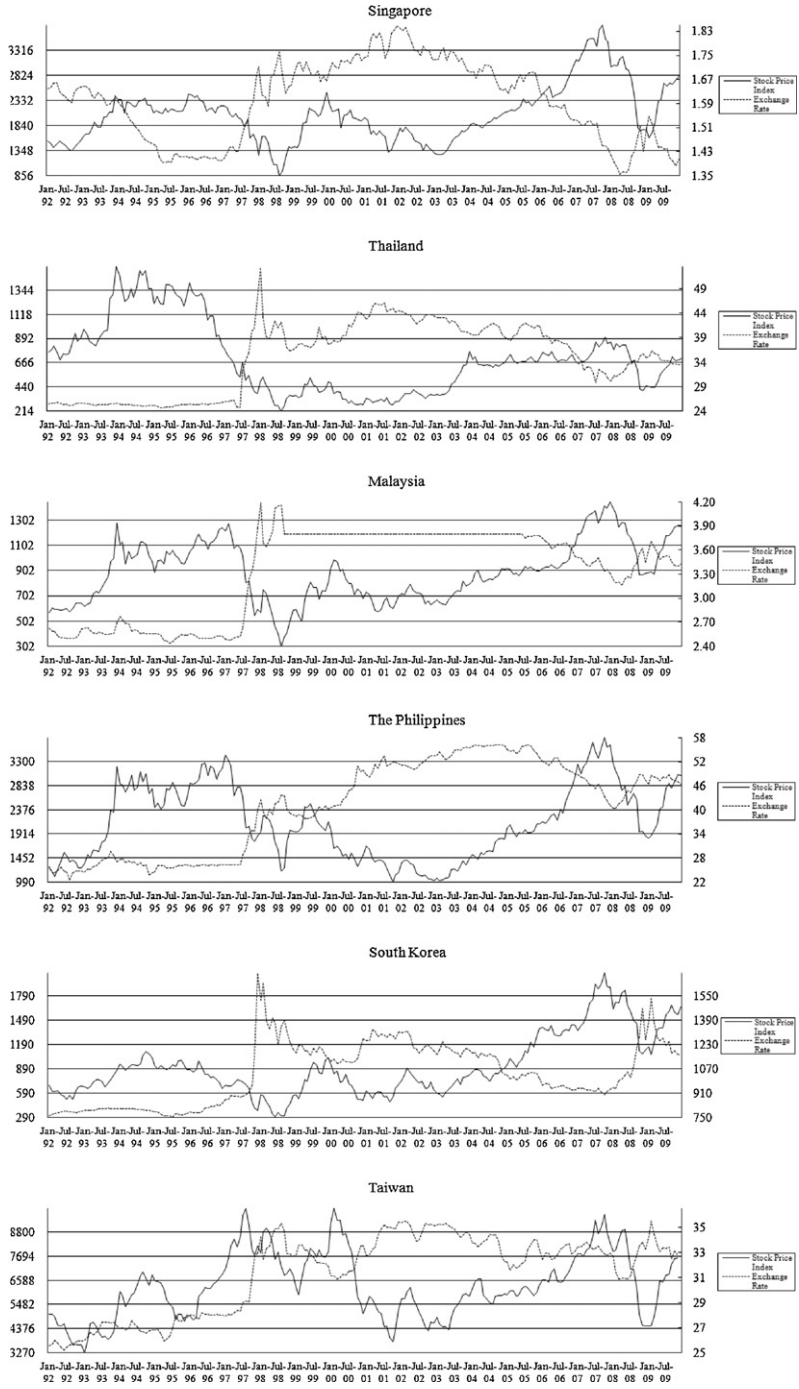

Fig. 1. Time series of the data.

Table 2
Unit root tests.

Country	Exchange rate		Stock price index	
	Levels	Differences	Levels	Differences
PP test				
Singapore	−1.0432(5)	−13.0970(8)***	−2.0965(6)	−13.4971(4)***
Thailand	−1.7320(4)	−12.5521(9)***	−1.5279(4)	−14.2803(3)***
Malaysia	−1.4950(3)	−11.2985(3)***	−2.1163(4)	−13.7875(3)***
The Philippines	−1.2971(5)	−13.4674(4)***	−1.9603(4)	−14.3406(3)***
South Korea	−2.2812(3)	−15.3827(5)***	−1.1149(4)	−13.1404(3)***
Taiwan	−1.9172(3)	−12.0408(7)***	−2.6104(4)	−9.9376(5)***
ADF test				
Singapore	−1.0057(0)	−13.1640(0)***	−1.6938(0)	−13.3816(0)***
Thailand	−1.6701(0)	−12.6513(0)***	−1.4085(0)	−14.2527(0)***
Malaysia	−1.6407(1)	−11.3866(0)***	−2.4933(2)	−7.8752(1)***
The Philippines	−1.2751(0)	−13.4167(0)***	−1.7869(0)	−14.3109(0)***
South Korea	−2.2867(0)	−15.3639(0)***	−0.8530(0)	−13.1085(0)***
Taiwan	−1.9450(1)	−12.1276(0)***	−2.9997(1)**	−10.0732(0)***

Entry in parenthesis stands for the optimal lag length chosen by the BIC with the maximum lag set to be 15.
** Significance at the 5% level.
*** Significance at the 1% level.

