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THE IMPACT OF STOCK MARKET VOLATILITY, INTEREST RATE FLUCTUATIONS, AND EXCHANGE RATE ON FOREIGN PORTFOLIO INVESTMENT IN THAILAND

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ABSTRACT

The vulnerability of the Thai economy to speculative attacks exposed by foreign portfolio investment (FPI), measured by the net flows of foreign equity portfolio investment to Thailand was largely neglected before the financial crisis in 1997 and 1998. Foreign portfolio investment is almost reversible as long as the local currency is convertible and transaction costs are trivial. The essentially revertible and uncommitted attributes of portfolio investments exposed the weaknesses of the Thai economy to a great extent. This research investigates the impact of stock market volatility, interest rate fluctuations and exchange rate on foreign portfolio investment in Thailand. Foreign portfolio investment is reported to be sensitive to exchange rates, interest rate volatility and stock market volatility.

Key Words: Exchange Rate, Interest Rate, Investment, Stock Market, Uncertainty

JEL Classification: F41, G12, E22, O16, D89

Introduction and research context

Stock Exchange of Thailand (SET) was established in April 1975 with only 14 quoted corporate and 2 government securities (Price, 1994). The first period 1975-1978 witnessed almost no trading. SET then suffered from the Second Oil Crisis and a worldwide interest surge during the period 1979-1983. After that, SET endured the hard economic slump of Thailand during 1981-1983, surviving the shocks of foreign trade and current account deficits, the threats of the government's fiscal balance, and the volatile interest and exchange rates. Trading in the recovering period 1984-1986 was fairly modest. The role of the SET during 1975-1986 was insignificant.

The number of listed companies increased from 7 in April 1975 to only 92 in December 1986. SET started to expand in 1987. Between 1987 and 1996, SET steadily moved towards better performance and dropped dramatically only twice, right after the Black Monday event on 19 October 1987 and during the Persian Gulf War in August 1990. The number of listed companies gradually increased from 102 in December 1987 to 192 in December 1992. The years 1993 and 1994 witnessed a marked boom with the number of listed companies increasing to 368 and 450 respectively. In 1995-1996, as a result of the foreign exchange crisis, in particular, the depreciation of the US Dollar and the devaluation of the Mexican Peso, rumours on the possibility of devaluation of a number of developing countries' currencies were prevalent [1].

The SET-Index performance reflects the different stages of development of the SET. The index achieved its lowest monthly record of 77.44 points on March 31, 1976 and reached its highest monthly peak of 1682.85 points on December 31, 1994. The rumours together with the capital flight from Asian countries back to the United States and Europe in 1995-1996 worsened the SET performance. However, the SET-Index still remained fairly high. Towards the end of 1996, those rumours started to attack Thailand on a fully-fledged scale and subsequently, a number of other Asian countries. SET was heavily hit by the crisis. The SET-Index plunged drastically. On July 31, 1998, the SET-Index of 260.89 points was roughly the same as its level in May 1987 or in December 1978. The number of listed companies constantly decreased from 431 in 1997 to 392 in 1999 and 382 in 2001.

Speculative portfolio investment became an important source of foreign capital amounting to US$2.7 billion in 1993 and US$2.25 billion in 1995, well above the FDI level of US$1.7 billion and US$2 billion respectively in the same period. Between these two peak years, net flow of foreign equity portfolio investment plunged to the bottom trough of US$ -394 million. Portfolio investment fluctuated, surged to a high level and plunged to a lowest point in a matter of a year. The excessive volatility of foreign portfolio investment makes Thai’s economy vulnerable from speculative attacks [1].

The causes of the financial crisis in 1997 and 1998 can generally be seen as the combined products of capital flight caused by panicking bank runs, and severe speculative attacks that failed to be rescued by the IMF, together with productivity declines, low capacity utilization, negligent foreign investors, high level of the private sector's unregulated short-term foreign currency denominated debts, and poorly-monitored foreign portfolio investments. During and after the crisis, Thailand experienced a period of severe recession. The struggle for recovery was harsh but Thai’s economy has recovered with strong macro and micro economic stabilisation and development.

