CHAPTER III

METHODOLOGY

3.1 Conceptual framework

It is obvious that this study focuses directly on partial equilibrium of international capital movements, especially the reactions of crucial economic determinant factors to international capital movements. Therefore, the conceptual framework of our study emphasizes on the Interest Parity Theory, Capital Asset Pricing Model and Capital Control Rationale for investigating the relationship of short-term capital flow in the form of short-term private capital flow in capital and financial account. We also construct monthly capital control index from information based on foreign exchange regulation press and notifications published by the Bank of Thailand in order to capture surge of capital mobility accurately.

3.1.1 Interest Parity Theory

Covered interest parity establishes the linkages across spot and forward currency markets simultaneously with domestic and foreign security markets[8]. The theory is drawn on the principle that two investment s exposed to the same risks must have the same returns. Interest parity is also maintained by an arbitrage condition which says that the returns in a country will equate with the exchanging that currency for another currency

[8] John Maynard Keynes (1923) made an early formulation of interest parity theory.

when investing in interest-bearing instruments of the second country while purchasing futures contracts for converting the currency back at the end.

Suppose that a domestic investor can place THB1 in a Thai risk-free security that earns an interest rate i_d for one period, and pays its interest rate once at the end of the periods. The ending wealth from this THB investment would be:

$$THB1 \times (1 + i_d)$$

Alternatively, the investor could take this THB1, convert it into US$ at the current spot rate (S_t), take the entire proceeds and invest it in a US$ risk-free security that earns interest at i_f for one period, and at the same time sell the entire proceeds of the investment (principle and interest) at the current one-period forward rate, $F_{t,1}$. By selling the THB proceeds in the forward market, we say that the investor is covering his or her exposure to US$ exchange rate changes. The ending wealth from this US$ investment would be:

$$THB1 \times \frac{1.0}{S_t} \times (1 + i_f) \times F_{t,1}$$

The pair of securities should be identical in all respects – that is, maturity, credit risk, liquidity risk-except for currency of denomination. When these conditions are met, the two investments should produce identical ending wealth, or:

$$THB1 \times \frac{1.0}{S_t} \times (1 + i_f) \times F_{t,1} = THB1 \times (1 + i_d)$$

Rearranging terms, we have:

$$\frac{F_{t,1}}{S_t} = \frac{1 + i_d}{1 + i_f}$$

And subtracting 1.0 into each side of the equality results as:

$$\frac{F_{t,1}}{S_t} - 1 = \frac{1+i_d}{1+i_f} - 1$$

$$\frac{F_{t,1}}{S_t} - \frac{S_t}{S_t} = \frac{1+i_d}{1+i_f} - \frac{1+i_f}{1+i_f}$$

$$\frac{F_{t,1} - S_t}{S_t} = \frac{i_d - i_f}{1+i_f}$$

or

% forward premium = % interest differential

The equation can be rewritten as:

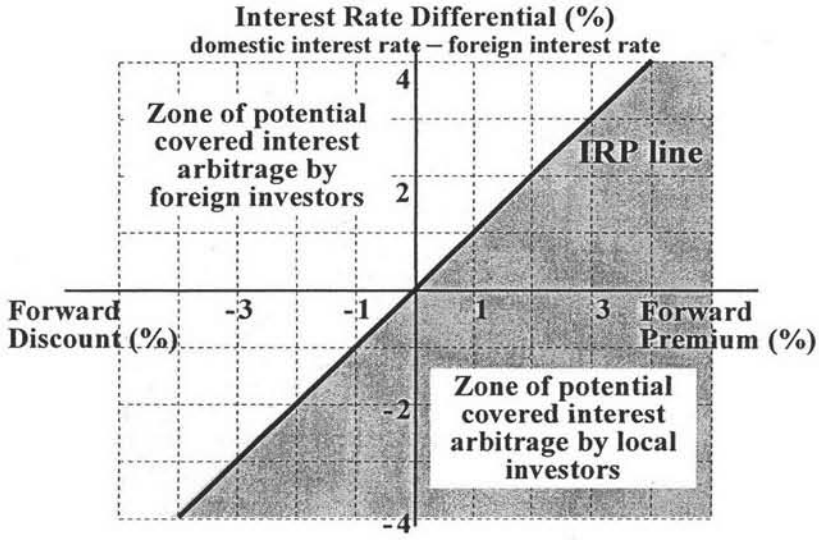
$$0 = \frac{F_{t,1} - S_t}{S_t} - \frac{i_d - i_f}{1+i_f}$$

The above equation represents parity regardless wherever investors will invest; the return will be the same. If the parity does not hold, arbitrage opportunities can be occurred, thus, $CIPD_t$ will not equate zero.

$$CIPD_t = \frac{F_{t,1} - S_t}{S_t} - \frac{i_d - i_f}{1+i_f} \quad \text{, where } CIPD_t \neq 0$$

The interest rate parity line represents the break-even point or the dividing line between investments in the domestic security and investments in the foreign security that have been covered against exchange rate risk. At the point to the north and west of the line, capital flows from THB to foreign currency should take place. At points to the south and east of the line, incentives favor capital flows from foreign currency to THB. At points on the interest parity line, the covered return on invested funds and the covered cost of raising funds are identical across currencies.