Table 3
Results of linear cointegration tests.

Null hypothesis: no cointegration		
	Value	*p*-Value*
Singapore		
Engle–Granger tau-statistic	−2.15	0.44
Engle–Granger *z*-statistic	−8.82	0.43
Thailand		
Engle–Granger tau-statistic	−3.19	0.08
Engle–Granger *z*-statistic	−18.31	0.07
Malaysia		
Engle–Granger tau-statistic	−2.54	0.27
Engle–Granger *z*-statistic	−13.34	0.20
The Philippines		
Engle–Granger tau-statistic	−2.04	0.51
Engle–Granger *z*-statistic	−7.70	0.51
South Korea		
Engle–Granger tau-statistic	−2.25	0.40
Engle–Granger *z*-statistic	−9.27	0.40
Taiwan		
Engle–Granger tau-statistic	−2.10	0.48
Engle–Granger *z*-statistic	−7.08	0.56

Notes: The optimal lag length was chosen by the Bayesian information criterion.
* Mackinnon (1996) *p*-value.

portfolio balance effect, in which the negative relationship is never a surprise, since Asian markets have become increasingly attractive to foreign capital in recent years. However, as the adjusted R^2 are very small and two residual series are auto-correlated, implying that the coefficient may change depending on different quantile functions. This paper then proceeds to re-estimate the model, this time using quantile regression approach.

As shown Table 5, the difference of coefficients obtained from different quantile functions is obvious. Fig. 2 draws the coefficients showing the relation between stock and foreign exchange markets under different quantile regressions. This can provide a more thorough use for understanding the relationship, especially when the conditional distribution is heterogeneous. The blue line with filled squares depicts the nineteen point estimates over the distribution of every five percentile. The solid