The data we use for the investigation of foreign portfolio investment decisions cover the period 1980 to 2002 inclusive, to investigate the impact of stock market volatility, interest rate fluctuations and exchange rates before and after the financial crisis. The data does not include the period of global financial crisis to avoid the impact of global demand decrease and global credit crunch. The boom and bust of the Thai economy during this period may pose some difficulties because firms would behave differently during a period of strong growth and during recession. However, the abnormal uncertainty associated with the time of local crisis would provide insights into the investigation of the relationship between uncertainty and foreign portfolio

investment.

Theoretical and Empirical Reviews

Firms' portfolio investment behaviour is substantively influenced by the uncertainty about the future movement of some business attributes, economic indicators, and political environment associated with an investment project. Different economic theories with emphasis on different channels based on different sets of assumptions and approaches suggest different size and sign of the impact of uncertainty on irreversible and reversible investment. Adjustment cost and q-theory literature based on the assumptions of the convexity of the marginal revenue product of capital support the idea that an increase in the volatility of the stochastic variables, say, output price or input costs, leads to an increase in the expected returns, hence, uncertainty encourages reversible investment.

Hartman [2] and Abel [3], [4], [5] show uncertainty can have positive impact on investment as a direct result of the Jensen's inequality effect if the marginal profitability of capital is a convex function of the sources of uncertainty. The hypotheses about negative investment-uncertainty relationship are widely used to test the validity of the real options argument [6], [7], [8]. Economic uncertainty often has an indirect impact on a firm's input cost or output price. Though a number of economic innovations can be listed, the most important are: exchange rate [6], [9], [10], [11]; interest rate [8], [12]; inflation [11], [12]; or aggregate output (GDP) [13].

Using US two-digit and four-digit manufacturing data over the 29 year period from 1958 through to 1986, Caballero and Pindyck [14] examine the effects of uncertainty and irreversibility on industry total investment in a competitive industry with constant returns to scale. They find in the absence of irreversibility, firms make investment whenever the price goes up, and divest it when the price falls down. The combination of irreversibility and aggregate shocks make firms more reluctant to enter or expand and industry-wide uncertainty reduces investment.

Pindyck and Solimano [11] suggests the methodology and theoretical model of the empirical work covers a broad range of countries and various measures of uncertainty. A set of 30 countries, of which 14 are LDC's and 16, OECD countries, over the period from 1962 to 1989 is divided into three sub-periods 1962-1971, 1972-1980, and 1981-1989. As in Caballero and Pindyck [14], they measure the trigger as the extreme (maximal) values of the log of marginal profitability of capital given by:

$$b(t) = \log(\alpha_K \alpha_L^{\alpha_L/\alpha_K} \alpha_M^{\alpha_M/\alpha_K}) + \frac{a_t}{\alpha_K} - \frac{\alpha_L}{\alpha_K} p_{L,t} - \frac{\alpha_M}{\alpha_K} p_{M,t}$$

which is derived from the constant returns to scale Cobb-Douglas production function, $Y_t = A_t K_t^{\alpha_K} L_t^{\alpha_L} M_t^{\alpha_M}$ and the Solow residual $a_t = y_t - \alpha_K k_t - \alpha_L l_t - \alpha_M m_t$, where t is the time index; Y, A, K, L, M, P_L, P_M are, respectively, the gross value of output (GDP plus the value of imported material inputs), productivity index, capital stock, labour, imported material, real price of labour and imported materials (exchange rates); and the lower case letters represent the logs of the corresponding uppercase variables.

They make a number of different tests by running the trigger proxies against a set of

different measures of uncertainties. The first measure of uncertainty is also the standard deviation of the first difference of the logs of the marginal profitability. They then include a variety of indicators for economic and political instability. The economic indicators included are the mean rate of inflation, the standard deviation of annual changes in the inflation rate, and the standard deviations of annual changes in the real exchange rate and real interest rate. Two measures of political uncertainty include the probability of a change in government, as estimated from a probit model by [12]; and a set of political variables measured by the number of assassinations, government crises, strikes, riots, revolutions, and constitutional changes per year over the period 1960-1985, which is taken from Barro and Wolf [16].