Figure 6.1: Interest rate differentials



By relaxing the stringent "Perfect Market Assumptions[9]", we can examine how interest parity is affected by the presence of transaction costs, taxes, and uncertainty. Arbitrage will not be occurred unless absolute magnitude of the deviation from parity exceeds the costs of undertaking the arbitrage transactions. This constraint has the effect of creating a neutral band within which covered interest arbitrage transactions will not happen. The neutral band can be descried by the limiting values on the forward premium, an upper limit (P_U) and a lower limit (P_L). The other points outside of the neutral band are considered as disequilibrium points that represent arbitrage profit opportunities (Levich, 1998).

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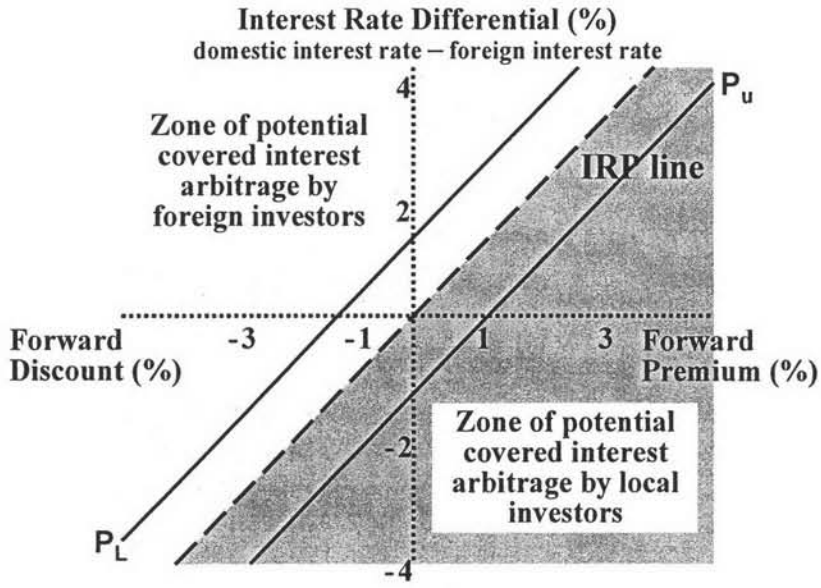
[9] The standard PCM assumptions by Fama and Miller (1972) describes that capital can move freely with no transactional costs, no tax and complete certainty –all participants have equal and costless access to information. Therefore, they share homogenious expectations about future outcomes. All buyers and sellers of securities are small and can not individually influence prices.

Figure 6.2: Interest rate differentials with band



3.1.2 Capital Asset Pricing Model (CAPM)

The capital asset pricing model (CAPM) offers intuitively pleasing predictions about how to measure risk and the relation between expected returns and risks. Harry Markowitz laid down the foundation of modern portfolio management since 1952. The CAPM was developed once a decade later in articles by William Sharpe (1964)[10] John Lintner (1965)[11] and Jan Mossin (1966)[12] that gave the birth of asset pricing theory (resulting in a Nobel Prize for Sharpe in 1990).

The development of the capital asset pricing model begins with the description of market setting within which equilibrium must be established. It is assumed that all production is organized by firms. At the beginning of period t-1, firms purchase inputs and the services of inputs (labor, machinery and so on) and use them to produce consumption goods and services that will be sold at the beginning of period t, which all firms are ceased. Firms finance their expenses for production in period t by issuing shares in their market values (equal sale of output at the beginning of period t) and these shares are investment assets held by consumers. It is the process by which period t-1 market prices of such assets are determined.

The objective of the theory is to analyze the nature of equilibrium in the capital market, and in particular on the measurement of the risks of assets and portfolios and the relationship between risk and equilibrium expected returns. The optimal consumption-investment decisions by individuals determine the risk structure of equilibrium expected returns. This analysis proceeds from partial equilibrium (consumption-investment) to

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[10] William Sharpe, "Capital Asset Prices: A Theory of Market Equilibrium," *Journal of Finance*, September 1964.