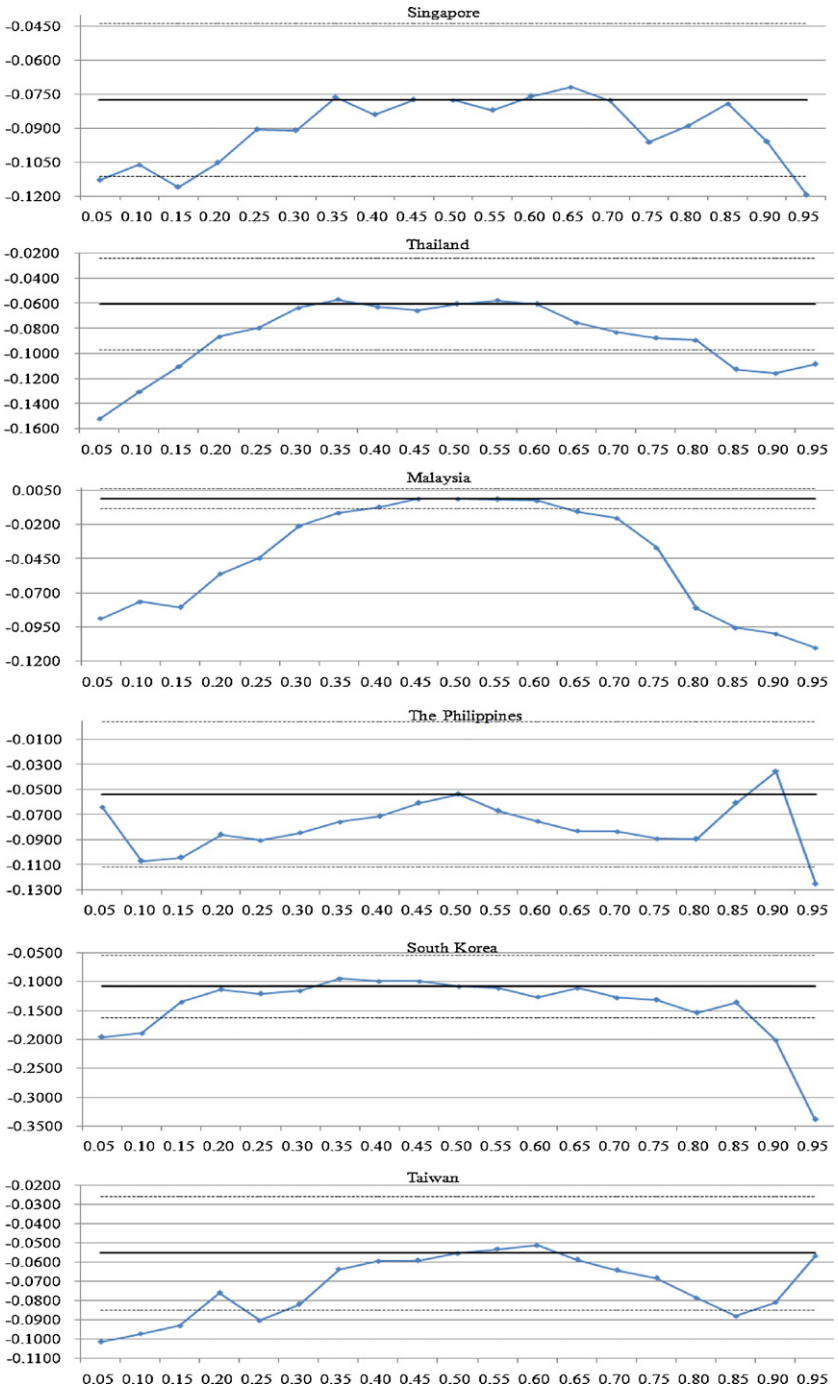

Fig. 2. Coefficients obtained from different quantile functions.

Table 4
Estimated results of ordinary least squares model: $\Delta \ln E_t = \alpha_0 + \alpha_1 \Delta \ln S_t + \varepsilon_t$.

	Country					
	Singapore		Thailand		Malaysia	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Variable						
α_0	−0.0004	***	0.0012	**	0.0016	***
α_1	−0.0943		−0.0597		−0.0989	
Adjusted R^2	0.1859		0.0222		0.1190	
Residual test: $Q(10)$	6.38		27.13	***	25.23	***
	Country					
	The Philippines		South Korea		Taiwan	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Variable						
α_0	0.0030	***	0.0027	***	0.0013	***
α_1	−0.0672		−0.1699		−0.0806	
Adjusted R^2	0.0326		0.1139		0.1221	
Residual test: $Q(10)$	9.43		15.07		8.05	

Notes: E_t is the exchange rate of a country; S_t is the stock price index of a country. $Q(10)$ is the Ljung–Box statistic based on the standardized residuals respectively up to the 10th order.
*** Statistical significance at the 1% level.
** Statistical significance at the 5% level.

horizontal line is the ordinary least squares estimate of the mean exchange rate, and the area between the two dotted lines indicates its corresponding 95% confidence interval.

All six Asian countries have a similar pattern in the various coefficients obtained by different quantile functions. The coefficients are more inclined to be negative when the exchange rates are extremely high (0.9th or 0.95th quantile) or low (0.05th or 0.1th quantile). As we can see in Table 5, the estimated results show that the coefficients using data of Singapore, Thailand, South Korea, and Taiwan are all significant under different quantiles, however, the pattern in the different coefficients obtained by various quantile functions is obvious. According to the Fig. 2, the absolute values of coefficients estimated under the 0.10 quantile and 0.90 quantile are the highest. These values are significantly higher than that of coefficients estimated under other quantiles. For example, the coefficient estimated using data of South Korea under the 0.90 quantile is −0.20, which is significantly different from the coefficient estimated under the 0.5 quantile.

The estimated coefficients using data of Malaysia and the Philippines are relatively significant under the 0.10 quantile and 0.90 quantile while the coefficients of Malaysia are not significant under 0.40–0.70 quantiles. The results from Table 5 and Fig. 2 indicated that the relationships between the stock price index and exchange rare are asymmetric; the negative relation between these two variables is more pronounced when exchange rates are extremely high or low.

As previously mentioned, this paper attempts to provide a new explanation for different empirical results of the relationship between stock and foreign exchange markets. It infers that the portfolio balance effect should not exist every time and everywhere. If the stock market of a country is not volatile, and if foreign capital will not be absorbed in this market, then the indirect influence on exchange rate may not occur. However, if the profit opportunity is obvious and causes the considerable quantities foreign capital to enter or leave the stock market, obvious capital inflow or outflow will occur, and significant influence on exchange rate may be found.