They find a negative relationship between the trigger values and the general measure of risks, which is the standard deviation of $\Delta b(t)$. However, the size of the relationship is moderate with greater magnitude for developing countries. Investment does not seem to be influenced by political instability in the panel regressions, but inflation shocks robustly explain the changes in the trigger values. Larger inflation shocks tend to increase the trigger values, hence depress aggregate investment.

Pindyck and Solimano note a number of drawbacks arising from using aggregate data, including poor and fragmentary data in several developing countries. Given the lack of quality data at firm level, the use of aggregate data to investigate the role of uncertainty on investment helps bridge the gap between theoretical and empirical studies on investment uncertainty relationship. Firm-level data studies will provide much more useful information for managers, policy makers and academics. The difficulties in obtaining firm-level data increase aggregate data st and concentrated on the combined net effect of the uncertainty on investment.

The regression model

With given technology and relative cost of capital to other input costs (rents, labours, or materials) there is a long run desired capital stock, which is optimally required to produce a specific amount of output for the economy in static equilibrium. In dynamic equilibrium, the optimal capital stock is achieved by adjusting the flows of capital of investment. There is a desired investment level that provides sufficient flows of capital to offset the natural depreciation of existing capital stock and to provide new capital to meet the expansion of aggregate demands. At aggregate level, it is reasonable to assume that depreciation rate is relatively stable in the long run. If there is no significant shock in technology, input costs and/or output demands, desired investment should be commensurate with the aggregate output and the corresponding optimal capital stock. Assuming the economy is in a steady state, growing at the balanced warranted natural rate and is characterised by the simple Cobb-Douglas production function with constant returns to scale, investment output ratio should be relatively stable [17].

Autoregressive Distributed Lag (ADL) Model is used to examine the impact of exchange rates and uncertainties proxied by stock market volatility and interest rate fluctuations on public fixed investment. Uncertainty measured by unexpected shocks in stock market returns and interest rates is assumed to be a more important source of variation that deviates average investment from its long-run equilibrium and determine the short-run desired investment output

ratio in each period of time. The following reduced-form investment function is defined in the form of Partial Adjustment Model (PAM):

$$Y_t = \gamma\beta_0 + (1-\gamma)Y_{t-1} + \gamma(\beta_1 SET_t + \beta_2 IRU_t) + \gamma u_t \quad (1)$$

where Y_t is the foreign portfolio investment output ratio, FPI_t/GDP_t; the desired ratio of foreign portfolio investment, FPI_t, to aggregate output/output demands, GDP_t, is not directly observed and partially adjusted by some fraction γ $(0 \leq \gamma \leq 1)$ of the desired change in any given period t; β_0 is the constant; β_i is the coefficients on the exchange rate, XR_t, the interest rate volatility, IRU_t, the stock market volatility, $SETU_t$, and their lags; u_t is the error term, which controls for the impact of all other factors that are not fully explained by the model and is assumed to be independently and identically distributed with mean zero and standard error, σ. If u_t satisfies the usual assumptions of the Classical Linear Regression Model (CLRM), so will γu_t [11]. Even though Y_{t-1} depends on u_{t-1} and all the previous disturbance terms, it is not related to the current error term u_t because under the assumptions of the CLRM u_t is not serially correlated. Ordinary Least Squares (OLS) estimation of (1) yields consistent estimates if u_t satisfies the CLRM assumptions; hence γu_t. The robust estimates of the ADL model is used to check for the consistency of the estimates. The number of lags of the exchange rate, XR_t, the interest rate volatility, IRU_{t-i}, and the stock market volatility, $SETU_{t-i}$, is determined using the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC).

Investment is determined by various determinants. The foreign portfolio investment output ratio is used as the dependent variable to control the impact of output demands on investment. Investment determinants that affect input costs including exchange rates and uncertainty proxies provide important source of variation that deviates average investment from its long-run equilibrium and determine the short-run desired investment output ratio in each period of time. Uncertainty is measured by unexpected shocks in the stock market returns and long-term government bond rates. This is consistent with the results presented in [18], which suggest uncertainty has a stronger effect on investment than other investment determinants.