[11] John Lintner, "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets," *Review of Economics and Statistics*, February 1965.

[12] Jan Mossin, "Equilibrium in a Capital Asset Market," Econometrica, October 1966.

capital market equilibrium—all the time, taking optimal production-investment decisions by firms and equilibrium in the markets for labor and current consumption goods as given.

The process originated from constructing an investor portfolio that can be considered as 2 sequences that are selecting the composition of a portfolio of risky assets, such as stocks or long-term bonds, and deciding how much to invest in the risky portfolio versus in a risk-free assets, such as short-term treasury bills. However, an investor can not decide how much they allocate amounts of funds between them without knowing its expected return and degree of risk they encounter. The crucial point of this theory is to characterize risk-return trade-off among assets for a portfolio.

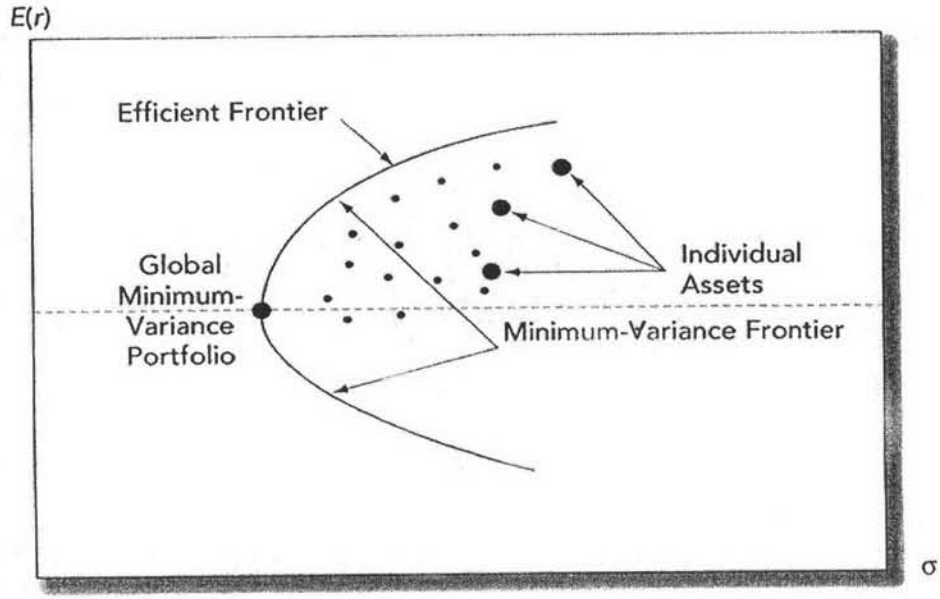
The utility function will be introduced into the model which allows each investor to assign welfare of utility scores to alternative portfolios based on expected return and risk and choose the portfolio with the highest score. Risky assets always correlate with risk premium in the market place. From this concept, it can assume that most investors are risk averse. (Risk-averse investors are willing to consider only risk-free or speculative prospects with solely positive risk premium.) A risk-averse investor penalizes the expected rate of return of a risky portfolio by a certain percentage to account for the risk involved. The higher the risk, the larger the penalty. The theory will assume that each investor can be assigned welfare or utility score to competing investment portfolios based on the expected return and the risk of those portfolios. Higher utility value is assigned to portfolios with more attractive risk-return profiles. Portfolios receive higher utility scores for higher expected returns and lower score for higher volatility. The function that has been employed by both financial theories assigns a portfolio with expected return E(r) and variance of return σ^2 as follow:

$$U = E(r) - \frac{1}{2} A\sigma^2$$

When U is the utility value and A is an index of the investor's risk aversion (A > 0). The factor of ½ is just a scaling convention where the risk-free portfolios receive a utility score equal to the rate of return because they receive no penalty of risk ($\sigma^2 = 0$).

The greater value of index of the investor's risk aversion (A), the lower utility of investors. In contrast to risk-averse investors, risk neutral investors[13] and risk lover investors[14] are abolished from this concentration.

Figure 7: The Efficient Frontier



Regarding to portfolio investors, the most straight forward direction to control the risk of the portfolio is through the fraction of the portfolio invest in treasury bills and other safe money market securities versus risky assets. The capital allocation decision is an example of an asset allocation choice rather than among specific securities with each asset class. According to Markowitz diversification, investors will choose the optimal portfolio from the set of portfolio that offers the highest expected rate of return for any

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[13] Risk neutral investors (A = 0) are investor who care only expected rate of returns regardless of how much risk they encounter. So risk neutral investors receive no penalty for risk.