Therefore, during normal times (no obvious capital inflow or outflow), only the international trading effect exists in the relationship between these two markets. However, during financial crises or bubbles in stock markets, profit opportunity occurs and causes the considerable quantities of foreign capital to leave or enter the stock markets. Subsequently, this causes the currencies to depreciate or

Table 5
Estimated results of quantile regression model: $\Delta \ln E_t = \alpha_{0\tau} + \alpha_{1\tau} \Delta \ln S_t + \varepsilon_{t\tau}$.

Country	Quantile	Coefficient (α_1)	t-Statistic
Singapore	0.10	−0.1061	−5.2926***
	0.20	−0.1053	−6.0746***
	0.30	−0.0910	−4.3317***
	0.40	−0.0841	−5.0489***
	0.50	−0.0777	−4.6256***
	0.60	−0.0760	−4.6345***
	0.70	−0.0779	−4.9378***
	0.80	−0.0888	−4.7849***
	0.90	−0.0960	−2.7389***
Thailand	0.10	−0.1304	−4.2641***
	0.20	−0.0863	−3.4987***
	0.30	−0.0634	−3.1350***
	0.40	−0.0628	−3.5661***
	0.50	−0.0604	−3.3000***
	0.60	−0.0603	−3.0952***
	0.70	−0.0830	−5.0514***
	0.80	−0.0893	−5.0416***
	0.90	−0.1155	−5.9099***
Malaysia	0.10	−0.0762	−2.3264**
	0.20	−0.0561	−2.8163***
	0.30	−0.0207	−2.0803**
	0.40	−0.0072	−1.5907
	0.50	−0.0011	−0.2908
	0.60	−0.0024	−0.6728
	0.70	−0.0152	−1.5579
	0.80	−0.0810	−2.8943***
	0.90	−0.0997	−7.1615***
The Philippines	0.10	−0.1069	−3.7616***
	0.20	−0.0859	−2.9141***
	0.30	−0.0844	−2.9317***
	0.40	−0.0713	−2.5731***
	0.50	−0.0537	−1.8573
	0.60	−0.0752	−3.0045***
	0.70	−0.0833	−4.0178***
	0.80	−0.0894	−4.0575***
	0.90	−0.0352	−1.5987
South Korea	0.10	−0.1886	−7.2219***
	0.20	−0.1135	−4.9615***
	0.30	−0.1155	−4.9948***
	0.40	−0.0988	−4.0119***
	0.50	−0.1081	−4.0361***
	0.60	−0.1264	−5.2857***
	0.70	−0.1272	−5.4534***
	0.80	−0.1538	−6.3536***
	0.90	−0.2009	−3.0038***
Taiwan	0.10	−0.0971	−3.8603***
	0.20	−0.0760	−3.2186***
	0.30	−0.0819	−3.6067***
	0.40	−0.0593	−3.6295***
	0.50	−0.0552	−3.7479***
	0.60	−0.0511	−3.7479***
	0.70	−0.0641	−4.6483***
	0.80	−0.0785	−5.0429***
	0.90	−0.0808	−2.0870**

Notes: E_t is the exchange rate of a country; S_t is the stock price index of a country.
*** Statistical significance at the 1% level.
** Statistical significance at the 5% level.

appreciate. In this case, the relationship between stock prices and exchange rates will be negative. The pattern in Fig. 2 supports the inference of this paper.

5. Conclusion

Using monthly data (from January 1992 to December 2009) of the stock and foreign exchange markets in six Asian countries (Singapore, Thailand, Malaysia, the Philippines, South Korea, and Taiwan), this paper uses the quantile regression model to estimate the relationship between stock price index and exchange rate in order to completely observe the relationship. When the conditional distribution is heterogeneous, the ordinary least squares method can only provide the estimation of the mean of depending variable. Therefore, the usefulness of the estimated results is limited and may even be biased.

The empirical results of this paper show that the data in all six Asian countries have a similar pattern in the various coefficients obtained from different quantile functions. The coefficients are more significantly negative when the exchange rates are extremely high or low. The negative coefficients support the portfolio balance effect in these two markets, which states that the increase (decrease) of the returns of stock price index will decrease (increase) the exchange rate, which means the domestic currency appreciates (depreciates). However, the coefficient can vary. This means that the relationship between stock and foreign exchange markets can change depending on market condition since the portfolio balance effect does not exist every time and everywhere. Only when the profit opportunity is obvious, causing considerable quantities of foreign capital to enter or leave the stock market, can obvious capital inflow or outflow occur. Here, the significant influence of stock price index on exchange rate may be found.

Although previous studies have properly documented the relationship between stock prices and exchange rates, empirical results show conflicting evidence. This paper uses a quantile regression approach to provide a new explanation for the different results of the relationship between stock price and exchange rate.

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