The aggregate data used in the following analysis are published by the Bank of Thailand and covers the period between 1980-2002 inclusive. Data aggregated at national level are available for time series regression and there are not sufficient data at industrial level for cross sectional regression analysis. The Autoregressive Distributed Lagged (ADL) approach using the partial adjustment mechanism (PAM) initiated by Marc Nerlove helps examine the dynamic structures of our investment models.

Our first choice of uncertainty proxy is the volatility of stock market returns to capture the effects of all other sources of uncertainty. The standard deviations of monthly stock returns for each year from 1980 to 2002 are used as the representative uncertainty proxy. This uncertainty proxy is widely used in related studies on investment uncertainty relationship [19], [20], [21], [22]. Other source of uncertainty includes the fluctuation of interest rate uncertainty [8], [12]. The uncertainty proxy for interest rates is calculated using the relative changes (first difference of natural logarithm of the long-term government bond rates). All the monthly standard deviations using 12 observations for each year are then multiplied by square root of 12 to obtain the annualised standard deviation.

We observe Foreign Portfolio Investment determined by the net flows of foreign equity portfolio investment to Thailand and examine its sensitivity to exchange rates and uncertainties proxied by stock market volatility and interest rate fluctuations. Portfolio investment is more revertible than real direct investment and hence uncertainty would have positive impact on foreign portfolio investment.

Findings

Our central purpose is to examine the relationship between uncertainty and aggregate investment. Foreign portfolio investment is almost reversible as long as the local currency is convertible and transaction costs are trivial. To find the determinants that can best explain investment, it would be ideal to start from a general testing model that includes all the theoretical explanatory variables and then gradually drop the insignificant factors and run the regression again. Raising the number of observations would improve the precision of the estimates statistically but increasing the sample period would increase the chance of having unstable estimated parameters in the sample. Foreign direct investment will provide more implications for irreversible investments and portfolio foreign investment would deal with reversible investment. Foreign private investment may or may not reflect fundamentals during the period of our investigation. Our earlier analysis of Thailand's business and investment environment has suggested that Thailand was the magnet for foreign investors, attracting both real and speculative investment in the late 1980s and early 1990s. During this period, forward expectation is pushed upwards (perhaps, irrationally too high) among foreign investors and it is the speculative force that affects foreign private investment and influences the way in which real investment should be made otherwise.

Table 1 reports the results for the regressions of the ratio of foreign portfolio investment to GDP on all uncertainty proxies using the autoregressive distributed lagged (ADL) method. The diagnostic regressions to search for the sources of uncertainty that matter most to aggregate foreign portfolio investments identify exchange rate, stock market volatility and interest rate shocks as the significant investment determinants.

If this assumption of the Classical Linear Regression Model (CLRM) is not satisfied, the OLS estimators are not only biased but also not consistent. The interpretation of the results under that situation would be misleading. By construction, our partial adjustment model should pose no such problem as long as there is no serial correlation of the disturbance terms. The Durbin's *h* test of serial correlation for autoregressive regression models confirms that there is no serial correlation in our models. To examine if higher order of autoregressive scheme, AR(p), is a problem, we use LM test (Breusch-Godfrey (BG) Test), with the longest length of the lag, p, defined by experimentation (starting from p=1, LM test is implemented until the LM statistic is no longer significant. When there is no evidence of autocorrelation LM statistic for p=1 is reported. White's test of heteroskedasticity also suggests heteroskedasticity is not present in our models. Additional regressions using Newey-West standard errors to adjust for heteroskedasticity and autocorrelation confirm that the significance of the estimates are generally unchanged either heteroskedasticity and autocorrelation are adjusted or not.