[14] Risk lover (A < 0) is willing to take on additional risk for an investment that has a relatively low expected return.

level of risk or the lowest risk for any level of expected return. The set of portfolio that responds to these conditions is known as "the Efficient Frontier" shown as above:

Appling the efficient frontier, investors who are surveying all investment opportunities will find that the possibilities of borrowing and lending exist. The straight line in figure 8 is called the capital market line (CML). It depicts all risk-return combinations available to investors. The slope of the capital market line equals the increase in the expected returns of the complete portfolio per unit of additional standard deviation.

The next step is to determine the risk-return opportunities available to the investors. These are summarized by the minimum-variance frontier of risky assets. Notice that all the individual assets lie to the right inside the frontier, at least when we allow short sales in the construction of risky portfolios[15]. This tells us that risky portfolios comprising solely a single asset are inefficient. Diversification of investment leads to portfolios with higher expected returns and lower risks or standard deviations. All the portfolios that lie on the minimum-variance frontier from the global minimum-variance portfolio and upward direction provide the best risk-return combinations and, thus, are candidates for the optimal portfolio. The part of the frontier that lies above the global minimum-variance portfolio is called the efficient frontier of risky assets. For any portfolio on the lower portion of the minimum-variance frontier, there is a portfolio with the same standard deviation and a greater expected rate of return positioned directly above it. The bottom part of the minimum-variance frontier is inefficient.

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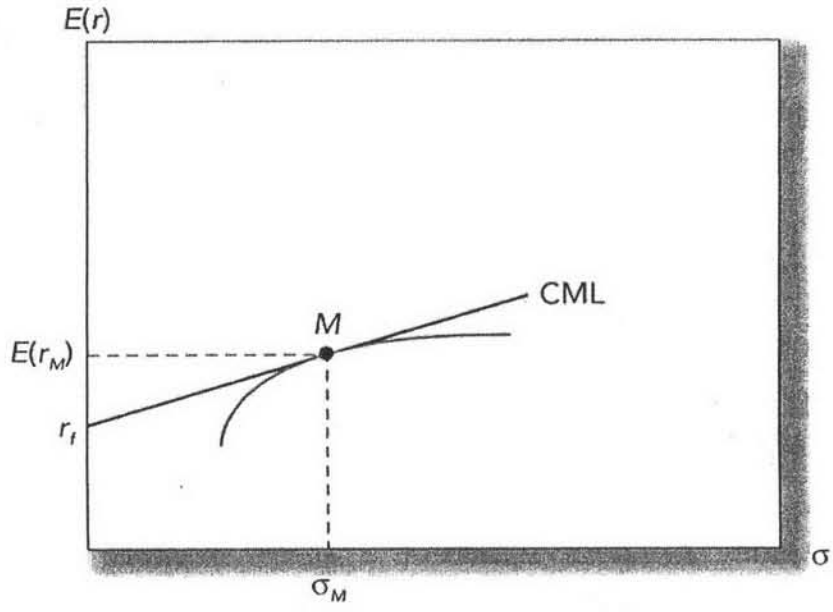
[15] When short sales are prohibited, single securities may lie on the frontier. For an example the security with the highest expected return must lie on the frontier, as that security that represent s the only way that one can obtain a return that high, and so it must also be the minimum-variance way to obtain that return. When short sales are feasible, however, portfolios can be constructed that offer the same expected return and lower variance. These portfolios typically will have short positions in low-expected-return securities.

The point that an investor has to pick in order to gain the highest rate of returns and the lowest risk among risky assets and risk-free assets is the point that the capital market line tangent to the efficient frontier.

Figure 8: The capital market line



From all development process of investment portfolios, the CAPM formula takes into account the asset's sensitivity to non-diversifiable risk, systematic risk or market risk, as well as the expected returns of the market and the expected returns of a theoretical risk-free asset on the concept of Markowitz diversification and the formula can be expressed as follows :

$$E(R_i) - R_F = \beta_i[\, E(R_M) - R_F \,]$$

or

$$E(R_i) = \beta_i[\, E(R_M) - R_F \,] - R_F$$

Where $E(R_i)$ is the expected returns on the capital asset, R_F is the risk-free rate of interest, β_i can be expressed as $Cov(R_i, R_M)/\sigma^2_M$ that measures the sensitivity of the asset returns to market returns that and $E(R_M)$ is the expected returns of the market portfolio.

However, the CAPM's concept lay down in unrealistic world, regardless to pace into real-world complexities. Any investor selects a portfolio at time t-1 that produces a stochastic return at t. The assumptions that can complete the compositions of the theory are simplified as follows:

1. There are many investors with small amount of endowment or wealth compare to the total endowment in the market so investors are price-takers.

2. All investors plan to invest in an identical period. We can assume that the investor's behavior is short-sight (myopic).

3. Investors are allowed to trade publicly financial assets, both risk-free assets and risky assets at risk-free borrowing or rending arrangements (non-tradable assets, such as education, government funds).

4. There are no taxes, commissions, fees or transaction costs paid on trade in securities.

5. Investors are risk-averse investor.

6. Investors are rationale mean-variance optimizers. They care only the mean and variance of their one-period investment return. As a result, investors choose mean-variance-efficient portfolios, in the sense of minimizing the variance of portfolio return and maximizing expected return, for any given variance and return respectively.

3.1.3 Capital Control Rationale

Capital control is the instrument that a country uses in order to restrict the volatile movements either capital inflows or capital outflows occurred from expanding global economy and a country's willingness to liberalize its financial system by allowing free convertibility of its currency. Generally, countries allowed liberalizing capital and financial accounts in order to finance international trade or receive direct investment. Capital account convertibility is another channel that also allows countries expose freely inflows and outflows that subject to speculation and exchange rate volatility. There are various types of capital control measures. The main classification of capital control is control on capital inflows and outflows.

Capital controls may be used to limit capital flow volatility for achieving stability of economy in the expectation of crisis or influencing the volume or composition of flows in the boom or bust cycles. Discouraging capital inflows would slow down currency appreciation in country which pursues fixed or manage float regime, reduce the quantity of foreign capital that may flight in the near future or change the composition of undesirable capital inflows (e.g. huge flow of portfolio investment) that can reduce instability.

Capital controls are the most acceptance to destabilizing effects of capital flows on fragile regulated financial systems that are characteristic of developing economy and emerging market. When a country adopts a fixed exchange rate regime, massive tide of capital outflow, sudden reversal of capital inflow or capital flight can either raise interest rates or devalue currency.

Capital controls can be used to prevent adverse effects of free flows on national economic policy-making and undermining economic stability. Any policy intended to restrict or redirect capital account transactions can be considered as a capital control. These consist of taxes, price or quantity controls and even bans on trade in certain kinds of goods. There are many different kinds of capital controls which may be introduced for various reasons. The effects of specific controls may change over time and could become

quite different from what may have been intended. Countries adopt capital control measure can have many economic reasons behind, for instance:

- Avoiding real currency appreciation due to monetary expansion.
- Avoiding inflation and enhancing macroeconomic stability by limiting potentially volatile capital inflows.
- Reducing financial instability by changing the composition of capital inflows.
- Restricting foreign ownership of domestic assets which might cause nationalistic resentment.
- Securing exchange rate stability and protecting fixed exchange rate or manage float regime.
- Correcting international payments imbalances either deficits or surpluses for achieve greater leeway for monetary policy.
- Ensuring the domestic utilization of national savings and enabling governments to allocate credit domestically without risking of capital flight (Jomo, 2001).

3.2 Model specification

This study will be proceeded by the Vector Autoregression Model (VAR) that drawn on the variables highlighted in the financial market equilibrium condition that is estimated by using monthly data from January 1999 to December 2007 to investigate the stability of monetary conditions. The model consists of the following equations:

$$Y_t = \alpha + \sum_{i=1}^{k} \beta_i (Y_{t-i}) + \delta_i(X_t) + \varepsilon_t$$

where Y_t = [ST_GDP_t $CIPD_t$ LXR_t CCI_t ROS_t $LUS1M_t$] and X_t = [Ø]
We can also break the methodology into the model of regression equations as:

$$ST\_GDP_t = \alpha + \sum_{i=1}^{k} \beta_1 ST\_GDP_{t-i} + \sum_{i=1}^{k} \beta_2 CIPD_{t-i} + \sum_{i=1}^{k} \beta_3 LXR_{t-i} + \sum_{i=1}^{k} \beta_4 CCI_{t-i} + \sum_{i=1}^{k} \beta_5 ROS_{t-i} + \sum_{i=1}^{k} \beta_6 LUS1M_t + \varepsilon_t$$

$$CIPD_t = \alpha + \sum_{i=1}^{k} \beta_1 ST\_GDP_{t-i} + \sum_{i=1}^{k} \beta_2 CIPD_{t-i} + \sum_{i=1}^{k} \beta_3 LXR_{t-i} + \sum_{i=1}^{k} \beta_4 CCI_{t-i} + \sum_{i=1}^{k} \beta_5 ROS_{t-i} + \sum_{i=1}^{k} \beta_6 LUS1M_t + \varepsilon_t$$