Table 1: Foreign Portfolio Investment and Uncertainty (Robust Estimates)

$\frac{FPI_t}{GDP_t}$	(a) ADL	(b) ADL (Robust Estimates)
$\frac{FPI_{t-1}}{GDP_{t-1}}$	.5499**	.5499**
	(.1927)	(.1646)
XR_t	.0010**	.0010**
	(.0003)	(.0002)
XR_{t-1}	-.0019**	-.0019**
	(.0004)	(.0003)
IRU_t	.0269*	.0269*
	(.0109)	(.0123)
$SETU_t$	.0222**	.0223**
	(.0076)	(.0061)
$SETU_{t-1}$	.0233**	.0233**
	(.0089)	(.0086)
Constant	.0133**	.0133**
	(.0046)	(.0052)
$\overline{R}^2$	.8610	.8610
F statistic**	$22.69_{(6,15)}$	$22.69_{(6,15)}$
Durbin's h	-1.00 (.31)	-1.00 (.31)
White's	$1.7286_{(1)}$	$1.7286_{(1)}$
LM test$_{(p)}$		$.6110_{(1)}$
AIC	90.34	90.34
SBC	97.34	97.34

** Significance at 1% level, * Significance at 5% level

Source: Equations estimated using STATA

Following the method used by [11], the investment determinant as exchange rate is included in the regression equation. The interest rates are the long-term government bond rates, capturing the cost of risk free capital. An increase in the government bond rates will generally shift all the interest rates corresponding to different risk classes, raising the cost of capital and reduce investment. SET returns measure the performance of the Thailand Stock Market's portfolio and can be used as a good proxy for macroeconomic performance. If the market is efficient, SET prices reflect fundamentals. If there is no significant shift in the underlying risk, higher SET returns generally encourage investment. Exchange rates affect firm investments in two ways: (i) through output demands of exporting firms; and (ii) through input costs if firms import materials or service debts denominated in foreign currency. An increase in XR_t means depreciation would have a positive impact on investment under (i) and a negative impact under (ii). The total effect is ambiguous however. At aggregate level and in the short-run, depreciation improves exports, contracts imports and expands aggregate demands, hence stimulates aggregate investment to

meet the output demand. In addition, depreciation attracts foreign capital inflow, increasing the availability of capital denominated in the local currency, hence reduces cost of capital and encourages investment. The total effect of exchange rates on investment is therefore positive in the short-run. Only significant factors are reported. In this case, exchange rate, XR_t, appear to provide useful information. Even though exchange rate is significant in the regressions of *Table 1* it has an ambiguous sign, with current exchange rate, XR_t, has negative impact on private investment and one-period lagged exchange rate, XR_{t-1}, has positive impact on private investment. The overall long-run impact of exchange rate is insignificant and negligible.

Foreign portfolio investment (FPI) is reported to be sensitive to exchange rates, interest rate volatility and stock market volatility. The regression results provide interesting implications. Firstly, even though the total long-run effect of the exchange rate on portfolio investment is negative, it is interesting to observe that the current exchange rate has a positive impact on FPI_t while the last period exchange rate has the opposite impact. This can be explained as follows. Depreciation makes the price of domestic investment instruments relatively cheaper in the short-run and leads to an immediate increase in portfolio investment. In the long run, foreign investors eventually take the investment proceeds back to their country and account their profits on the basis of their own currency. If the investment proceeds are higher than the investment costs then exchange rates are expected to have a negative impact on long-run investment expenditures. Secondly, when investment is reversible the positive Jensen's inequality effect overwhelms the real options negative impact of uncertainty on investment. Assuming the marginal profitability of capital is a convex function of interest rates and exchange rates, then higher interest rate uncertainty and stock market volatility push the expectation of payoffs upwards, resulting in higher investment.

Conclusions

The use of Autoregressive Distributed Lag (ADL) Model, specifically the Partial Adjustment Model (PAM), has made it possible for us to examine the dynamic structure of the aggregate foreign portfolio investment equations for Thailand. To investigate the investment uncertainty relationship, the research focuses on the analysis of private foreign portfolio investment. When investments are reversible, they are very sensitive to uncertainty of future returns. The regression results consistently indicate that exchange rates, uncertainties of interest rates and stock market returns have a very significant positive impact on aggregate private foreign portfolio investment.

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