$$LXR_t = \alpha + \sum_{i=1}^{k} \beta_1 ST\_GDP_{t-i} + \sum_{i=1}^{k} \beta_2 CIPD_{t-i} + \sum_{i=1}^{k} \beta_3 LXR_{t-i} + \sum_{i=1}^{k} \beta_4 CCI_{t-i} + \sum_{i=1}^{k} \beta_5 ROS_{t-i} + \sum_{i=1}^{k} \beta_6 LUS1M_t + \varepsilon_t$$

$$CCI_t = \alpha + \sum_{i=1}^{k} \beta_1 ST\_GDP_{t-i} + \sum_{i=1}^{k} \beta_2 CIPD_{t-i} + \sum_{i=1}^{k} \beta_3 LXR_{t-i} + \sum_{i=1}^{k} \beta_4 CCI_{t-i} + \sum_{i=1}^{k} \beta_5 ROS_{t-i} + \sum_{i=1}^{k} \beta_6 LUS1M_t + \varepsilon_t$$

$$ROS_t = \alpha + \sum_{i=1}^{k} \beta_1 ST\_GDP_{t-i} + \sum_{i=1}^{k} \beta_2 CIPD_{t-i} + \sum_{i=1}^{k} \beta_3 LXR_{t-i} + \sum_{i=1}^{k} \beta_4 CCI_{t-i} + \sum_{i=1}^{k} \beta_5 ROS_{t-i} + \sum_{i=1}^{k} \beta_6 LUS1M_t + \varepsilon_t$$

$$LUS1M_t = \alpha + \sum_{i=1}^{k} \beta_1 ST\_GDP_{t-i} + \sum_{i=1}^{k} \beta_2 CIPD_{t-i} + \sum_{i=1}^{k} \beta_3 LXR_{t-i} + \sum_{i=1}^{k} \beta_4 CCI_{t-i} + \sum_{i=1}^{k} \beta_5 ROS_{t-i} + \sum_{i=1}^{k} \beta_6 LUS1M_t + \varepsilon_t$$

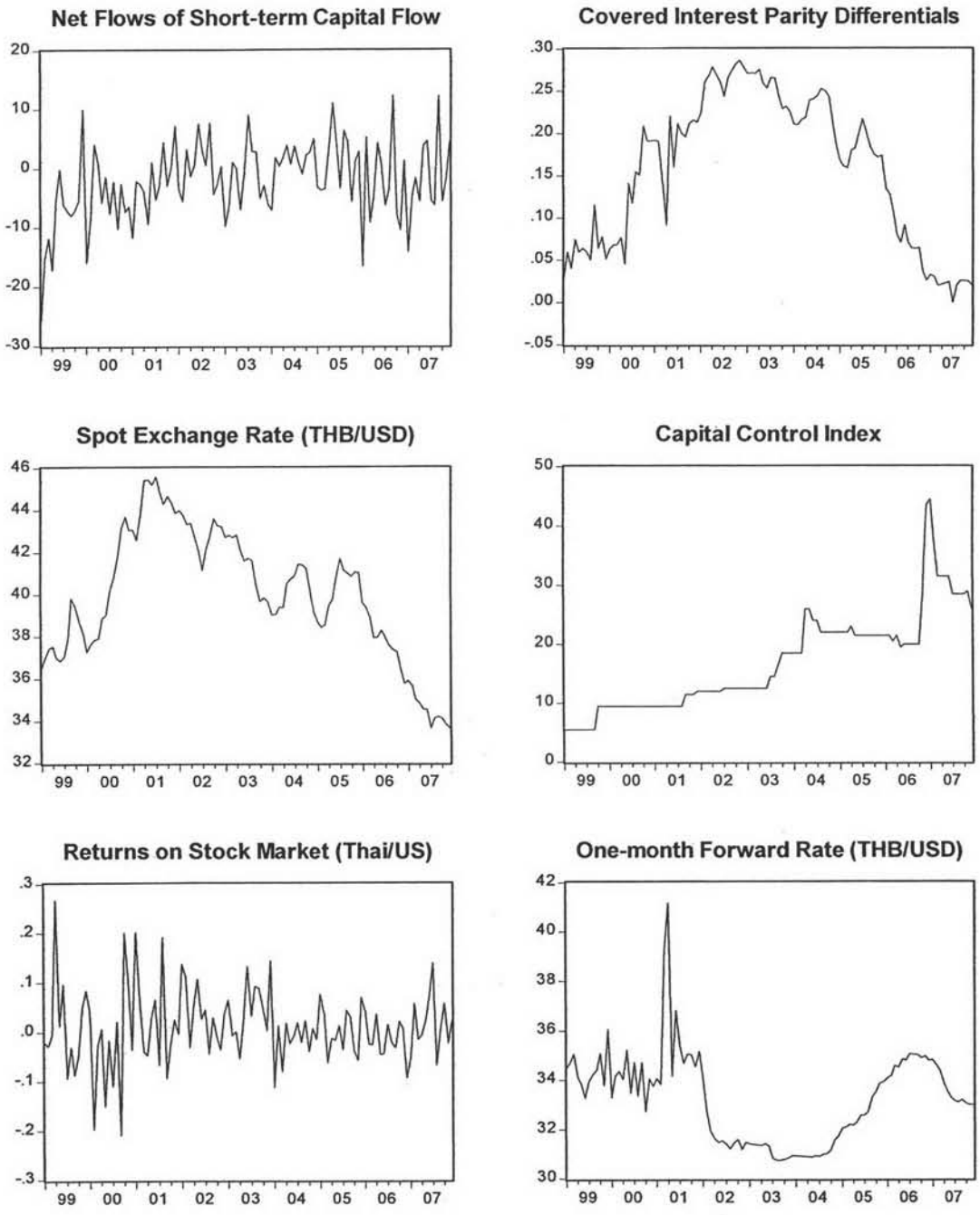
3.3 Sources of data

The data of this study are gathered from CEIC database, Reuter database, the National Economic and Social Development Board (NESDB), and the Bank of Thailand (BOT). The capital control index that is the heightening of this study is calculated from available information on foreign exchange regulations published by the Bank of Thailand. The source of each variable is shown in detail as below:

Table 4: Sources of data

Symbol	Variable	Measurement	Source
ST_GDP	Ratio of short-term capital flows to GDP	Net flows of short-term capital flow in BOT's capital and financial accounts as a percentage of GDP	BOT/ NESDB
CIPD	Covered interest parity differentials	Different value between Thai three-month treasury bill rate on US three-month treasury bill rate and forward premium	CEIC/ Reuter
LXR	Spot exchange rate	Logarithm of THB/USD onshore spot exchange rate	CEIC
CCI	Capital control index	Monthly index of capital controls	BOT/ Author's Calculation
ROS	Relative returns on Thai to US stock	Difference between average returns on Set Index and average returns on S&P 500	CEIC/ Reuter
LUS1M	US forward rate	Logarithm of THB/USD one-month forward rate	Reuter

Figure 9: Graphical figure of data used



3.3.1 Ratio of short-term capital flows to GDP

Ratio of short-term capital flows to GDP are calculated from net flows of short-term capital flows in term of percentage of GDP so as to measure how large foreign flow of capital affects domestic income in each period. The short-term capital in this model is represented as the net flows of private financial accounts in the Bank of Thailand's capital and financial accounts.

3.3.2 Covered interest parity differentials

Covered interest parity differentials is counted as a variable in the model to represent arbitrage opportunities for earning excess profits from stagnation between nominal exchange rate and interest rate of countries by measuring different between Thai three-month treasury bill rate to US three-months treasury bill rate plus forward premium. Gap between them are represented as an attractive arbitrage opportunity.

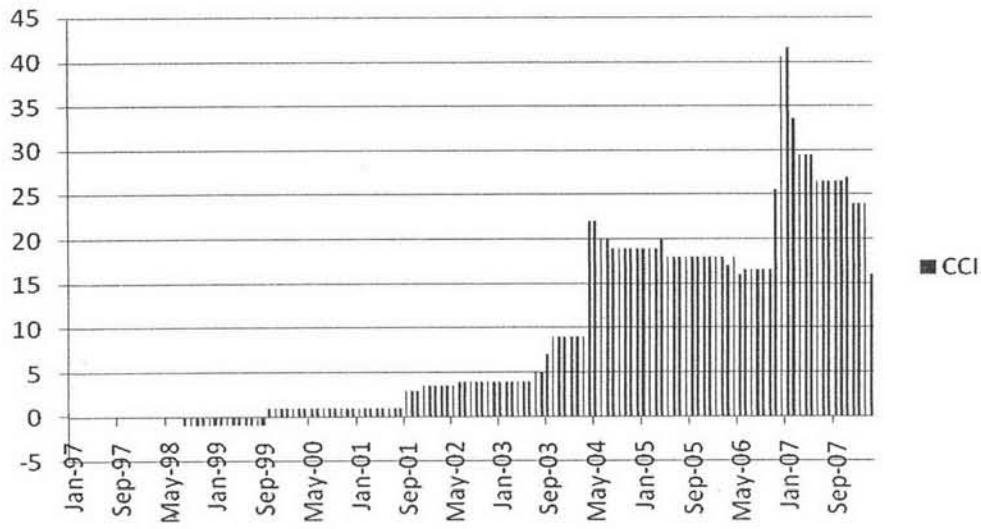
3.3.3 Spot exchange rate

Logarithm of THB/USD onshore spot exchange rate is considered in the model as a proxy of exchange rate between Thailand and the United States. This variable is written in American term.

3.3.4 Capital control index

Index of capital control or capital control index (CCI) is one of the main contributions of this study calculated from information published by the Bank of Thailand which is used as a proxy of capital and financial account restrictions.

Figure 10: Capital control index



Most of capital control index that has been used widely is constructed from information in Annual Report on Exchange Arrangements and Exchange Restrictions published by International Monetary Fund (IMF). The problem of conducting index from this annual report is limitation of data. The finest data obtained is binary, combination of a zero and a one. Moreover, the annual report has been produced once a year. The data is available solely for using in term of yearly-based model as explanation in the literature reviews.

The behaviors of short-term capital flow or hot money that we are interested in are promptly change, volatility and reverse rapidly. The yearly-based index might not capture behavior accurately.

The index used in this paper is constructed from information on notification, press and speeches related on foreign exchange regulations and published formally in the Bank

of Thailand website. Measures and relaxations rely on exchange restriction are rearranged serially by effective date, regardless date of announcement (we imply that all policy have an affect to stakeholder behaviors at the effective date). Each policy is classified separately by sub accounts—which are direct investment, portfolio investment (equity securities and debt securities) and other investment that are loans and currency and deposits.

The index's score is graded by sequential systematic pattern in order to avoid subjective characteristics which is scaled by 2 distinction criteria as:

1) Direct and indirect effects

This effect comes up with an assumption that not all policy pressures direct impact on capital flows and the impact on capital inbound and outbound are also different.

1.1) Regulations rely on capital inflows

An intension of the foreign exchange regulation by the Bank of Thailand aimed to control on foreign capital inflows. Hence, measures or regulations related directly with capital inflows are weighted with greater amount. So measure which aim to block or relax directly on capital inflows from non-residents with amounts of fund greater than US$ 1 million are weighted by "2".

The measures or regulations for managing indirectly on capital inflows included allowing or prohibiting domestic financial institutions for dealing with foreign exchange transactions, hedging or derivative transactions, optional alternative in foreign exchange transaction or transactions rely on non-residents with amounts of fund lower than US$ 1 million are weighted by "1".

Other small indirect restrictions or regulations that reflect limitation or relaxation on capital inflows are graded by "0.5".

1.2) Regulations rely on capital outflows

Most of regulations rely on capital outflow offer an optional alternative so the effects of alternative may not be strong as direct effects of controls on capital inflow so the weights assigned for all direct regulations on capital outflow are graded by "1".

Other regulations are not familiar with direct effects to limit or relax capital outflows (for instance, promoting investment in neighboring countries) or transactions with amounts of fund lower than US$ 1 million will be scored by "0.5".

2. Accumulation and deterioration effects

The criteria of this effect are separated as accumulation on foreign reserves with deterioration on foreign reserves. Changes of capital flow regarding to preventing currency appreciation that can be interpreted as either any tightening restrictions on inflows or relaxing of capital control on outflows are multiplied by positive sign or "+1" in order to represent level of capital control. On the other hand, preventing currency depreciation such as restrictions on capital outflows or relaxing of capital control for receiving capital inflows are multiplied by negative sign or "-1".

The restriction scores assigned will be accumulated over time as long as the regulation imposed by the Bank of Thailand is pursued.

3.3.5 Relative returns on overall Thai to US stock market

Differentiation of average returns on overall Thai stock market divide by average returns on Standard and Poor 500 (S&P500) is used in this study as a proxy of relative returns on Thai to US stock index in order to compare realized returns from the investment.

3.3.6 US forward rate

Although, most studies have mentioned that forward rate might not be the best predictor of future spot exchange rate and there are most empirical studies reject effectiveness of forward exchange rate. However, a recent study by Raj, Brian and Sunil (2006) used a new and improved statistical methodology to examine the rationality of forward exchange rates for forecasting of future spot rates over longer period (1973-1998). This methodology accounts and corrects for both non-stationarity and non-normality in the data series. This improved statistical methodology documents significant deviations from efficiency and rationality for the US dollar forward rate as a forecast of the future spot rate for the most of countries in the study. Hence, this study employs Raj, Brian and Sunil study in 2006 so THB/USD one-month forward rate is displayed as a proxy of US forward rate in this study.